APPENDIX A Demonstration Planning Document

National Automated Highway System Consortium Technical Feasibility Demonstration Planning Document

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National Automated Highway System Consortium

**3001 West Big Beaver Road , Suite 500
Troy , MI 48084**

NAHSC

Sign-Off

Terry Quinlan
Demonstration Task Lead

Patrick McKenzie
Integration Lead

Robert Smilgis
Infrastructure, Vehicle Production Lead

Ron Colgin
Vehicle Lead

Victoria Dewey
Expo Production Lead

Aimee Cochran
Communications Lead

Tommy Viner
Program Office Integration

Pat Langley
Technical Integration, Operations Lead

Celeste Speier
Public Education Lead

Foreword

This report was developed by the National Automated Highway System Consortium (NAHSC) as part of the agreement with the United States Department of Transportation, DTFH61-94-X-00001.

This report is a living document and subject to updates as needed.

Please provide comments to:
Patrick Langley
Lockheed Martin
P.O. Box 179
Denver, Co. 80201
Phone (303) 977-6761
Fax (303) 971-4093
E-Mail pat.langley@ast.lmco.com

Acronyms and Abbreviations

ACC	Adaptive Cruise Control
AHS	Automated Highway System
ALTS	Automatic Location and Tracking System
AUGV	Autonomous Ground Vehicle
AVCS	Automated Vehicle Control System
CAD	Computer Aided Design, Computer Aided Dispatch
CCD	Charge Coupled Device
CMU	Carnegie Mellon University
D2D	Development of Demonstration Systems
DOE	Department of Energy
DOT	Department of Transportation
DPC	Demonstration Presentation Center
ORV	Obstacle Removal Vehicle
FA	Free Agent
FHWA	Federal Highway Administration
FTT	Future Transportation Technologies
GIS	Geographical Information System
GM	General Motors
GPS	Global Positioning System
HAC	Hughes Aircraft Company
HOV	High Occupancy Vehicle
HUD	Heads Up Display
I-15	Interstate 15
ICC	Intelligent Cruise Control
IDV	Infrastructure Diagnostic Vehicle
ISTEA	Intermodal Surface Transportation Efficiency Act
ITP	Integrated Test Plan
ITS	Intelligent Transportation System
JPO	Joint Program Office
LMC	Lockheed Martin Corporation
MCC	Miramar Community College
MOA	Memorandum of Agreement
MPO	Metropolitan Planning Organization
NAHSC	National Automated Highway System Consortium
NHTSA	National Highway Transportation Association
NSA	North Staging Area
OSU	Ohio State University
PB	Parsons-Brinckerhoff
PMC	Program Managers Council
PMOC	Program Managers Oversight Committee
PS&E	Plans, Specifications and Estimates
PSB	Program Steering Board
R&D	Research and Development
RGMD	Requirements, Goals, and Milestones Document
SAE	Society of Automotive Engineering
TBD	To Be Determined
TBR	To Be Reviewed
TMC	Transportation Management Center
TSB	Temporary Service Building
VCR	Video Cassette Recorder
VDS	Vehicle Design Specification
VIP	Very Important Person

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1.0 INTRODUCTION

In 1997 the National Automated Highway System Consortium (NAHSC) will conduct a Proof-of-Technical-Feasibility Demonstration required by the United States Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. NAHSC was selected by the United States Department of Transportation to lead in the development and demonstration of an automated highway system. The 1997 AHS Demonstration will be a full-scale live vehicle exhibition, integrating the latest technological achievements of the Participants of the NAHSC. The event will also include a technical conference, an exposition providing stand-alone demonstrations, static displays, computer simulations, technical presentations, educational posters, literature, audio visuals, and a Demonstration Presentation Center (DPC).

2.0 PURPOSE

The purpose of this document is to provide the NAHSC Demonstration team and the Program Managers Council (PMC) with an integrated plan for the preparation and conduct of the Demonstration '97 that meets all of the goals and objectives for Program Milestone II. It addresses the "Live Vehicle Demonstration" portion of the event, the Exposition Center, and the Technical Conference. In addition, this document provides the Demonstration objectives, the description of the Demonstration content with an emphasis on live vehicle demonstrations and the plan for conducting the "live vehicle" portion of the Demonstration. Detailed schedules are included, as well as, plans for specific issues such as safety and risk mitigation. For specific details on various tasks, the reader is referred to the Development of Demonstration Systems (D2D) Statement of Work

Effective integration of Demonstration '97 depends on all participating Consortium organizations having a clear understanding of their roles and responsibilities and on executing effective plans. This document also provides a top-level set of guidelines and plans to integrate Demonstration '97.

3.0 DEMONSTRATION OBJECTIVES

In response to the 1991 ISTEA Congressional mandate, the following objectives have been established:

- The demonstration will provide a fully automated highway or automated test track by 1997.
- The demonstration will show that technologies capable of implementing a fully automated highway system are available and practical.
- The demonstration will show stakeholders and the public that AHS is a credible and achievable solution to traffic problems.

3.1 Specific Objectives

The following objectives will be addressed by various venues at the 1997 Demonstration and Exposition.

- Demonstrate key AHS elements and features adapted from existing technologies.
- Identify and evaluate feasible alternative conceptual approaches.
- Safe operations for the operators, visitors, observers.
- Demonstrate lateral (steering) and longitudinal (acceleration and braking) control subsystems and control.
- Demonstrate longitudinal vehicle control by controlling vehicle braking and acceleration to maintain spacing between vehicles. ("feet free")
- Demonstrate lateral vehicle control by controlling the vehicle steering to keep the vehicle in the lane. ("hands free")
- Demonstrate lane changing.
- Demonstrate coordinated lane changes between vehicles.
- Demonstrate entry and exit maneuvers.
- Demonstrate the transition between manual and automated control.
- Demonstrate the maintenance of vehicle position in the traffic flow.
- Demonstrate various malfunction management capabilities.
- Demonstrate collision warning.
- Demonstrate collision avoidance control.
- Demonstrate a collision-free automated driving environment.
- Demonstrate lane departure warning.
- Demonstrate lane departure correction.
- Demonstrate detection of moving and stationary objects on the automated lanes and avoid collisions with these objects.
- Demonstrate entry onto the automated highway with simultaneous speed adjustment between several vehicles to successfully merge vehicles.
- Demonstrate the highway system's ability to track the position of the vehicles in real-time.
- Demonstrate vehicle-to-vehicle communications.
- Demonstrate roadway-to-vehicle communications (tag beacon).
- Demonstrate ride comfort that is as smooth as good manual driving, with no sudden changes in speed or direction under normal circumstances.
- Demonstrate multiple vehicle operations.
- Demonstrate ease of maintenance and construction.
- Demonstrate alternative technologies.
- Demonstrate a priority emergency response vehicle.
- Demonstrate heavy vehicle control, both buses and trucks.
- Build support for the continuation of the NAHSC mission and funding.
- Promote the vision and potential benefits of AHS deployment to likely system users, operators and implementers.

- Increase the credibility of AHS through coordinated demonstration activities and timely, accurate and consistent communications from the NAHSC Core and Associate Participants (especially the live vehicle demonstrators).
- Provide the news media with timely, accurate and consistent communications about AHS, the NAHSC and the Demonstration activities in formats they can readily understand and use.
- Provide key media with in-depth, first-hand experiences of AHS technologies and its promise to benefit future surface transportation - in the U.S. and the world.
- Communicate Demonstration activities to the Southern California region, involving officials and targeted segments of the general public in the overall success of the endeavor.
- Promote the region as technology-friendly and astute for hosting the Demonstration.

3.2 Compliance Matrix

This matrix summarizes the objectives that will be met by each scenario and segment of the exposition.

	Scenario **										
Objective	PT	FA	MV	H	OSU	T	DPC	SD	PD	PS	E
Adaptability from existing technologies	●	●	●	●	●	●	●		●		●
Safe operations for the operators, visitors, observers.	●	●	●	●	●	●	●		●		●
Automated Longitudinal (acceleration and braking) control.	●	●	✓ ❶	●	●	●			○		●
Lateral vehicle control (steering)	●	●	● ❶	●	●	●			○		
Automated Lane changing.	●	●	○	●	●	●					
Coordinated lane changes between vehicles.	●			●		●	✓				
Lateral vehicle control during entry and exit maneuvers.			✓								
Transition between manual and automated control.	●	●	● ❶	●	✓	●	✓				●
Maintenance of position in the roadway traffic flow.	●	●	● ❶	●	●	●	✓	=	●		●
Demonstrate various malfunction management capabilities.	●		○			✓	●				
Collision warning.		○				●	○		○		●
Collision avoidance control.		○				○					
Demonstrate a collision-free automated driving environment.	●	●	● ❶	●	●	●					○
Lane departure warning.		●	○			●			●		
Lane departure correction.						●			●		
Merge vehicles.	○	●				●					●
Track the position of the vehicles in real-time.	✓		●			✓	●		✓		
Detect obstacles		●		●		●	○		✓		
Vehicle-to-vehicle communications.	●	●		●		●					
DPC to vehicle communications	✓	✓	●				●				

3.2 Compliance Matrix (Continued)

	Scenario **										
Objective	PT	FA	MV	H	OSU	T	DPC	SD	PD	PS	E
Roadway-to-vehicle communications.	✓		●	✓		✓	✓				
Demonstrate ride comfort.	●	●	●	●	●	●					●
Multiple vehicle operations.	●	●	✓	●	●	●	O				●
Maintenance			●				●		O		

**PT=Platoon, FA=Free Agent, MV=Maintenance Vehicle, H=Honda, OSU=Ohio State University, T=Toyota, DPC=Demonstration Presentation Center, SD=Static Displays, PD=Parking Lot Demos, PS=Presentations, E=Eaton Vorad

● = Strong Relationship O = Moderate Relationship ✓ = Weak Relationship ➊ = May be different for IDV and ORV

4.0 DEMONSTRATION CONTENT

The 1997 event will demonstrate the technical feasibility and benefits of an automated highway system and will contain demonstrations of highway and vehicle scenarios depicting automation technologies. The 1997 Demonstration is not intended to represent the final prototype design, scheduled for completion in 2002. Rather, technologies will include supporting systems and subsystems which form the building blocks leading to a fully Automated Highway System.

4.1 Description

The Demonstration event will include live vehicle demonstrations as well as an exposition center and a technical conference. The exposition center will be the main hub of activity for the 1997 AHS Demonstration. It will be located at Miramar Community College (MCC) adjacent to I-15. All activities will start and end at this facility. The Interstate 15 reversible high occupancy vehicle express lanes will serve as the primary live-vehicle demonstration site. Due to limited space at the I-15 facility, only selected spectators will actually travel to the facility for demonstration rides. Large screen monitors, kiosks, and other communication devices located throughout the exposition center will provide real-time and pre-recorded video of all I-15 demonstrations. Bus tours to and from the I-15 demonstration site will originate at the exposition center. Figure 4.1-1 depicts an artists rendering of what the interior of the exposition center could look like. A map of MCC is shown in Figure 4.1-2.

Figure 4.1-1 Artist Rendering of Exhibition Hall

The live vehicle demonstrations will be conducted through a number of scenarios designed to depict actual AHS operation. The scenarios have been segregated into Core team scenarios and Associate scenarios. The Core scenarios will demonstrate technologies related to independent vehicle operations (Free Agent), cooperative vehicle operations (Platooning), and infrastructure based maintenance operations. The Associate scenarios will demonstrate technologies related to obstacle detection, lane keeping and lane changing, collision warning, adaptive cruise control, and evolutionary deployment of an AHS for passenger vehicles, transit vehicles, and trucks.

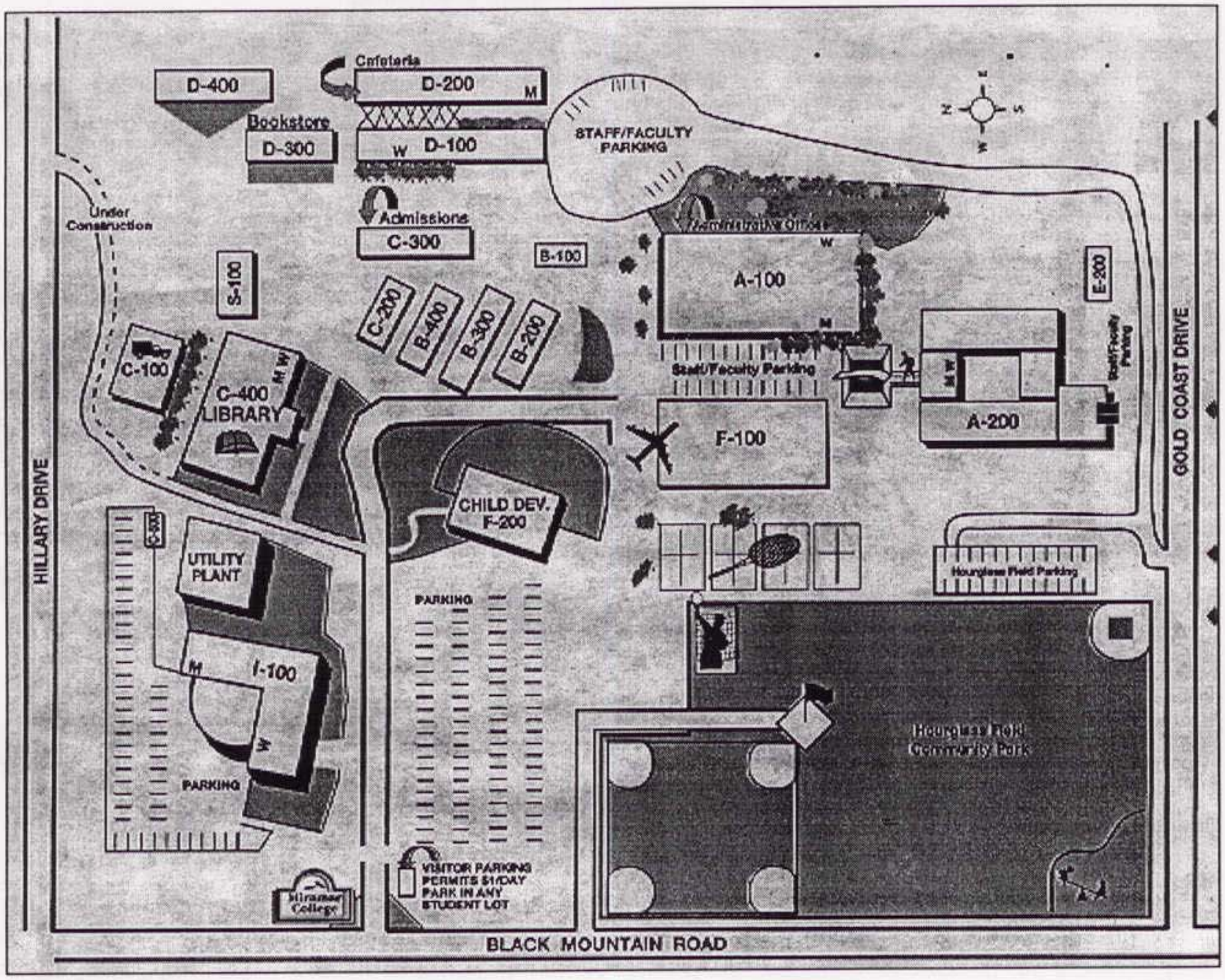


Figure 4.1-2 Map of Miramar Community College

The demonstrations will be conducted using modified production and concept automobiles employing currently available and emerging technologies. Transit vehicles along with heavy trucks will also be used for the I-15 demonstration. The demonstration will also contain possible spin-offs and exhibits of other vehicle automation technologies from related programs. Repeated demonstrations, target audience activities, and media demonstrations will be conducted throughout the event. During the live vehicle demonstration, the I-15 HOV Express lanes will be closed to public vehicles and will include Demonstration traffic only. The opportunity will be provided for selected individuals to ride in the demonstration vehicles and experience automated driving first-hand. The number and type of vehicles expected on the Express lanes during the demonstration include the following:

- Eight sedans will demonstrate vehicle-to-vehicle communications and platooning.
- Three sedans and two transit vehicles will demonstrate free agent lateral and longitudinal control, check-in, and obstacle detection and avoidance.
- Two maintenance vehicles will demonstrate system health interrogation and roadway maintenance.
- Multiple sedans (Associate Participant vehicles) will demonstrate other forms of obstacle detection and avoidance, lateral and longitudinal control as well as control transition (using one technology for lateral control and transferring to a different technology for lateral control "on the fly").
- One truck will demonstrate intelligent cruise control and obstacle warning.

In addition to showcasing the progress to date of highway automation and vehicle control, the event will feature exhibits, simulations, technology presentations, and models of promising aspects of an AHS at a near by exposition center.

4.1.1 Location

The 1997 Demonstration is planned for a 7.6 mile segment of reversible high occupancy vehicle express lanes of Interstate 15 north of San Diego, California, as shown in Figure 4.1.1-1. The segment consists of two twelve foot wide concrete paved lanes with two ten foot wide asphalt paved shoulders. The segment is in the median of I-15 and is open for southbound traffic during the morning commuting hours and north bound traffic during the afternoon commuting hours. Jersey barriers are installed on both sides of the lanes for the total length, providing isolation and protection from vehicles traveling in the mainline traffic lanes. Radio communications, loop detectors, and other monitoring systems are available to support communications to the Caltrans Transportation Management Center (TMC). Access to the lanes is controlled by the TMC through pop-up tubes, gates, and on-site personnel.

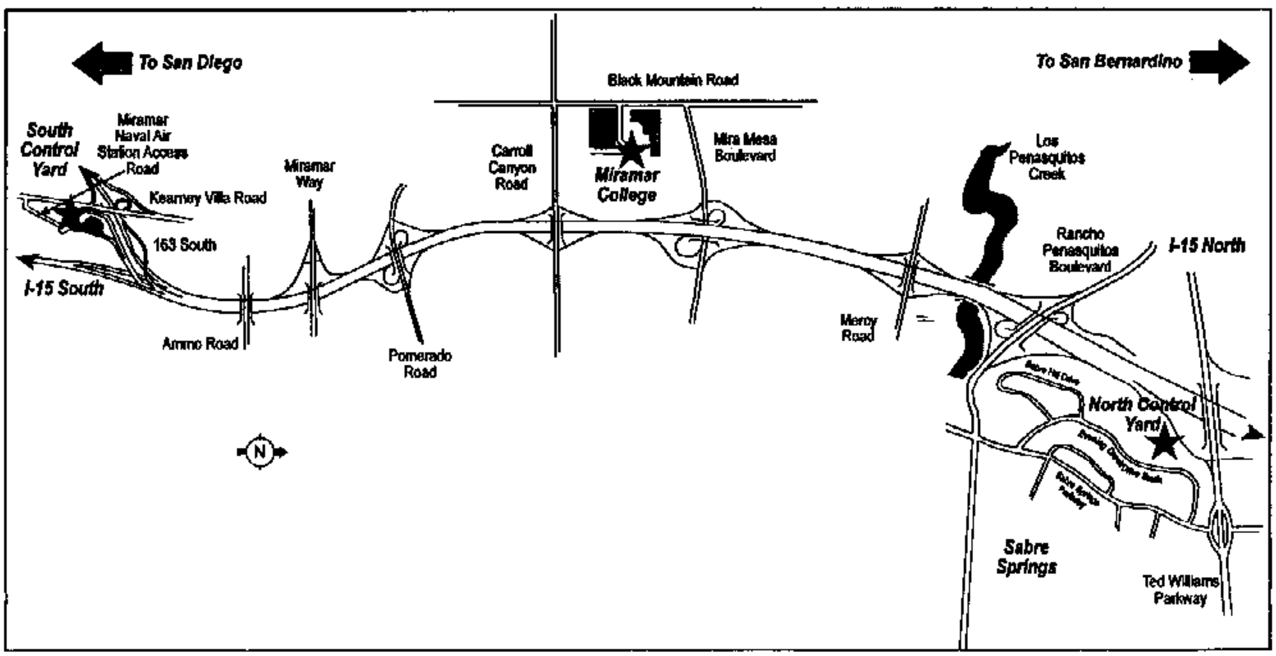


Figure 4.1.1-1 I-15 Demonstration Site

At the South end of the lanes is the Vehicle Service Center, or South Control Yard (SCY). This is the primary location where vehicle servicing takes place. It is comprised of a Temporary Service Building, where offices, workshops, and garage facilities reside, and the temporary storage structure, which is used for overnight storage of the vehicles, as well as the loading area for passengers. Associate participants have space available to them to set up temporary vehicle servicing and storage facilities. Only light service is permitted at the Vehicle Service Center. This area is also used for the loading and unloading of passengers. Figure 4.1.1-2 illustrates the layout of the South Staging Area.

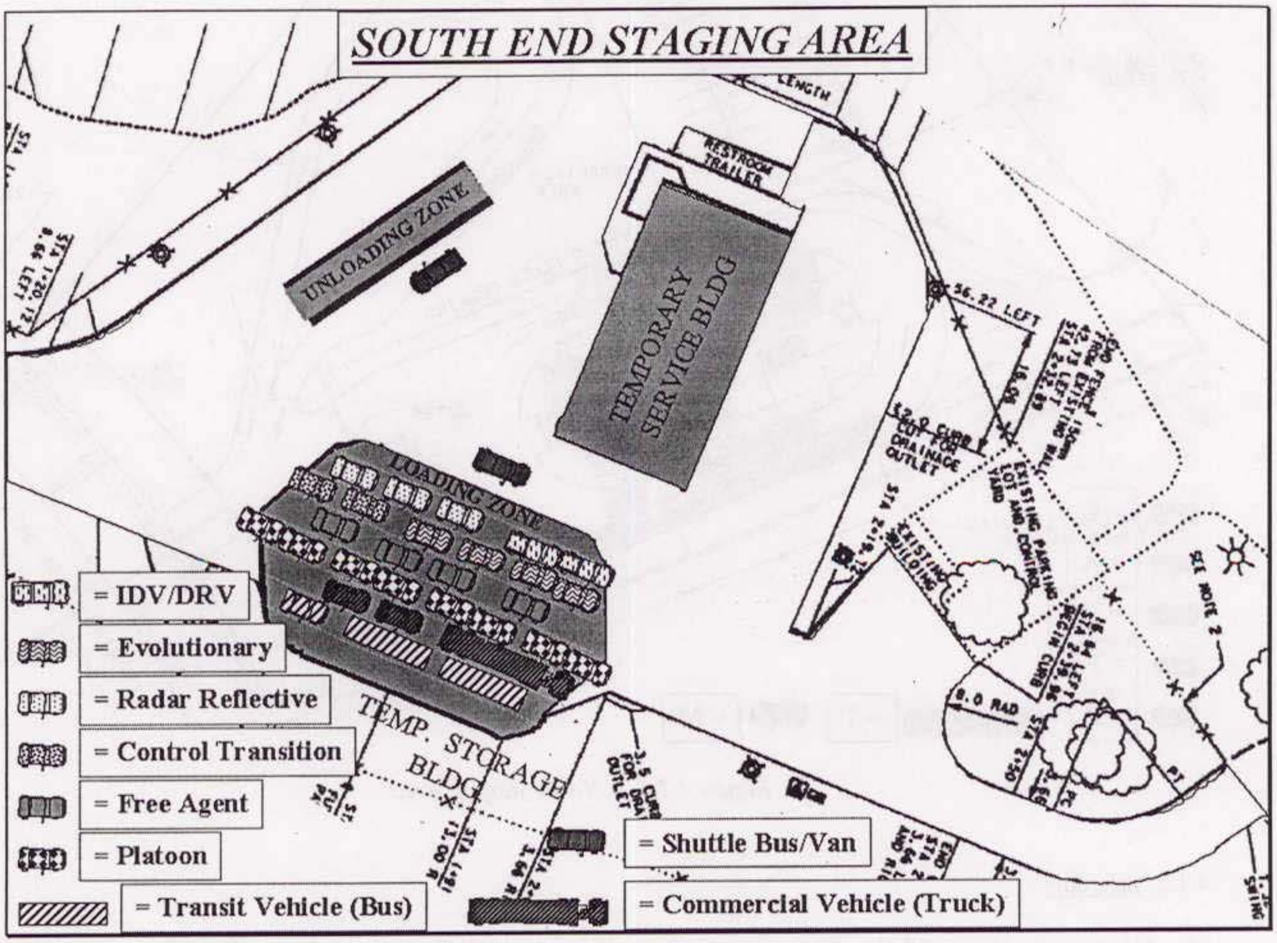


Figure 4.1.1-2 South Staging Area

At the North end of the lanes is the North Staging Area (NSA). This area is the focal point for exposure of the Demonstration vehicles to the media. This is also the principal hospitality area (on the lanes) for the Very Important Persons (VIPs). The area contains a hospitality tent, a media tent, and a driver break area. It also accommodates small areas in which each participant can perform very minor servicing. Figure 4.1.1-3 shows the layout of the North Staging Area.

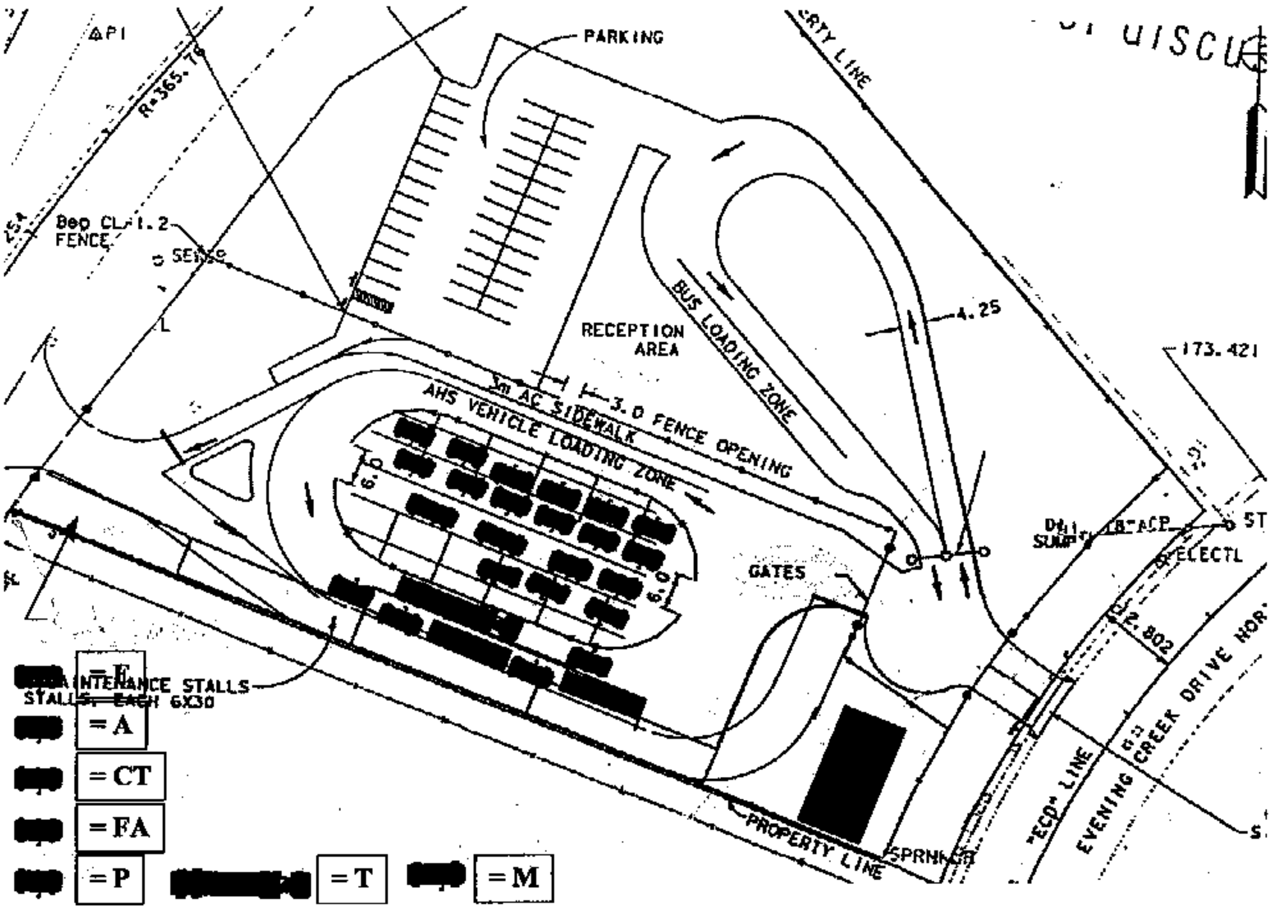


Figure 4.1.1-3 North Staging Area

4.1.2 Schedule

The demonstration is expected to be a multiple day event spanning a four day time period starting August 7, 1997. In order to maintain the demonstration planning schedule, several key dates have been established. By April 1997 infrastructure modifications for live vehicle testing must be complete. All vehicles developed for the demonstration must be certified by 17 July, 1997. The vehicle storage building and service center is scheduled for completion by February, 1997. By March 1997, all exhibitors must be registered for the exposition. For detailed schedules refer to section 7.0.

4.1.3 Key Publics

- Federal government officials, Congressional representatives and their staffs (especially members of appropriation and transportation committees) and the U.S. Department of Transportation
- State Departments of Transportation, State government officials (especially California and other states with the highest propensity/greatest need for highway improvements)
- AHS-related (stakeholder) industry management/decision makers (including commercial fleet and transit association management)
- Metropolitan Planning Organizations (MPO) and other area transportation officials (especially from areas of the U.S. with the highest propensity/greatest need for highway improvements)
- International, national and local print and broadcast general and technical media
- The technological community including academia, the intelligent transportation systems (ITS) industry and the stakeholder category industries:
- automotive, electronics, construction, engineering design, insurance and the
- legal profession
- Special interest groups and associations: environmental interests, the American Association of Retired Persons (AARP), etc.
- Transportation Users: commercial fleet and private vehicle drivers and future drivers. Also included are user associations/groups such as the American Automobile Association
- International government and transportation officials, the global technical community and international (stakeholder) industries
- Core and Associate Participant organization employees and their families/associates

Consideration has been given to holding a "Public Day". However, additional attendees from the general public have not been included in the total estimate.

Coupling the Demonstration to other meetings such as an Intelligent Transportation System meeting may be desired. In addition, the Autonomous Ground Vehicle (AUGV) student competition may be held during the Demonstration. This competition attracts 200-300 competitors and spectators annually. Both of these will contribute significantly to the attendance of the Demonstration.

4.1.3.1 Public Perspective

Aside from the possibility of a general "Public Day", the general public will be a secondary audience to the Demonstration. Print and electronic media will cover the Demonstration before, during, and after the Demonstration activities. Details of these activities are discussed in section 6.7. Commuters using both the High Occupancy Vehicle (HOV) and conventional I-15 lanes will witness activity ranging from construction on the lanes, testing, and the actual live vehicle scenarios.

The public attending the Demonstration will tour the exposition center, watch mini-demos in progress, possibly see portions of a student vehicle competition, and view I-15 demonstrations via video monitors in the exposition center and at the DPC. A list of numbers of attendees from different attendee groups is displayed in Table 4.1.3.1-1.

Table 4.1.3.1-1 1997 Exposition & Demonstration Attendees

NAHSC Core Participants (Ten from each Core organization and the NAHSC Program Office Staff)	115
NAHSC Associate and Outreach Participants (five from each organization)	500
US DOT (In addition to the Core which will be from the FHWA Research Center, guests are expected from the Office of the Secretary, JPO, NHTSA, Federal Transit Administration, Office of Motor Carriers, etc.)	50
Other US Executive Branch (DOE, Commerce, PNGV, DOD, Executive Office of the President)	50
US Legislative Branch (Senate and House of Representatives elected and Congressional Staff, and applicable home district staff)	50
California State Government (Officials and staff from the Department of Business, Transportation and Housing Agency, the CHP, Caltrans Headquarters and District Officials, Office of the Governor, State Assembly and Senate, Air Resources Board))	100
Local Government (SANDAG, MPOs County Government - Board of Supervisors, School Boards, Board of Regents, Commissions, Transit Agencies - Metropolitan Transit Development Board, North County Transit, Orange County Transit, City Staff)	200
Other Government Officials (State DOTs, Turnpike Authorities, Executive Staff)	100
Local Business Leaders (Members of Chamber of Commerce, Economic Development Commission, Regional Technology Alliance, Regional Transportation Technology Alliance, Business owners and executives)	400
International Dignitaries (Vertis, Ertico, Ministers of Transportation, Manufacturers representatives and executives)	100
Intelligent Transportation Society (Board of Directors, Coordinating Council, support and technical staff)	150
SAE Conference Attendees	500
University Researchers and Faculty	300
NAHSC Demo Team (Including live vehicle express lane demonstration technical and support staff)	100
Media	250
Exhibitors	500
Sponsors (Commercial products/service sponsors not participating in the technical execution of the events)	50
Supporting Contractors and Staff (Exhibit management and labor, security, medical, catering, material handling, communication staff)	200
Public	1000s
TOTAL (less public)	**3715**

4.1.3.2 VIP Perspective

Two levels of VIP participants will be defined, those who receive rides in the demonstration vehicles, and those who are provided special escorts in addition to participating in a demonstration ride. All VIPs will receive special briefings.

4.1.3.3 Passenger Groups

There will be four different classifications of passengers. These are the Top Level VIPs, VIPs, Media and the general Public.

The Top Level VIPs consist of the Presidential Staff, members of Congress and associated Staff, the Secretary of Transportation, State and Federal DOTs, Local Government Officials, and Senior Corporate Executives.

The VIPs consist of Core members, Participating Associates, Sponsors, Federal and State DOT's and Local Government Officials.

The Media consists of all broadcast and print organizations.

The General Public consists of Core Member Staffers, Associates, Exhibitors, Associations, and a limited group from the general public.

4.1.4 Participants

Exhibit and live-vehicle demonstration participants will include NAHSC Core and Associate participants, along with contractors and other supporting entities. Only NAHSC Core and Associate Participants will conduct live vehicle demonstrations on I-15. Other contractors and ITS organizations will augment the content provided by the NAHSC with specific technologies, systems, and analyses which support the objectives of the Demonstration. Contractors will support the Demonstration where appropriate and necessary. Trade associations, professional societies, government agencies, educational institutions, and student groups interested in highway and vehicle automation, may participate. Participation by both domestic and foreign organizations is anticipated.

4.1.5 A Day in the Life of the Demo

Demonstration Week: August 7 (Thursday) to August 10 (Sunday)
Set-up: Tuesday & Wednesday (Aug. 5,6)
Clean-up: Monday (Aug. 11)
Exhibition Open: Thursday (Aug.7) - Sunday (Aug. 10)

Format: There are two formats for running the I-15 portion of the Demo. On Thursday and Friday the lanes will be available between 9:30 AM and 1:30, PM and after 6:30 PM in the evening. Saturday and Sunday the lanes will be available 24 hours a day.

I-15 Demo: A choreographed series of runs on I-15 that includes an appropriate distribution of multiplatform free agent, platooning, trucks, and miscellaneous vehicles. The runs are continuous and in series. Key demonstration functions will be displayed and there will be minimum wait time for the passengers. Viewers at the Exhibition Center will have live video of the Demonstration augmented by presentations on the different scenarios, as well as pre-recorded videos. As one vehicle group demonstrates, the other groups will be doing preparation work or be loading VIP guests into designated vehicles.

Table 4.1.5-1 illustrates a possible schedule of usage of each of the sites to be used during the Demo.

Table 4.1.5-1 Seven Day Demonstration Schedule

TIME	CONFERENCE CENTER	EXHIBIT HALL	I-15 DEMO
TUESDAY (Aug 5) 8:00am		Exhibit Hall Move-In for Core, Associates & Contract Participants	Final Dress Rehearsal
4:30pm		Exhibit Hall closed	
WEDNESDAY (Aug 6) 8:00AM		Exhibit Hall Move-In	Short Lead Media Day
4:30PM		Exhibit Hall closed	
5:00PM	Registration Opens		
6:00PM	***Welcome Reception***		
8:00PM	Registration Closes		
THURSDAY (Aug 7) 8:00AM	Registration Opens		
9:00AM	***Plenary Welcome Session & Overview***		
9:30 AM	Simulcast of the Exhibit Hall Ribbon Cutting Ceremony	***Ribbon Cutting Ceremony - Exhibit Hall Open***	***Ribbon Cutting Ceremony on I-15***
10:00AM	Simulcast of the I-15 Ribbon Cutting Ceremony	Simulcast of the I-15 Ribbon Cutting Ceremony (DPC)	Demo
10:30AM	Management Session #1 Simulcast of the Demo		
11:30AM	⇩		
Noon			
1:00PM	Tech. Session #1		
1:30PM	⇩		Demonstration concludes
3:00PM	⇩		
5:00PM	Tech. Session adjourns	Exhibit Hall closed	
6:00PM	AHS Reception at the Conference Center		

Table 4.1.5-1 Seven Day Demonstration Schedule (Continued)

TIME	CONFERENCE CENTER	EXHIBIT HALL	I-15 DEMO
FRIDAY (Aug 8) 8:00	Registration Opens		
9:00AM	Management Session #2		
9:30		Exhibit Hall open	Demo
10:00AM	Simulcast of the Demo		
10:30AM	⇩		
Noon			
1:00PM	Tech. Session #2		
1:30PM	⇩		Demonstration concludes
3:00PM	S&I Session #1		
5:00PM		Exhibit Hall closed	
7:00PM			
SATURDAY (Aug 9) 8:00AM	Registration Opens		
9:00AM	Management Session #3		
9:30AM			Demo
10:00AM	Simulcast of the Demo	Exhibit Hall open	
10:30AM	⇩		
Noon			
1:00PM	Tech. Session #3		
1:30 PM			
2:00PM	⇩		
3:00PM	S&I Session #2		
5:00PM		Exhibit Hall closed	Demonstration Concludes
9:00PM			
10:00PM			

Table 4.1.5-1 Seven Day Demonstration Schedule (Continued)

TIME	CONFERENCE CENTER	EXHIBIT HALL	I-15 DEMO
SUNDAY (Aug 10) 8:00AM	[redacted]		[redacted]
9:00AM			
			Demo
10:00AM			
11:00AM		Exhibit Hall open	
Noon			
1:00PM			
2:00PM			
3:00PM			
4:00PM		Exhibit Hall closed & move-out	
5:00PM			Demonstration Concludes
7:30 PM			[redacted]

	[redacted]	EXHIBIT HALL	[redacted]
MONDAY (Aug 11) 8:00 AM		Exhibit Hall move-out	
4:30 PM			

4.2 Live Vehicle Demonstration Scenarios

The demonstration scenarios for the I-15 Express lanes involved all NAHSC Core and several Associate Participants. The Core Participant demonstrations are organized in three categories:

1) Multi-Platform Free-Agent Scenario - Carnegie Mellon University with participation from an Associate, Houston Metropolitan Transit Authority
2) Platoon Scenario - University of California - Berkeley - PATH
3) Maintenance Scenario - Lockheed Martin and California Department of Transportation (CALTRANS)

Associate Participant Demonstrations consist of:

1) Evolutionary Deployment Scenario - Toyota Motor Corporation Japan
2) Control Transition Scenario - Honda R&D North America
3) Alternative Technology Scenario - Ohio State University
4) Commercial vehicle (truck) Scenario - Eaton VORAD Technologies

4.2.1 Multi-Platform Free Agent

The Multi-Platform Free Agent Scenario is a combination and enhancement of the CMU Free Agent and Houston Metro Transit demonstration. The following text and diagrams describe the scenario flow. In the diagrams, vehicles move from right to left. The P1 and P2 vehicles are 1996 Pontiac Bonneville's, the P3 vehicle is a 1996 Oldsmobile Silhouette, and the B1 and B2 vehicles are 1996 Low Flyer Low Floor busses. The Multi-Platform Free Agent scenario is depicted in Figures 4.2.1.1-1 and 4.2.1.1-8. The accompanying narrative was presented by vehicle narrators.

4.2.1.1 Scenario

Segment 1: Entry and Mixed Platform Lane Departure Warning

The scenario begins with B1, then P1, followed by B2 entering the right lane and accelerating to 45 mph. (Call this vehicle group G1.) Initially, each vehicle in G1 is operating manually. After G1 has entered the right lane, P2 enters the highway in the left lane about 150 meters behind G1. P3 follows in the left lane about 75 meters behind P2 . Both vehicles accelerate to 45 mph. P2 is operating autonomously while P3 is under manual control. B1, B2 and P3 are being driven manually toward the lane boundaries to demonstrate the lane departure warning function of those vehicles.

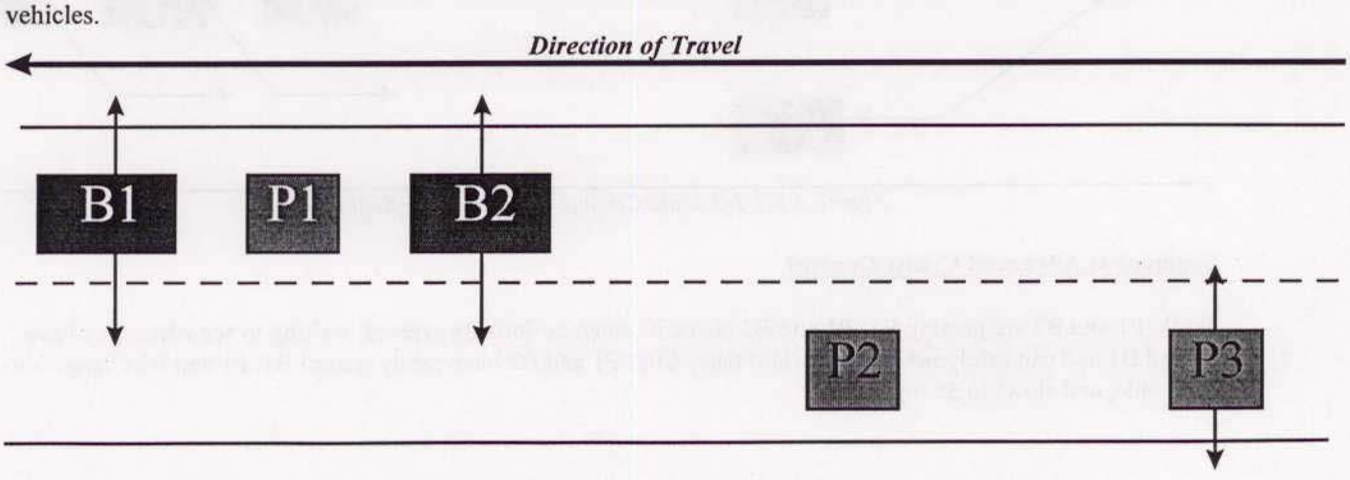


Figure 4.2.1.1-1 Entry and Mixed Platform Lane Departure Warning - Segment 1

Operation of all vehicles continues as described for 1 mile.

Segment 2: Headway Warning and Tailgater Lane Change

Autonomous operation is initiated in all vehicles in the scenario except P3. P2 and P3 accelerate to 60 mph and 65 mph respectively. While passing B2, P1, and B1, P2 checks its side/rear looking sensors, waiting to see when it has passed all three vehicles and can safely moves to the right lane. P3 closes the gap to P2 as they are passing G1. P2 detects the fast approaching vehicle with its backward looking sensors and begins checking to see if it is safe to change lanes. P3 detects that it is closing very quickly on P2 and alerts the driver. Once P2 passes B1, P2 initiates a lane change maneuver to the right lane in front of B1.

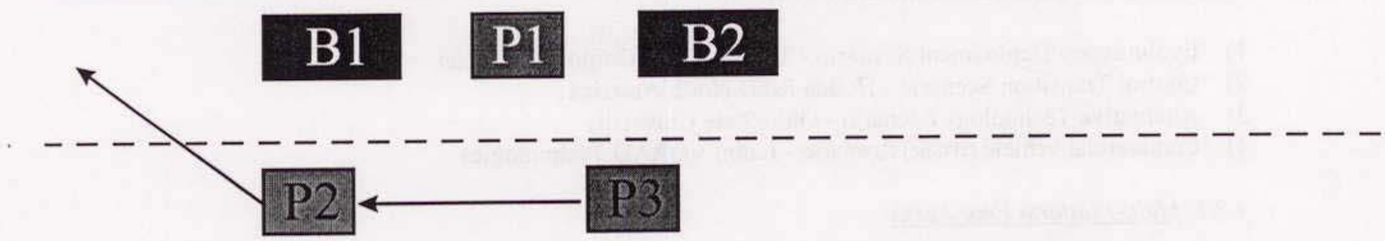


Figure 4.2.1.1-2 Headway Warning and Tailgater Lane Change - Segment 2

The maneuvers for Segment 2 take 1.5 miles to complete.

Segment 3: Lane Change and Passing

After P2 has safely passed G1, P2 changes into the right lane, and slows to 55 mph. P3 goes into auto mode and continues past in the left lane. As P2 changes into the right lane, P3 continues past P2 and then executes a lane change maneuver to the right lane in front of P2. Simultaneously, P1 and B2 executes a lane change maneuver to the left lane and accelerates to 60 mph.

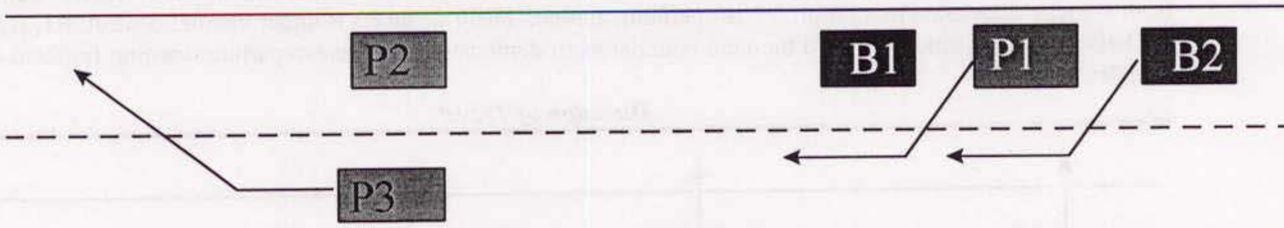


Figure 4.2.1.1-3 Lane Change and Passing - Segment 3

Segment 4: Advanced Cruise Control

While P1 and B2 are passing B1, P1 and B2 check its side/rear looking sensors, waiting to see when they have passed B1 and can safely return to the right lane. After P1 and B2 have safely passed B1, P1 and B2 change into the right lane, and slows to 55 mph.

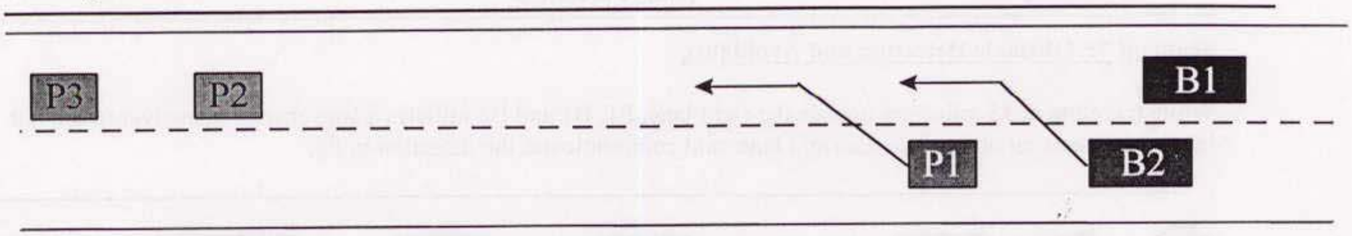


Figure 4.2.1.1-4 Advanced Cruise Control - Segment 4

Segment 5: Obstacle Detection and Avoidance

While traveling at 55 miles per hour in the right lane, P1, B2 and B1 initiates a lane change maneuver to the left lane. P3 detects an obstacle in the right lane and communicates the detection to P2. P3 and P2 swerve around the obstacle and return to their original lane.

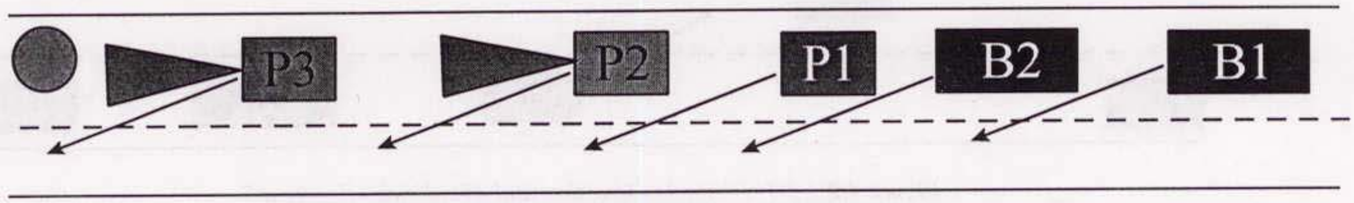


Figure 4.2.1.1-5a Obstacle Detection and Avoidance - Segment 5

Once B2 passes the obstacle, B2 changes to the right lane. B1 continues in the left lane past B2 and initiates a lane change maneuver to the right lane just to the front of B2. P1 continues in the left lane past P2 and initiates a lane change maneuver to the right lane just to the front of P2.

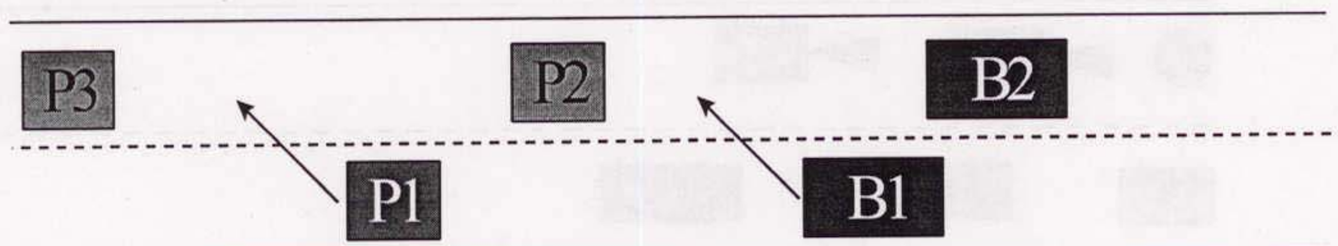


Figure 4.2.1.1-5b Obstacle Detection and Avoidance - Segment 5

Segment 6: Driver Interaction

The driver of P2 interacts with the car using the driver interface buttons on the steering wheel to initiate a lane change/passing maneuver to pass P1.

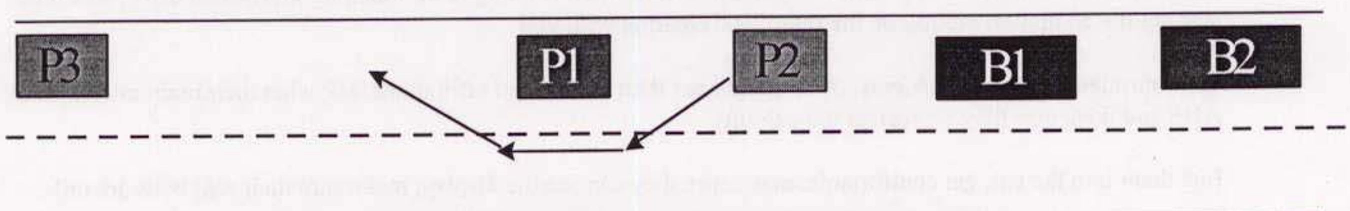
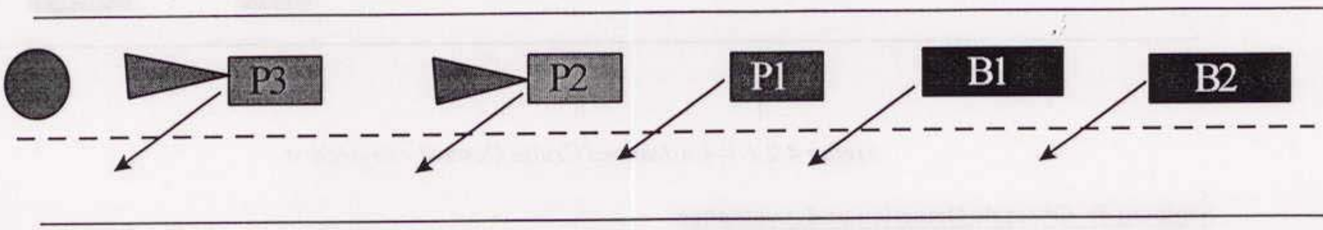


Figure 4.2.1.1-6 Driver Interaction - Segment 6

Segment 7: Obstacle Detection and Avoidance

While traveling at 55 miles per hour in the right lane, P1, B1 and B2 initiates a lane change maneuver to the left lane. P3 detects an obstacle in the right lane and communicates the detection to P2.



P3 and P2 swerve around the obstacle. P3 continues in the left lane. P2 returns to the right lane. Once P1 passes the obstacle, P1 changes to the right lane behind P2. B1 and B2 continues in the left lane.

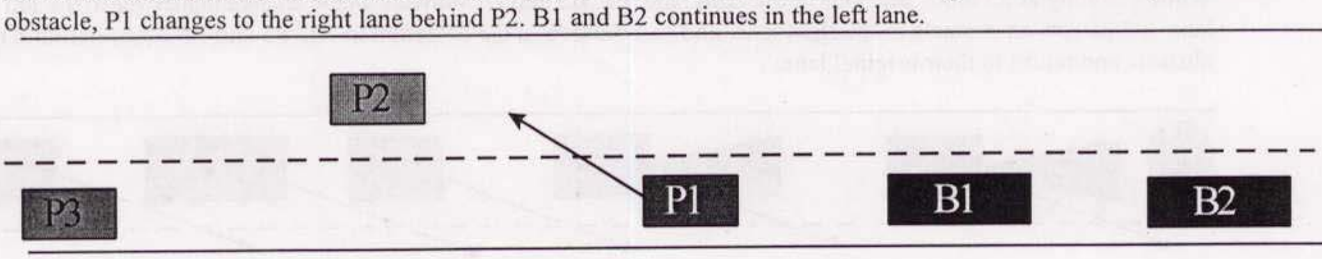


Figure 4.2.1.1-7 Obstacle Detection and Avoidance - Segment 7

Segment 8: Finish

P2 detects an obstacle in the right lane and slows to a stop. P1 detects that P2 is slowing and does the same. P3, B1 and B2 come to a coordinated automated stop.

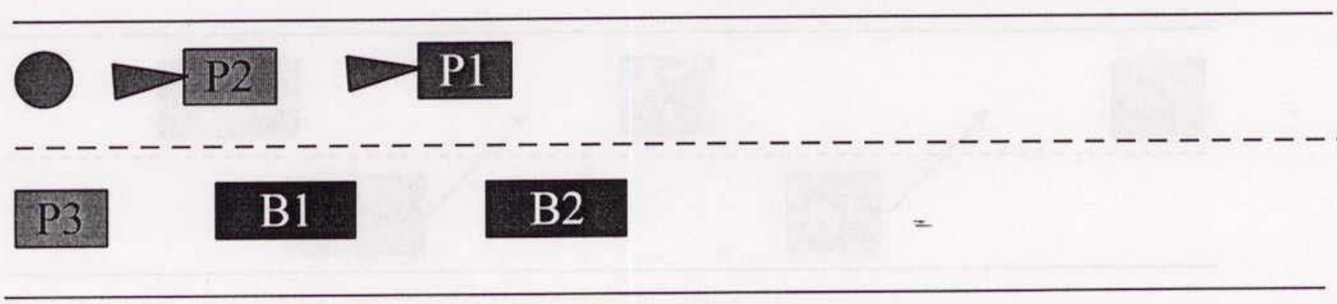


Figure 4.2.1.1-8 Finish - Segment 8

4.2.1.2 Accompanying Narrative

Hi, and welcome to the Free Agent Demo. I'm Chuck Thorpe from Carnegie Mellon University. Our driver today is my colleague Richard Petty. For safety purposes, Richard is going to be watching the system drive, so I'll be starting the computer, talking on the radio, and chatting with you.

[get introduced to the passengers, try to remember their names and affiliations, ask what their main interest is in AHS and what else they've seen at the exhibit]

[get them into the car, get comfortable, make sure they can see the display, make sure their seat belts are on]

As you know, in the AHS Consortium, we're looking at a variety of technologies, and a variety of concepts. The concept work is looking at different system architectures, different operational modes, and different deployment strategies. Part of the reason for having several different approaches is that we're just in the third year of a 7-year program, and we haven't settled on the best technology or concept. But an even better reason for the variety is that there may not be a single best answer for all AHS systems. It may turn out that we need to have, for example, dedicated lanes in urban areas, for high throughput, but mixed traffic in rural areas, where there aren't enough automated vehicles to justify a dedicated lane.

So the demos we showing here today are deliberately set up to show off the variety of technologies and concepts. The Free Agent demo, which you see here, is designed to show several things. The technology is vehicle-based, using no changes to the roadway. We run in mixed traffic, that is with a mixture of automated and non-automated vehicles. We are demonstrating mixed vehicle classes, showing both cars and busses. We use communications with other AHS-equipped vehicles to improve safety and throughput, but we don't rely on communications, since there are non-AHS vehicles running with us that do not communicate with us.

The technology for this demo starts with computer vision to see the road. If you look here, behind the rear view mirror, there's a miniature black and white video camera looking forward. By burying it behind the mirror it gets a pretty good view of the road, from a pretty high vantage point, but it's still inside the vehicle so it uses things like the windshield wipers and defroster to keep its view clear. This particular camera is really cute. It's tiny and low-power, which makes it good for our applications, but it's also used for surveillance and other jobs. You can even buy one integrated into a necktie, if you're part of Candid Camera.

The TV is connected to an ordinary PC that sits in the trunk.. When we're done with the run, we'll pop open the trunk so you can see what the electronics look like. For a production systems, we could put all the processing into a single chip. In fact, we have a separate program, funded by DARPA, that's working on that. But for an experimental vehicle like this one, it's easier just to use a standard PC, so we can reprogram it and try different image processing ideas.

The PC interprets the video image and decides where the road is. Once the computer knows which direction the road is headed, it can do a couple of things. In warning mode, you can drive this vehicle like a normal car. If you start to fall asleep and drift off the road, the computer will notice that the direction you're headed is not the right direction, and will warn you and wake you up. We have a separate research project, funded by NHTSA, that's using the same vision system in that kind of a warning mode. For automated driving, the vision system talks to a motor buried behind the steering column, that turns the steering wheel to follow the road. This vision system is called RALPH, and two years ago, it did the steering for one of our earlier vehicles on a Washington DC to San Diego trip. It steered 98.4 % of the trip, through all kinds of conditions, day and night.

For safety purposes, we sized the steering motor to be relatively weak. It's strong enough to keep the vehicle on the road, even in fairly quick lane changes, but it's not as strong as a driver, so it's possible to take control back from the automated system at any time just by grabbing the wheel. If you fight the motor for more than a couple of seconds, it senses that and gives up.

We have a couple of other sensors on the vehicle. There's a Delco radar integrated into the front bumper that's looking for other vehicles and for obstacles. It's a mechanically-scanned radar, that measures bearing, range, and range-rate to targets it sees. It has a 12 degree wide field of view. Normally, that wide of a field of view could be a problem, because it picks up objects off the side of the road, like signs and guard rails. But since the radar gives the bearing to the target, we can combine the position of the target, from the radar, with the position of the road, from the vision system, to tell whether the object we're seeing is in our lane or the next lane or off the road, even if we're going around a curve. We've hooked the radar to our control computer, and in turn that talks to the cruise control, so we can maintain a set speed until we get close to a slower vehicle, then slow down to keep a constant separation. We also have an interface to the ABS system, so we can apply the brakes, but for this scenario we don't need to do that until the very end, when we bring the vehicle to a stop. GM did the throttle and brake controls for us on this vehicle and the other Bonneville; we did our own on the Houston Metro busses.

There are a couple of other sensors that we use during this demo. On the back of the vehicle, looking to the rear, we have a miniature scanning laser rangefinder. It's about the size of a couple of video tapes. It's looking back, sweeping the laser back and forth through a 20 degree arc, looking for vehicles behind us. We're suing thing laser on the back and the radar on the front to get on-road experience with different kinds of sensors. There's also a GPS antenna on the roof. GPS is the satellite-based positioning system. With ordinary GPS, we can get our position to a few tens of meters. That's good enough to tell what road we're on, and when we're coming to an exit. We're running a more sophisticated system, called differential GPS, which gets are accuracy to a few meters. That's good enough to act as a check on where other vehicles are next to us. If another automated vehicle tells us, over the radio link, that it is at the same GPS coordinates, then we'd better check beside us before we do a lane change.

Back in the lab, we're using an even more sophisticated GPS system, called carrier phase. That gets our accuracy down to a few centimeters. With that system, we're able to drive blind, just based on the GPS and an accurate map.

On this car, we also have a yaw-rate gyro, and encoders on the wheels that tell us how fast we're moving. So at any time, we know where we are roughly, based on GPS; where we are in the lane, based on the vision system, and how fast we're going and turning, based on the encoders and gyro. GPS also tells us our velocity, quite accurately, so we can double-check what the encoders are telling us.

We also have a couple of displays here. This one is just for demo purposes, so we can see what the camera is seeing, and what the computer vision system is doing. This is a touch screen, so I can use it to set up the computer without having to have a keyboard. Up here is Delco's interface. This is more like what a production vehicle might have. It displays the system status, things like whether the check-in succeeded or failed, when the vehicle is in auto mode, and so forth. There's also a head-up display for the driver. If you look over Richard's shoulder from the rear left seat, you might be able to see it reflected in the windshield. That shows only important messages that the driver needs to see while driving.

<somewhere around here the checks are done and the vehicle starts to move>

At the first part of the demo, we're all just picking up speed, entering the AHS roadway, and checking the vehicle status to make sure we're clear to turn on auto mode. There, you can see on the screen that we passed the check-in, so we're free to go automated. When the driver hits that green button - there - we're running automated. He can take his hands off the wheel and were driving under computer control. Here on the screen you can see what the vision system is seeing. The blue dots show the edge of the detected lane, and the cross up here is the steering point. This vision system doesn't just look for lines, it looks for all the linear features that are running parallel to the road, like pavement cracks and shoulder edges. You can also see on the display this dot, which is the radar reflection from the back of the bus.

We have a set speed of 50 mph, but the bus in front of us is running at 45, so for now we keep a set distance at the lower speed. The bus behind us has decided it doesn't want to run at 45, so it has automatically changed lanes and is going to pass us. The busses and cars are all running the same vision system, with some differences in radar and other sensors, but basically identical control systems. Once the rear bus has finished its pass, it will pull back into our lane, and the bus in front of us will accelerate to match its speed. For this demo, we're running with a script that says things like when to change set speeds and when to pass. But the scripts doesn't spell out things like exactly what speed each of the followers should be running, so that really is determined automatically based on the radar data. Now when the bus in front speeds up, we automatically speed up to match.

The cars in the other lane are now going to speed up and pass us, and eventually we'll speed up and pass the busses, too. You can see that for this demo we're not tightly packed in. We're keeping about a 40 meter gap to the vehicle in front of us. That gives us plenty of room to see the road with the vision system, and to react to changes in the speed of the vehicle in front of us without having to crank up the gains on the speed control loops. For this part of the demo, we're not relying on communications from vehicle to vehicle in order to control speed. This loose spacing gives us a theoretical throughput number of about 2500 vehicles per lane per hour, which is somewhat of an improvement over manually driven vehicles, which do about 2000 per lane per hour. This is fine for rural AHS application, and shows that we can introduce automated vehicles intermixed with manual vehicles without losing throughput, and maybe making marginal gains. This gives consumers the chance to have a more relaxed drive, and pay attention to other things like reading or talking on the cell phone. Then, once enough automated vehicles are in the traffic mix, we can start relying on vehicle to vehicle communications between pairs of automated vehicles, and we can close up the gaps and start to get higher throughput.

The mini-van that passed us was coming up pretty quickly on the car in front of it, so the lead car sensed the rapid closure and decided to get out of the way, just for the sake of being polite. That's why it changed lanes and let the van past. Now we're going to decide that it's time to pick up the pace. Once we're past the buses, the other sedan will pull out and join us. You can see that in this case, the two sedans are communicating, so we've closed up the gap somewhat.

Now we're going to demonstrate obstacle detection and avoidance. If you look up ahead, we've placed a standard orange construction barrel in our lane. The radar can't see it as far ahead as it can see a car, because it isn't metal so it doesn't reflect as well. But we can see it when we get to be about 80 meters away. That's still far enough away to initiate a pretty smooth lane change to avoid it, or to hit the brakes and come to a fairly fast stop in case the lane next to us is occupied. The car behind us, though, is following so closely that it couldn't wait until we move out of the way and still have time to see the barrel and react smoothly. So our car is going to broadcast the detected barrel location to any AHS vehicle in the vicinity that's listening. The car behind us realizes where it is, based on GPS, and where the barrel is, and changes lanes without having to wait to see the obstacle.

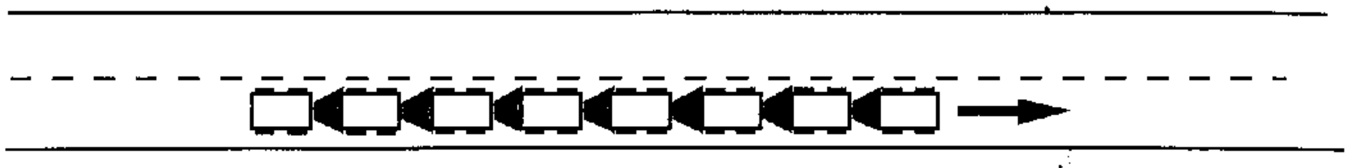
And now the script calls for us to come to a smooth halt at the end of the demo. So you can see, we've showed you smooth lane following, lane changing, speed keeping, headway keeping, obstacle detection, obstacle avoidance, and loosely cooperative driving that doesn't rely on high-bandwidth communications. These are all building blocks for a complete AHS system. There's still a lot of work to be done on tuning the individual components, and on down-selecting both technologies and concepts, but you can see that we're well on our way to an automated system that's safe, smooth, deployable and desirable. We'll pull off the lanes here into the parking lot, so the next demo can get started, then we'll open the trunk so you can see the electronics and we can chat some more and answer some questions.

4.2.2 Platoon

The Platoon Passenger Vehicle scenario demonstrated several important benefits of the AHS, particularly the capability to reduce congestion and increase throughput, by creating consistent travel speeds and reducing vehicle headway at highway speeds. The scenario consists of up to eight GM full size four door sedans (Buick LeSabre). The Platoon scenario is depicted in Figures 4.2.2.1-1 and 4.2.2.1-6. The accompanying narrative was presented by vehicle narrators.

4.2.2.1 Scenario

The vehicles with two passengers each enter the lanes and position themselves in a closely spaced single file. The vehicles enter the right express lane of I-15 (with respect to direction of travel) under manual control, and transfer to automated control.



After transferring to automated control, separation distances are reduced to less than ten meters.

Figure 4.2.2.1-1 Initiate Platoon Operation

As they proceed, the single large platoon splits between the first and second and second and third vehicles. The split separation distance is approximately 30.4 m (100 feet).

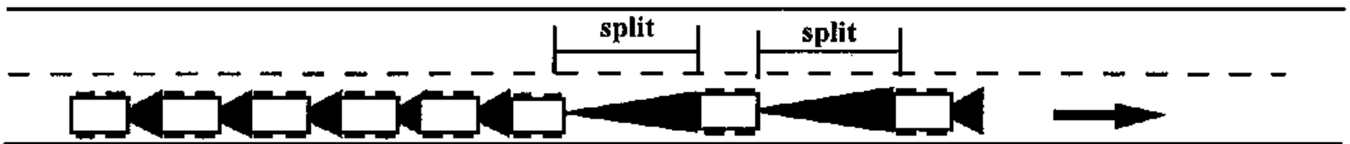


Figure 4.2.2.1-2 Platoon Split

After traveling about a mile the second vehicle conducts a lane change maneuver to the left lane.

Figure 4.2.2.1-3 Platoon Lane Change

The new vehicles 2 through 7 close the gap and rejoin vehicle 1 again.

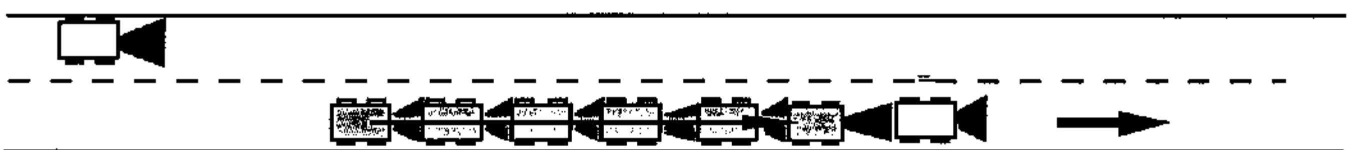


Figure 4.2.2.1-4 Platoon Join

The former vehicle 2, now new vehicle 8, executes a lane change maneuver from the left lane to the right lane to join platoon.

Figure 4.2.2.1-5 Platoon Lane Change and Join

At the far end, the vehicles return to manual control, stop, turn around, and regroup.

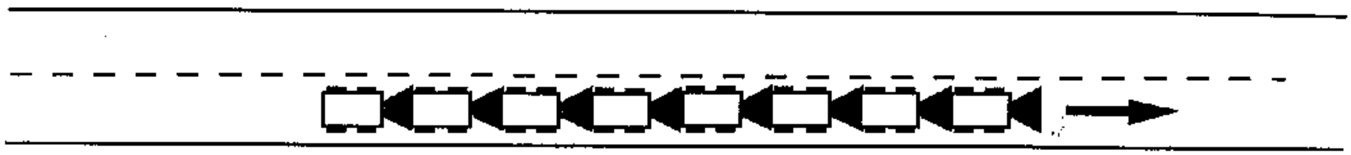


Figure 4.2.2.1-6 End Platoon Operation

4.2.2.2 Accompanying Narrative

Two narration scenarios

A. Narration only takes place in the vehicle during the demo run. The assumed available time includes:

- 5 minutes in the demo vehicle prior to vehicle start
- 8 minutes demo run
- xx minutes for questions and answers

B. The narration begins with an overview presentation to the visitor group prior to entering the demo vehicles and followed by a step-by-step description of the demo sequence during the demo run. The assumed available time includes:

- 5 minutes group presentation
- 3 minutes in the demo vehicle prior to vehicle start
- 8 minutes demo run
- xx minutes for questions and answers

Before demo starts

- Welcome and introduction
- The demo will start in xx minutes. Before we begin, let me show you the in-vehicle instrumentation.

What will be demonstrated?

We are going to demonstrate an automated "platoon" system to you. The demonstration system includes eight automobiles traveling at a spacing of xxx feet at 65 mph. The functions to be demonstrated include: lane keeping, (lane-changing), close spacing longitudinal control, and platoon split and join.

What is the significance of this demonstration?

This demonstration will show the technical feasibility of operating standard automotive vehicles under precise automatic control at close spacing at highway speeds. These capabilities make it possible for AHS to provide significantly higher lane capacity than conventional roadways, which can help relieve congested conditions and thereby reduce travel delays on our urban and inter-city highways. At the close spacing, aerodynamic drag is significantly reduced as well, which can lead to major reductions in energy consumption and pollutant emissions.

What special equipment is on the vehicles?

The demonstration vehicles are instrumented with radios for vehicle-to-vehicle communication, radar for measuring the distance between vehicles, magnetic sensors for measuring the vehicle's lateral position relative to the lane center, drive-by-wire steering, throttle and brake actuators, and two Pentium computers.
(Show the system if possible) They also have special interface features, including buttons for the driver to turn the automatic control systems on and off and display screens to illustrate what is happening at each stage of vehicle operations, plus a head-up display to provide information to the driver while he is watching the road and the vehicle in front.

What special equipment is on the roadway?

The roadway is instrumented with magnetic markers buried along the centerline of each lane at 4 ft. spacing. The magnetic markers will enable the vehicle to detect its lateral position and, by alternating the polarities of the magnetic markers, they also transmit roadway characteristics such as upcoming road geometry information, milepost, entrance and exit information to the vehicle.

Human Machine Interface

This demo vehicle has a few switches on the steering wheel which allow the operator to engage automated control. This is the head-up display which provides information for the driver to monitor the system performance and to take over the control when necessary. The human machine interface is designed to facilities driver/vehicle interaction and display the status of the automated maneuvers throughout the demo. The demo system provides the driver with a number of ways to take over the control when needed. The add-on automatic control system and devices will not interfere with the normal manual driving capabilities of the vehicle.

'Destination selection' screens

The AHS will have automated route selection and guidance functions. Now, the driver is asked to input the destination of the trip. The vehicle later can be guided to the nearest exit under automatic control. In this demo, the destination is the "AHS demo endpoint".

'Diagnosis" screen

The vehicle system will then perform automatic self-diagnosis and will report back to the driver the status of the vehicle.

'NAHSC' screen

Now we are ready to begin the demo. The driver presses the "engage automatic control" button and the vehicle is switched to the automated mode [automatic control on screen].

'Begin motion' screen

The vehicle motion is coordinated among the vehicles by the control and the communication system so that precise control of spacing at short distances can be achieved together with a smooth ride.

While accelerating

Normally in an operational system, we would not be starting an entire platoon from a stop the way we are doing it in this demonstration. Each vehicle would enter individually from an on-ramp and would join a platoon automatically when it reaches the AHS lane.

'Vehicle following' screen

We are now following the front vehicle at a xx ft gap. We are about 7.6 miles from the destination. It will take about xx minutes to arrive at the destination if we maintain the current speed. If you were driving the vehicle yourself, you would feel like you were tailgating at this speed and spacing. However, the control system has more precise sensors and faster actuators than you do, so it is able to follow the other vehicle very accurately. By the time we reach the other end of the demonstration track, this close spacing should feel a lot more natural to you.

'Split initiated' screen

- When needed, platoon can be split to allow any vehicle in the platoon to depart. Unless the departing vehicle is the first or the last vehicle, the departing vehicle will need to perform 'split' and 'lane changing' maneuvers.
- The separated platoon can later re-join after the lane-changing vehicle completes its maneuver.
- (for splitting vehicle) In this demo, our vehicle is the 'split' vehicle.
- (for other vehicles) In this demo, the vehicle number xx will split. The split may be commanded by the system based on route guidance information or requested by a driver if the initial destination is changed.

Screens for the splitting vehicle

Our vehicle is now in the process of enlarging the vehicle spacing to 30 meters (about 90 ft).

Screen for following vehicles

Our vehicle is slowing down because vehicle number xx is decelerating to split from the rest of the platoon.

'Lane changing initiated' screen

- (for lane changing vehicle only) Our vehicle will begin a lane change. [for other vehicles] You may or may not be able to see, number xx vehicle is performing a lane change.
- (for all) The lane changing is coordinated by the system at the right place and the right time. When vehicles travel in the adjacent lane, adjacent vehicles will be instructed to coordinate their movements with the lane changing vehicles, using the radio communication system, so that safe, efficient and smooth lane changing can be performed.
- (for free lane changing) The automatic control system has 'dead reckoning' capability. Therefore, it can estimate vehicle locations between the magnetic references in the two lanes while it is doing the lane change.
- (for infrastructure guided lane changing) The lane-changing vehicle will perform an infrastructure guided lane change. The lane changing vehicle will follow a predefined lane changing reference. The lane changing references are strategically placed in the roadway to ensure that all lane changing needs can be accommodated.

'Join' screen

- After the lane changing is completed, the two adjacent platoons can re-join.
- (for 'join' vehicle and the vehicles behind) Our vehicle will accelerate to close the spacing to the front platoon. The closing rate of the platoon join can be adjusted to provide both ride and perception comfort.

Comments made during the periods when no special maneuvers

The system is designed to deliver superior performance. The automated lateral control can perform accurate lane tracking with errors less than +/- 3 inches. The longitudinal control can maintain the spacing between vehicles with errors less than 6 inches, which are so small that you can usually not perceive any changes in the spacing.

The system can work with a variety of visibility, weather and road conditions, because none of its sensors are significantly affected by these factors.

Redundant information sources are used to maximize safety. For example, the longitudinal control system has spacing measurements as well as vehicle status and control information from the lead vehicle and the vehicle in front.

The technologies demonstrated in this vehicle can be individually applied for different system designs. Many of them can be used to provide driver assist functions such as adaptive cruise control and lane departure warning.

(Especially when going up the grade at the north end) Notice that the electronic coupling between the vehicles is so tight that it almost feels as though we have a mechanical connection to the vehicle in front, and it is pulling us up the grade.

'Stop' screen

We are now approaching the destination of the demonstration. The platoon will perform a synchronized stop.

Finishing

The demonstration is completed. Thank you very much for attending this demonstration. We'll be happy to answer your questions.

4.2.3 Maintenance

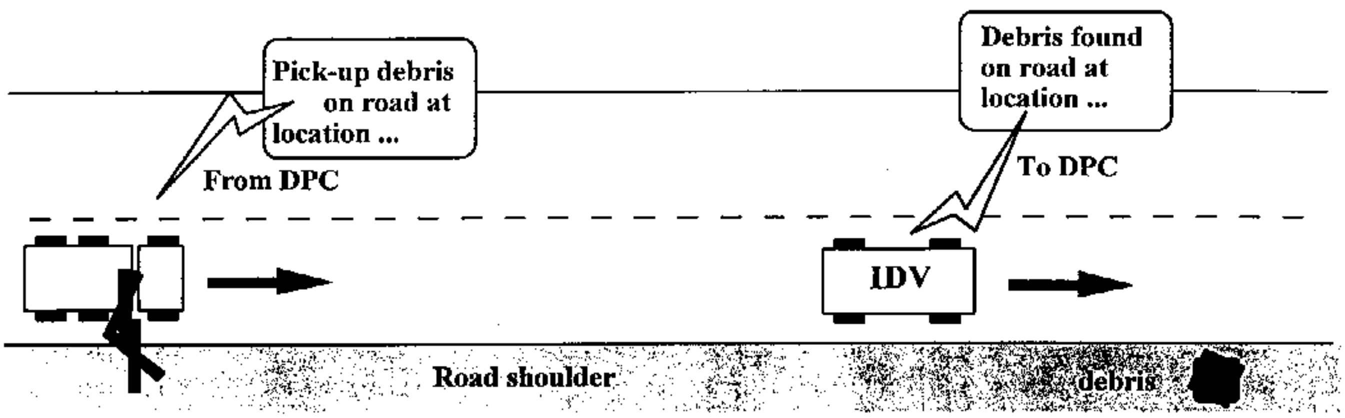
Demonstrations of maintenance operations target two specific goals. These are 1) system operational status interrogation and 2) obstacle detection/removal.

The Infrastructure Diagnostics Vehicle (IDV) is based on a GM small passenger van (Chevrolet Lumina). This scenario illustrates simple AHS infrastructure inspection and performance verification without impacting the traffic throughput. The vehicle is equipped with three magnetometers for magnetic reference marker detection, a vision-based lateral control system, and conventional speed (cruise) control that is tied in to the on-board computer to permit velocity profile following. The vehicle travels north and south on the lanes verifying the presence of functioning magnetic markers. A faulty or missing marker is scripted; the IDV identifies the location of the marker, notifies the observing passengers on-board and also communicated this to the Demonstration Presentation Center (DPC) at the Expo center, in near real-time. Debris is also located on the edge of the road and the on-board Automatic Location and Tracking System (ALTS) logs the problem and location into its GIS database and informs the DPC. The associated narration is also included.

4.2.3.1 Scenario

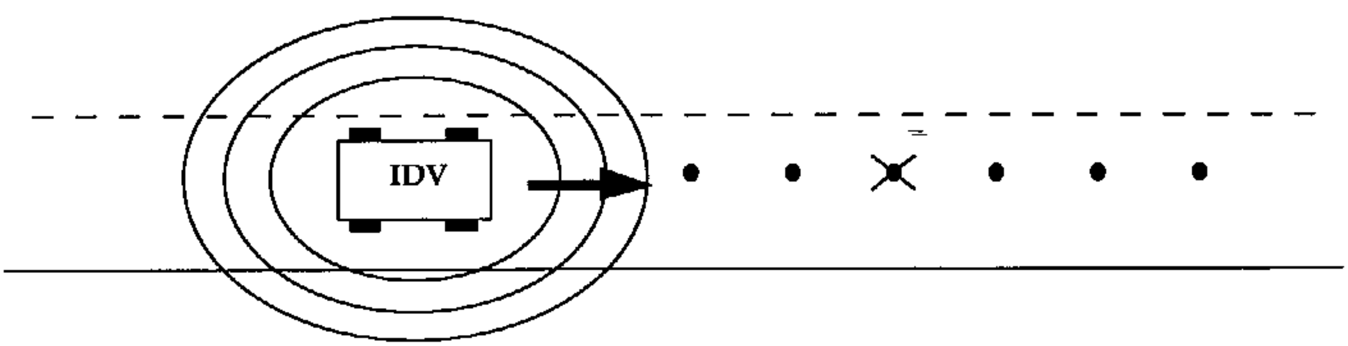
The IDV uses an autonomous lateral control and conventional cruise control. The IDV operator detects debris on the edge of the road and logs the location information into the ALTS. ALTS transmits the location to the DPC. The DPC dispatches the Caltrans Obstacle Removal Vehicle (ORV). The manually driven ORV picks up the obstacle with a robotic "manipulator" arm and continues in the same direction as the IDV. The IDV detects a scripted failed magnetic marker and automatically logs the problem into the ALT system. The scenarios are shown in Figures 4.2.3.1-1 and 4.2.3.1-2.

- IDV vehicle travels with lateral control and cruise control in the right lane.
- Driver identifies debris on the shoulder of the road and logs debris onto ALT system. ALT system automatically informs the DPC which, in turn, simulates calling for a Caltrans ORV to remove problem. The ORV actually leaves after the IDV on a pre-set time delay.
- Caltrans ORV starts far behind the IDV and picks-up the debris.
- Both vehicles stop at the north end of I-15.



Figures 4.2.3.1-1 Debris Location and Removal

- IDV vehicle travels in right lane. The interrogative electronics check and verify the location and the strength of the magnetic markers
- One or two marker are missing or are found to be malfunctioning and the IDV vehicle records the location for future maintenance.
- ALTS transmits error information to the DPC.



Figures 4.2.3.1-2 Faulty Magnetic Marker Detection and Location

4.2.3.2 Associated Narration

AHS Maintenance Theme:

Welcome to the Automated Highway System Infrastructure Diagnostic Vehicle, which we call IDV.

The IDV is a vehicle equipped with automatic control, using a vision system for road-following, much like other vehicles in the demonstration.

It is intended to demonstrate the ability to automate maintenance and inspection of the future smart transportation system know as the AHS.

The system shows how AHS technologies can be used in order to ease the burden on transportation maintenance organizations. The IDV provides a necessary tool to support post-construction inspection of an AHS. In addition, it will be a critically important aid in verifying the health of an AHS after a natural disaster, such as a flood or an earthquake.

High Level Vehicle Description:

The concepts illustrated by the IDV can be applied to a wide variety of envisioned AHS architectures. The specific sensing technologies used for the diagnostics are targeted to the infrastructure components used in the current AHS demo on I-15. For example, the IDV is meant to diagnose the health of the reference system used for automatically steering vehicles. In the current demo, on of the main infrastructure components that supports this is the magnetic reference marker embedded in the center of the pavement. So, the IDV includes magnetic sensors, called magnetometers, in order to diagnose this reference system.

What to Expect:

In today's demonstration, you'll see several things, including automatic vehicle control, diagnostics of magnets and communications systems, and detection of roadside obstacles.

First, you'll see the vehicle manually driven to the check-in point. The vehicle will perform standard check-in, like all other automated vehicles. Once the vehicle passes check-in, it will switch to automatic control. At this time, the diagnostic component of the IDV checks the function of the radio-frequency vehicle-to-roadside communication system, or VRC. It does this using a Global Positioning System (GPS) receiver to compare the vehicle location to the location where we expect to receive a signal from the roadside VRC system. The status of the VRC is then relayed to the TMC, which takes any action needed if there are problems.

Once past check-in, the vehicle will be under full automatic control, i.e., the vehicle will steer itself, as well as control its speed.

During this time, the system is constantly sensing and diagnosing the health of the magnetic reference system and reporting this information to the TMC by a wireless modem link.

At some point along our travel, the operator will identify a roadside hazard. He'll enter this information into the system known as the Automated Location and Tracking System, or ALTS. The operator can do this just by talking into a microphone, since ALTS has voice input and speech recognition capability. Once the ALTS knows about the obstacle, it marks the location using the GPS receiver and notifies the TMC, which will dispatch the Obstacle Removal Vehicle (or ORV) to drive into the system and remove the debris with a robot arm. You won't see this, as we'll continue driving automatically down the road.

At another point, the IDV will detect a simulated magnetic marker failure. While the I-15 AHS is a new installation, and we know that the markers are all fully functional, the IDV can check each magnet to make sure it is there, has the right magnetic field strength, and the right polarity for digital coding of the roadway information system. To illustrate this capability, the system simulates a magnetic marker polarity error in software. This error is detected automatically and an error message is sent to the TMC, which notes the error in a schedule for future maintenance.

BEGINNING OF LIVE DEMO

What is happening/technology Description:

We now going to begin manual driving to enter the system

...

The system is already automatically checking the magnets.

...

We're approaching the VRC reader, and check-in and VRC diagnostics are about to occur.

..

We've now passed check-in and are approved for automatic control and entry to the AHS.
The VRC has passed it's diagnostics, as you can see on the screen.

...

We're now switching over to full automatic control. At this point the operator no longer needs to driver the vehicle, and can concentrate on his maintenance tasks.

...

The operator just detected and object on the roadside, and has notified the TM by speaking into the ALTS microphone. The TMC is now dispatching the ORV to remove the obstacle. Note the warning message on the display.

...

Discussion regarding the coding of information and the general uses of the magnets for guidance and information. Also discus the technologies used in the IDV for automatic control and system diagnostics. Also occasionally note status updates on the HMI.

...

The system has just detected the simulated magnet polarity error. It automatically sends a note to the TMC regarding this error, and the TMC will schedule a repair at the earliest possible time.

...

We're now about to exit the system, and switch back to manual driving. I hope you've enjoyed your automated driving experience, and also have a better feel for how AHS can address some of the current maintenance problems, as well as future maintenance concerns that are specific to AHS. As you can see, the technologies shown in today's demonstration show how AHS is a smart choice to solve today's transportation problems, and is also a smart choice to solve problems that concern the highway construction and maintenance industry.

...

END OF LIVE DEMO

Questions ...

ORV Narrative

AHS Maintenance Theme:

Welcome to the Automated Highway System Obstacle Removal Vehicle, which we call the ORV.

The ORV is a vehicle equipped with technology that allows for tele-robotic retrieval of road obstacles and debris in or near the automated lanes. It is important to note that this vehicle does not have automatic guidance control and thus will be driven conventionally in the AHS lanes. What will be demonstrated today is the tele-robotic retrieval of an obstacle(s) as detected by the Infrastructure Diagnostic Vehicle (IDV) that is located directly in front of us.

The concepts illustrated by the ORV can be applied to both conventional and AHS systems and are demonstrated here to indicate the enormous savings that can occur when advanced technology is integrated into transportation maintenance operations. For example, through the demonstration of this machine you will see a vast improvement in speed and subsequent safety over manual retrieval of roadway obstacles and debris. In fact, the higher vehicle volumes of traffic envisioned for an AHS will dictate the use of more automated maintenance operations and thus increased savings over conventional means.

The ORV is intended to demonstrate the ability to automated maintenance of the future smart transportation system know as the AHS and the application nearer term advanced technologies can be used in order to ease the burden on transportation maintenance organizations.

High Level Vehicle Description:

The ORV utilizes a conventional truck chassis used for standard debris retrieval operations but has been specifically equipped with a tele-robotic mechanism that is completely controlled from the cab of the vehicle. The tele-robotic mechanism consists of a multi-position arm and clam bucket end-effector with all the associated hardware and software to implement automated and tele-operated control. As you will see during the demonstration, the arm has the ability to be maneuvered to virtually any position on either side of the track while al control is performed from within the confines of the cab of the ORV.

What to Expect:

[Narrator will briefly indicate to the passenger what to expect and that because of the dual nature of his job, both operator and narrator, the demonstration description will continue approximately three miles into the AHS lanes.]

In today's demonstration you'll see a couple of things that you won't see in a conventional debris retrieval operations. First the automatic dispatch of the ORV from the Traffic Management Center (TMC) complete with detailed obstacle position; and second, tele-robotic retrieval of any obstacles or debris in or near the automated lanes.

Following the dispatch, I will determine on which side to deploy the arm, and because of the duel-steering capability of the ORV I may have to switch seats with you prior to the obstacle retrieval. (Recall the ORV is dual steered). I will deploy the arm as we near the obstacle to one of three pre-programmed positions, and will fine tune the clam bucket position as needed via the cab mounted joystick. If all goes well and I am positioned right, the retrieval will occur on-the-fly. Following the retrieval into the bucket, I will actuate the dump feature that will place the obstacle/debris directly into the packer body of the ORV. This operation will automatically occur from any position that the arm may happen to be in. We will then resume operation and we can discuss the actual operation and I can answer any questions you may have about the ORV.

Now at this point I will concentrate on the dispatch and retrieval operation and we will have time to talk about the ORV following the scheduled retrieval(s). Please buckle up.

BEGINNING OF LIVE DEMO

END OF LIVE DEMO

Further description of the technology, its purpose and need. This might include range of motion of the arm, the types of obstacles an AHS lane may expect to see, the benefit of the ORV in an AHS or a conventional lane, the ease of calibration/maintenance of the ORV, etc.

4.2.4 Heavy Commercial Vehicle (Truck)

The heavy commercial vehicle scenario consists of a Class 8 tractor (Freightliner) and trailer and one passenger (1994 Chevrolet Corvette) vehicle.

4.2.4.1 Scenario

The scenario is divided into three segments. Figures 4.2.4-1 through 4.2.4-7 depicts each of the segments.
The starting configuration for the truck scenario is as follows:
First Vehicle = Vehicle B (Passenger Car)
Second Vehicle = Vehicle A (Class 8 Tractor and Trailer)

Segment 1
The Truck and Car start the scenario at the Control Yard or Staging Area location. Both the Car and Truck start in the right lane.
The Car starts the scenario ahead of Truck by 15 ft.
The Truck releases service brake and creeps forward. Truck observes Creep Alert.
The Car accelerates to 65 mph to approximately 350 feet ahead of the Truck.
Truck accelerates to 55 mph.
Car decelerates to 50 mph.

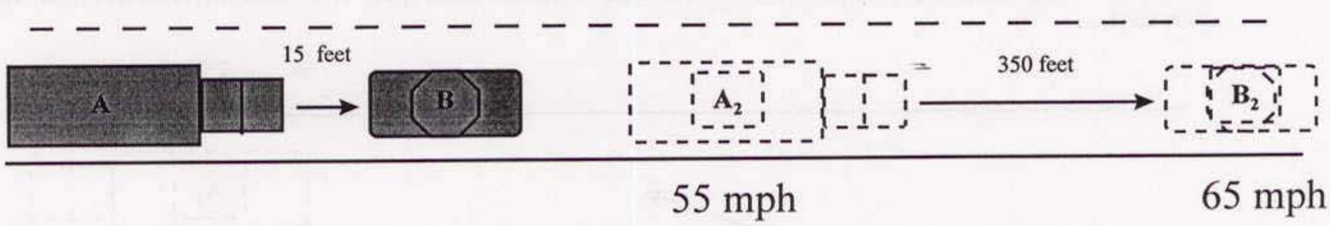


Figure 4.2.4-1 Creep Alert

As the Truck closes the spacing on the Car, the Truck driver observes Forward Collision Warning System (FCWS) reports at a 3 second alert (242 ft), a 2 second alert (161 ft), a 1 second alert (81 ft).

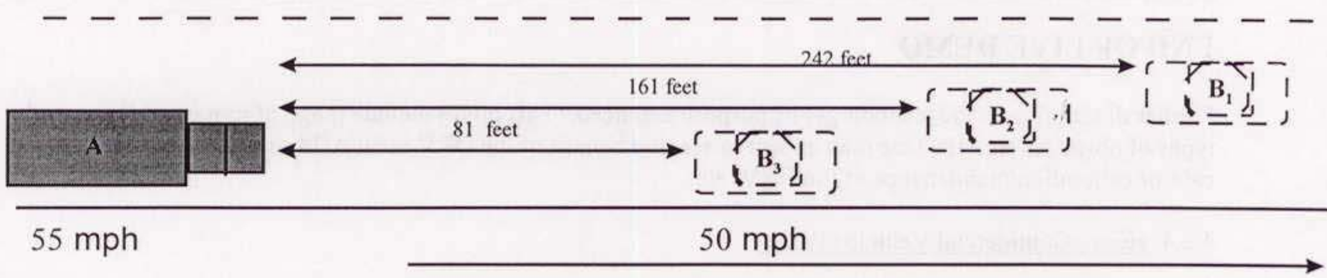


Figure 4.2.4-2 Forward Collision Warning

Segment 2

The Car then accelerates to 65 mph to approximately 350 feet ahead of the Truck. The Car decelerates to 35 mph. The Truck now moving at 55 mph, approaches the slower moving Car at a 20mph differential. The Truck driver observes a FCWS 3 second report.

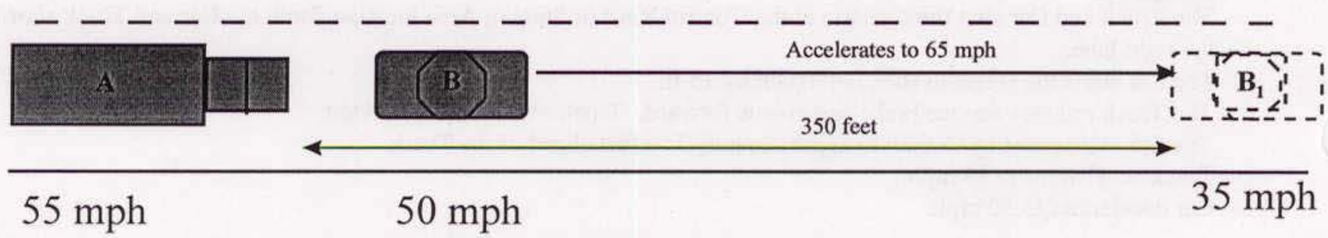


Figure 4.2.4-3 Forward Collision Warning

The Truck driver executes a lane change to left lane to avoid car. The Car waits for truck to pass, then the Car accelerates to approximately 55 mph in right lane and stays in truck blind spot. The Truck driver observes the Blind sport alert.

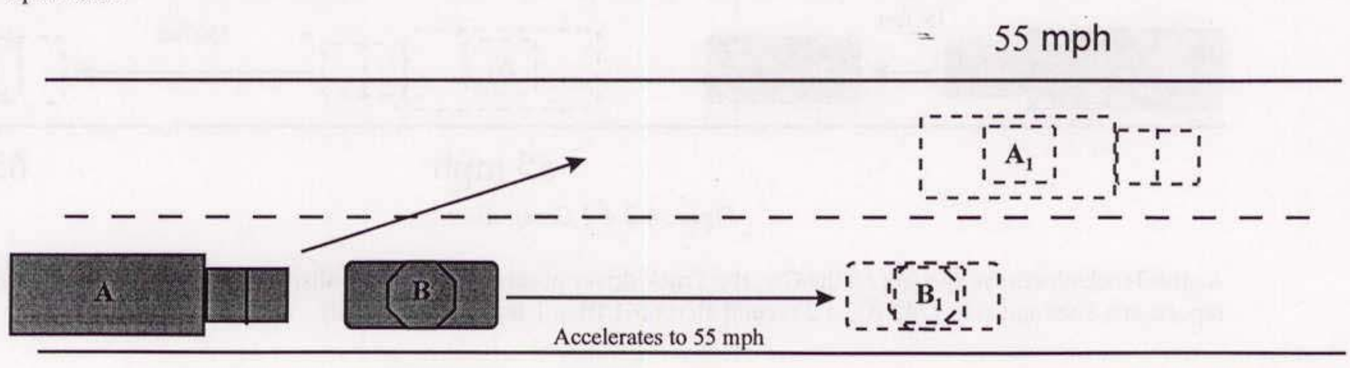


Figure 4.2.4-4 Blind Spot Alert

The Car accelerates to 65 mph in right lane and pulls ahead of truck approximately 1/4 mile, Truck returns to right lane at approximatly 45 mph.

The Car comes to stop, activates hazard warning lights, the Truck driver observes the FCWS report and moves to left lane to avoid the stopped Car.

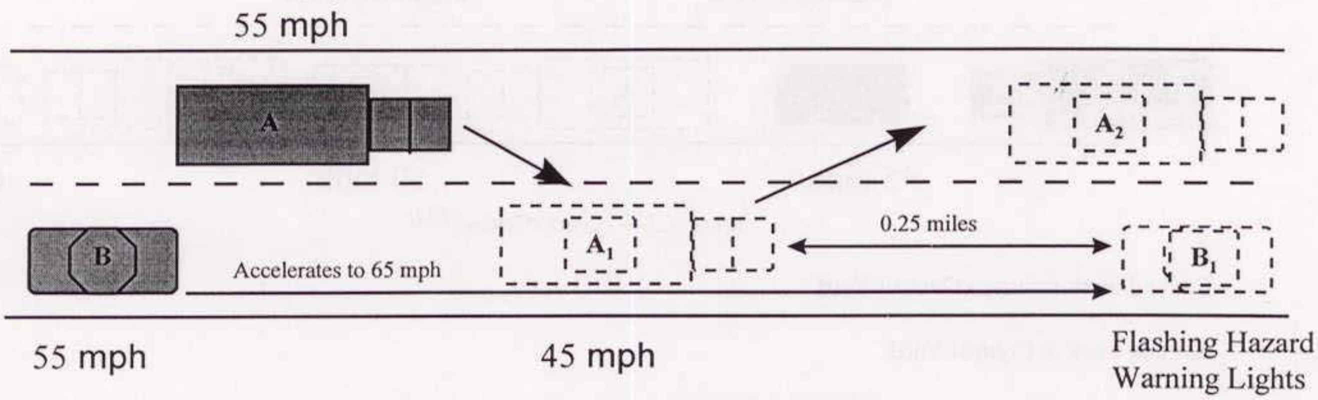


Figure 4.2.4-5 Forward Collision Warning

Segment 3
The Truck driver executes a lane change maneuver to the right lane and proceeds at approximately 55 mph. The Truck driver sets SmartCruise(TM) speed and headway.
The Car accelerates to 65 mph, moves to left lane and passes truck. The Car then moves to right lane in front of truck. The Truck driver observes the FCWS yellow light but takes no action because the Car is moving away from the Truck.

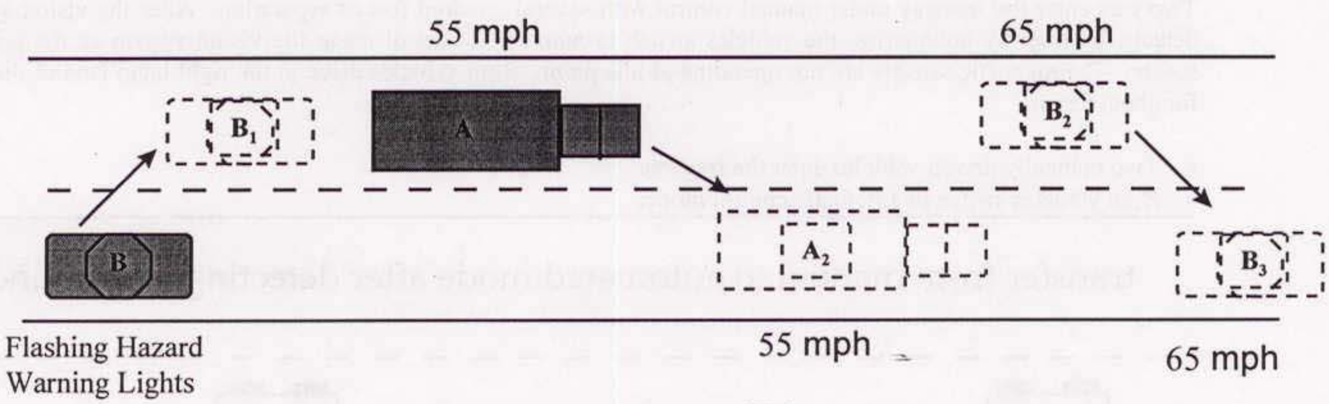


Figure 4.2.4-6 SmartCruise(TM)

The Car slows to 45 mph. As the Truck approach the Car the Truck SmartCruise(TM) matches speed and preset headway.
The Car accelerates to 50 mph, the Truck SmartCruise(TM) matches change in speed of target car and maintains preset headway.
The Truck driver changes headway setting. The Car accelerates to 65 mph. The Truck SmartCruise(TM) returns to driver's preset cruise speed.

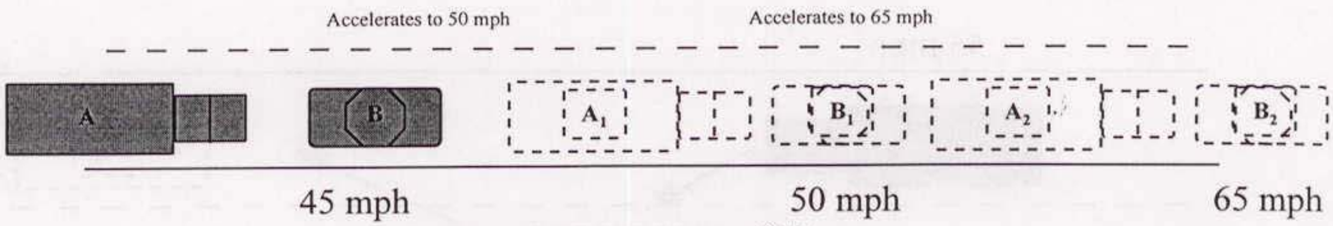


Figure 4.2.4-7 SmartCruise(TM)

Car and truck return to Control Yard

Car and truck at Control Yard.

4.2.5 Control Transition (Honda R&D North America)

NAHSC Associate participant Honda R&D North America provided a two vehicle (1996 Honda Accord) demonstration divided into four segments. The goal of this demonstration is to demonstrate technologies of how a free-agent and a platoon demonstration can co-exist as parts of a layered approach to deployment. These segments are depicted in Figures 4.2.5.1-1 through 4.2.5.1-4.

4.2.5.1 Scenario

Two cars enter the freeway under manual control with several hundred feet of separation. After the vision system detects the freeway boundaries, the vehicles switch to automated control using the vision system as the primary sensor. The magnetic sensors are not operating at this point. Both vehicles drive in the right hand lane of the I-15 for about a mile.

- Two manually driven vehicles enter the freeway.
- Both vehicles switch to automatic control mode.

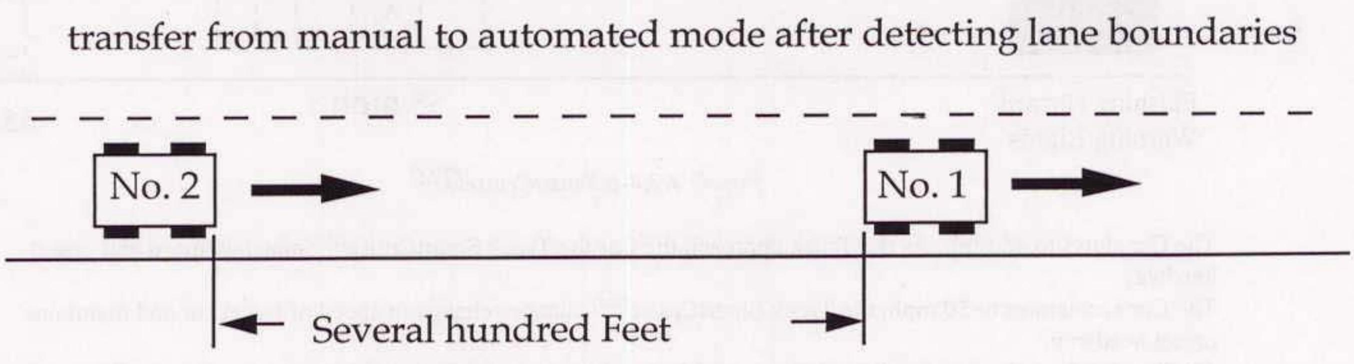
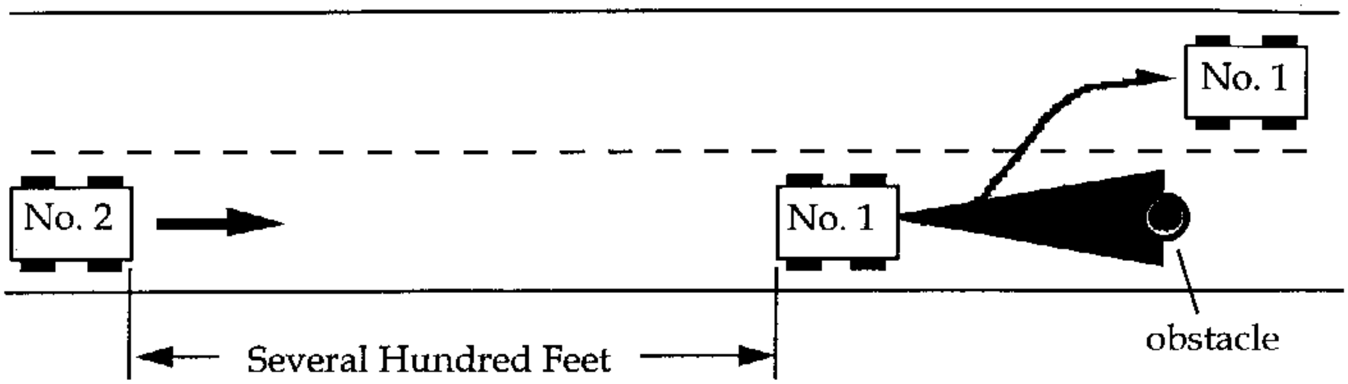


Figure 4.2.5.1-1 Freeway Lane Tracking - Segment 1
(Lateral Control - Vision ; Longitudinal Control - Laser and Stereo Vision)

At this point, the cars encounter an obstacle in their lane. Each vehicle independently detects the obstacle and performs a lane change to avoid the obstacle.

Independently, Vehicle No. 1 detects obstacle and performs lane change.



Independently, Vehicle No. 2 also detects obstacle and also performs lane change.

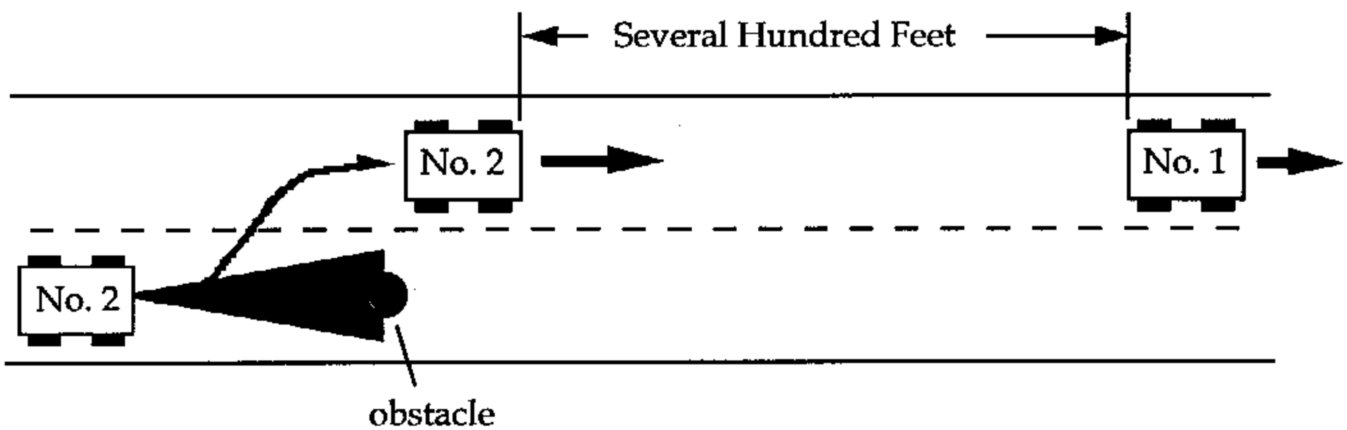


Figure 4.2.5.1-2 Obstacle Detection/Avoidance - Segment 2
(Lateral Control - Vision ; Longitudinal Control - Laser and Stereo Vision)

Under autonomous control, Vehicle No. 1 sets a speed of approximately 80.5 kph (50 mph) and Vehicle No. 2 sets a speed of approximately 104.6 kph (65 mph). Vehicle No. 2 closes in on Vehicle No. 1 until the following distance is a moderate to long spacing (TBD m). The vehicles maintain this spacing for about one and one half kilometers.

- The speed of Vehicle No. 1 is set at 50 mph.
- The speed of Vehicle No. 2 is set at 65 mph.
- Vehicle No. 2 closes onto Vehicle No. 1 and keeps a moderate spacing (i.e. combined lateral control and non-cooperative Adaptive Cruise Control).
- Moderately spaced Vehicles No. 1 and No. 2 enter "Urban AHS Corridor".

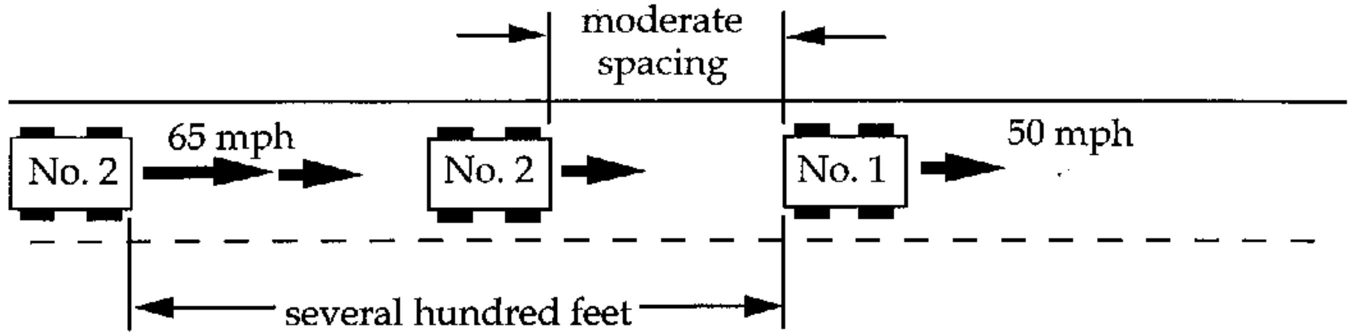
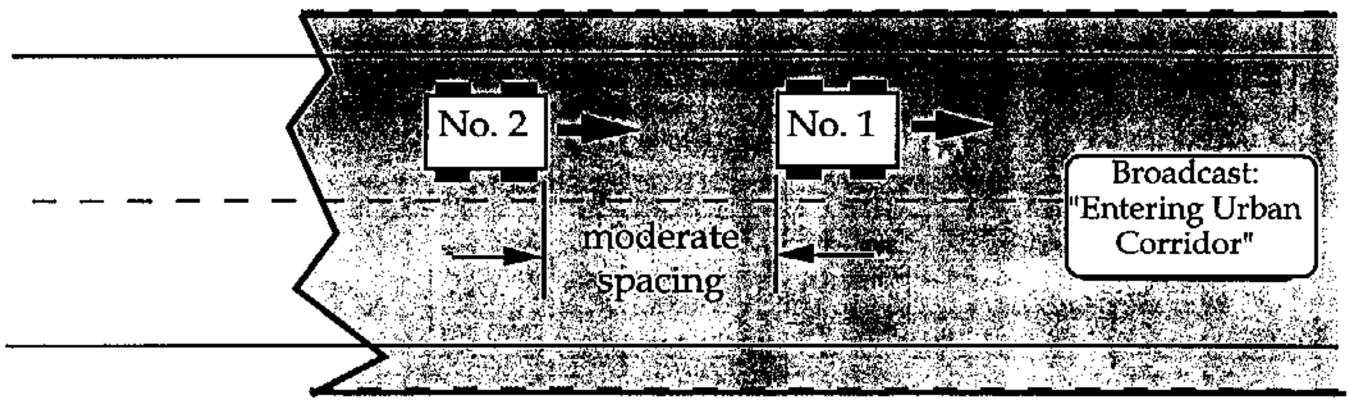


*Figure 4.2.5.1-3 Non-Cooperative Adaptive Cruise Control - Segment 3
(Lateral Control - Vision ; Longitudinal Control - Laser)*

The scenario then simulates the vehicle entering an urban AHS corridor. Upon entering the "corridor" the vehicle controls switches from the vision based system to magnetic marker and radar as the primary sensors. The trailing vehicle then closes to TBD meters and the vehicles continue for about one and one half kilometers.



Vehicles No. 1 and No. 2 switch from vision control to magnetic marker-following control. Vehicle No. 2 closes on Vehicle No. 1 reducing headway, establishing vehicle to vehicle communications and demonstrating platooning. At this point the scenario ends

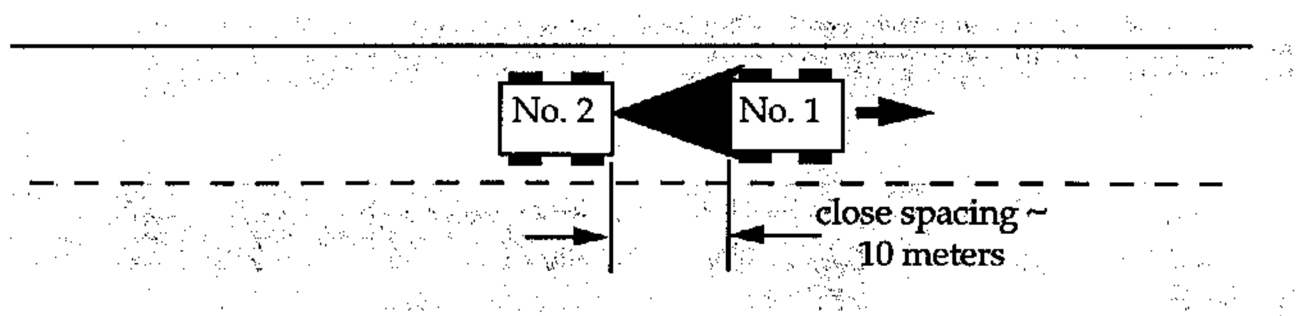


*Figure 4.2.5.1-4 Cooperative Adaptive Cruise Control - Segment 4
(Lateral Control - Magnetic Nail; Longitudinal Control - Laser)*

4.2.6 Alternative Technology (The Ohio State University (OSU))

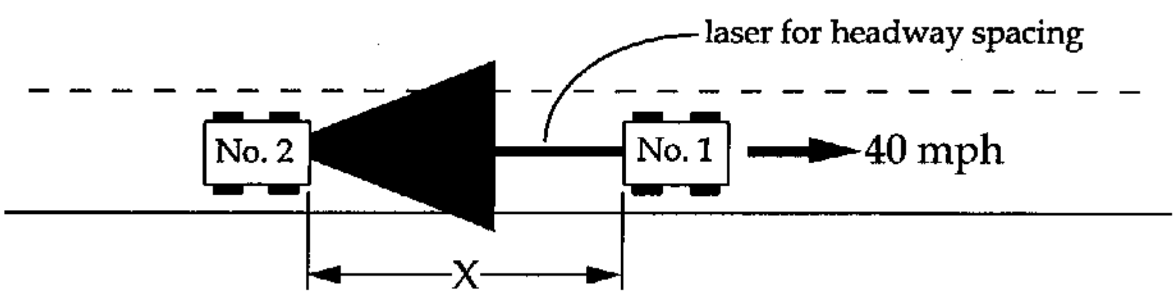
4.2.6.1 Scenario

The OSU scenario consists of three vehicles (1996 Honda Accord), two of which were automated. Approximately 4 km (2.5 miles) of highway was equipped with radar reflective stripe. This scenario is depicted in Figures 4.2.6.1-1 through 4.2.6.1-3.

Vehicle No. 1 (manual) followed by Vehicle No. 2 (automated) travel along the highway at approximately 64.4 kph (40 mph). Separation distance is approximately 12.2 m (40 feet). Vehicle No. 2 uses vision for lane guidance and a laser system for headway maintenance. After reaching the radar reflective stripe, Vehicle No. 2 switches from vision guidance to its stripe guided radar system for lateral control.

Vehicle No. 3 (automated) starts after Vehicle No. 2 and travels at 88.5 kph (55 mph). When Vehicle No. 3 catches Vehicle No. 2, Vehicle No. 3 slows down to 64.4 kph (40 mph) and follow Vehicle No. 2 at a distance of about 12.2 m (40 feet). After about .8 km, Vehicle No. 2 executes a lane change maneuver to pass Vehicle No. 1. Vehicle No. 3 then closes the gap to vehicle No. 1 to a distance of about 12.2 m (40 feet). After another mile of travel Vehicle No. 2 then returns to its original lane using the vision based system.

- Mixing of Automated and Non-Automated cars is possible.
- Three cars total: two automated and one manual (Vehicle No. 1).
- Radar Reflective Stripe guidance demonstrated.



- Vehicle No. 1 is manually driven. Vehicle No. 2 is autonomous and uses vision for lane guidance and a laser system for headway.
- Vehicle No. 2 switches to stripe guided radar for lane guidance.
- Vehicle No. 3, staged in the right lane and farther back, approaches Vehicles No. 1 and No. 2 , which are traveling slower.
- Vehicle No. 3 adapts to vehicle No. 2 and reduces its speed to match the other vehicles.

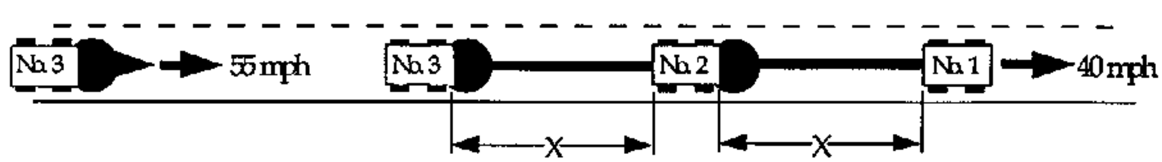


Figure 4.2.6.1-1 Alternative Technology Scenario - Segment 1

- Vehicle No. 2 decides to pass Vehicle No. 1. Thus, Vehicle No. 2 performs a lane change and Vehicle No. 3 closes to Vehicle No. 2.

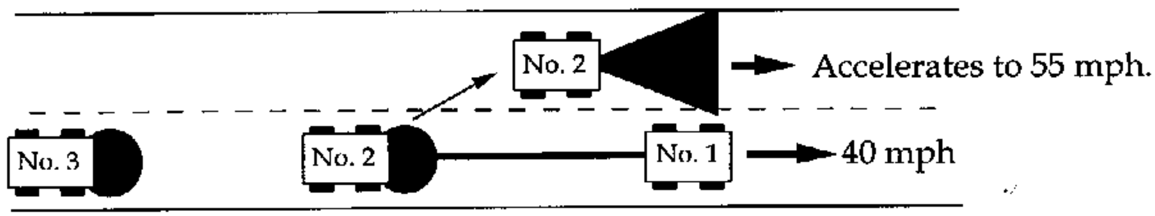
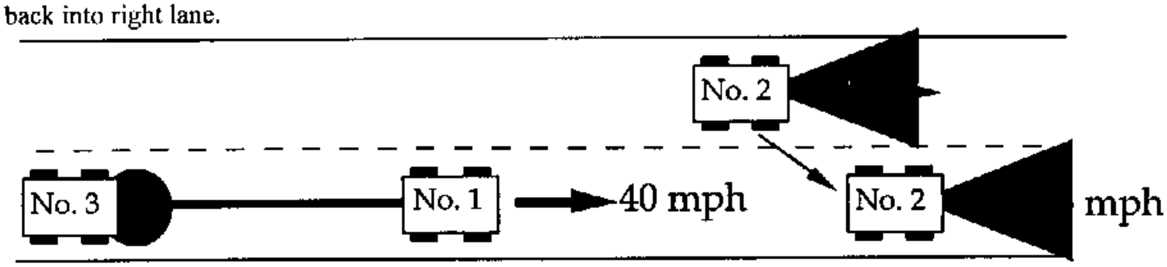


Figure 4.2.6.1-2 Alternative Technology Scenario - Segment 2

- Vehicle No. 2 accelerates past Vehicle No. 1 in left lane. After passing Vehicle No. 1, Vehicle No. 2 switches back into right lane.



- Vehicle No. 3 and No. 2 change back to vision/laser lane-guidance system.

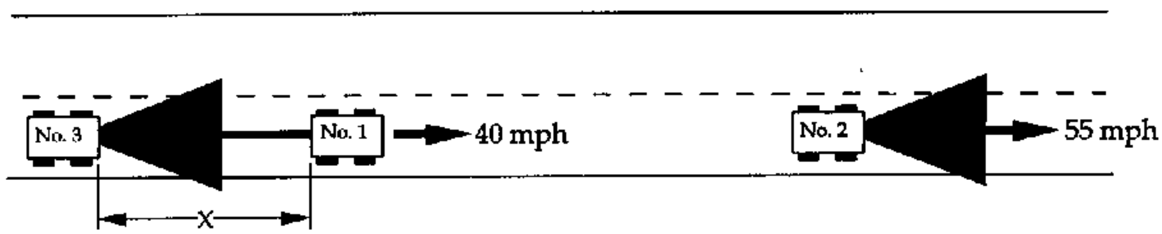


Figure 4.2.6.1-3 Alternative Technology Scenario - Segment 3

4.2.6.2 Associated Narration

The attached narrative is in four basic parts:

1) The Welcome/Introduction/Overview Segment
2) The At/In Vehicle Pre-Run Orientation Segment
3) The Actual Demo Run Segment (With customized versions for Cars #2 and #3)
4) The Post Run Comments and Question & Answer Segment

It is anticipated that Part 1 can/will be given during the shuttle bus ride to the place where the demonstration cars are parked. {In case of an "emergency", a "condensed version of the highlights of Part 1 would be inserted at the beginning of Part 2.}

Part 2 would be given at the vehicle. It would begin standing outside the vehicle, and continue briefly upon first entering the vehicle. Part 2 would end with a request for the rider(s) to fasten their seat belts.

Part 3 would be given during the start of the run (including the approach to the I-15 test lanes) and continue over the course of the run. It would conclude at the end of the run on the test lanes proper. It is intended that Part 3 not be a steady running narrative, but the delivery of key points for the rider(s) to note or observe at selected intervals.

Part 4 would begin at the end of the run on the test lanes proper and continue until the rider(s) disembark at or near the shuttle bus pickup point.

WELCOME/INTRODUCTION/OVERVIEW

Good morning/afternoon (as appropriate) Mr./Ms./Congressman________________ or ladies and gentlemen (as appropriate). Thank you for your interest in automated highway systems (usually referred to by the acronym, AHS). And thank you in particular for your interest in The Ohio State University's part of today's demonstration. As you may know, OSU is one of 7 "vehicle developers" participating in today's demonstration organized and managed by the National Automated Highway System Consortium. Each developer is demonstrating a test sequence (i.e., a scenario involving several steps) featuring one or more unique AHS technologies or AHS modes of operation plus a number of generally expected AHS functions or features.

In the OSU Scenario, the primary unique feature that we are demonstrating is the use of what we call radar reflective stripe technology. In this technology, there is a minimal amount of impact on the infrastructure—i.e., special radar reflective stripes are laid down the middle of the lanes (or at the edge of the lanes where lane divider markers are typically provided)—that's it! Special radar sensors and control systems on-board the vehicle use these stripes to automatically guide the vehicle though basic driving maneuvers such as driving the vehicle in the center of the lane and executing a double-lane change passing maneuver.

Other key features of the OSU Scenario are the demonstration of using a combination of vehicle control technologies (e.g., radar, vision, and laser) to provide special flexibility and back-up capacity. This fusion of technologies is especially important to both (1) accommodate a variety of mixed traffic situations and (2) provide extra control redundancy for improved safety. [The term mixed traffic as used here refers to situations in which automated and non-automated vehicles can share a common roadway—a feature which many see as a key to success in the initial deployment of AHS vehicles and technologies.]

Some of the inherent AHS capabilities that the automated vehicles being demonstrated by OSU share with the other vehicles being demonstrated include such features as:

Intelligent Cruise Control,

1) Obstacle detection, warning and/or avoidance, and
2) Lane departure warning and/or intervention.

At the root of the development of these various functions and features is a common goal of providing as many of the following benefits as possible and practical:

1) Reduced congestion and greater highway productivity (because vehicles can safely travel at closer spacing at freeway travel speeds and with fewer accidents)
2) Improved safety (because of reduced opportunity for driver error)
3) Better quality of life (because of increased passenger safety, lower driver stress and reduced competition for highways with other desired land uses and other needs for public funds)
4) More predictable travel times

OSU has been involved in AHS research and development work for a long time. Some of our pioneering efforts in this field date back to the 1960's and 1970's. This work supports the overall mission of The Ohio State University to promote education, research, and service.

In addition to providing benefits to the public (e.g., providing various optional approaches for roadway planners and providers to reduce congestion and improve the safety and productivity of our state's and nation's highways) such work provides:

1) Excellent research opportunities for OSU's students which involves hands-on development of cutting-edge hardware for real-world applications,
2) Exposure of our students to fellow researchers and to people and organizations who may be potential future employers, and
3) Additional means of attracting and retaining world-class faculty while also adding to the interesting experiences they can bring to their classrooms.

AT/IN VEHICLE PRE-RUN ORIENTATION

The OSU Scenario uses 2 special Honda vehicles and 1 conventional Honda vehicle. The special vehicles (Cars #2 and #3) are of an advanced, AHS capable design. The major features which make the special vehicles AHS capable are (1) their "control-by-wire" brakes, throttle, and steering systems and (2) their radar laser and vision based control systems. The later serve as the eyes and brains of the vehicle during automated operation. The former act as the "hands" and "feet" of the automated driver. I would point these special features out to you but we have intentionally incorporated them into the vehicle in such a way that they are essentially transparent to the typical car owner. As you sit in the car, the only additional sensor you are noticing is the single camera.

Another unique feature of Cars # 2 and #3 is the use of status displays visible to each of the vehicle passengers. Each of our cars has 3 of these displays—one is located there (point) in the center of the instrument panel, and the other 2 are located here (point) and here (point). These status displays are not an AHS requirement—they are installed in these vehicles solely to allow the vehicle passenger(s) to know what is going on at the moment—for example, is the vehicle currently under manual control or automatic control, which sensor is operating and what the car notices about the adjacent cars.

Other equipment that you see on these vehicles (for instance, the special radios, walkie-talkies, and cell phones) are installed solely to facilitate the overall demonstration—that is, they are not required for the vehicle to perform its automated functions. As appropriate we will use these communication devices to coordinate our various activities with other parts of the demonstration and Expo.

By the way, for ease of reference we sometimes refer to the three cars by the type of role they play:

- Car #1 is a car under the manual control of a Grandma or tourist who is satisfied with moving along at the minimum posted speed
- Car #2 is an automated car which is being driven by a Teenager or Super Mom who is anxious to make the best possible time while not exceeding 55 mph.
- Car #3 is an automated car which is being driven by a guy we call Jack who likes to travel at the maximum allowable speed but is adverse to passing.

****

Please fasten your seat belt and we will get under way.

CAR #2

ACTUAL DEMO RUN

As we drive, under manual control, over to the actual demonstration area on the I-15 HOV lanes, I would like to brief you on what specifically we will be demonstrating and in what order. The focal point of our demonstration will be to show you a vehicle guidance technology which is unique to OSU. However, during the course of our demonstration we will actually show you 4 major AHS capabilities in the following order—(1) vision controlled lane-following, (2) radar reflective stripe controlled lane-following, (3) Intelligent Cruise Control which using laser or radar based car-to-car distance measurement and separation gap control , and (4) a double lane change maneuver under full automation. I will explain some of this terminology to you in a few minutes when we are actually demonstrating that particular capability.

The primary unique AHS element of the OSU Scenario is the use of what we call radar reflective stripe technology. In this technology, special radar reflective stripe material (such as the sample I am holding in my hand) is laid down on the center of the highway lane (or along the edges of the lane where land dividing indications are required anyhow). The use of this stripe in conjunction with radar sensors and on-board computers permits the car to (1) automatically follow the lane once the driver has engaged the automatic control and (2) make automatic lane changes if and when appropriate.

For this demonstration, our special stripe has been laid on both of the I-15 HOV lanes along the center third of the 7.5 mile test section. Our demonstration involves about 6 major steps spread over approximately 15 minutes. I will identify and describe each of these steps as they occur. Following along will be a little bit like watching a 3-ring circus—you may want to (A) watch the driver as he engages automatic control and releases the steering wheel, or (B) watch the status display in front of you to see if you can physically sense the changes in status as they occur, or (C) watch the roadway to see how it feels to be a passenger in a car under automated control, or (D) all of the above. The time will go quickly, so you may want to assume the role of a highly attentive rear seat passenger so you can monitor and "critique" our "invisible automated driver". [PAUSE]

1) We are now at the start of Step 1 of our Scenario. Car #1 of our group is a manually controlled car which will precede us. Car #1 is now accelerating up to 40 mph and will continue at that speed throughout the demonstration. As I mentioned earlier, the role of Car #1 is to simulate a slow moving non-automated car (for example, a grandmother or a tourist) whose presence and driving pattern our automated care will have to detect and then respond appropriately. [PAUSE]

2) Our Car (Car #2) is now accelerating up to its cruise speed of 55 mph. Our car will initially use it's vision control system to automatically guide the vehicle along the center of the lane. [PAUSE] We are now switching to automatic operation and you can see the Driver has taken his hands off the steering wheel! At this point, the driver has also taken his foot off the accelerator pedal. Our car is now functioning somewhat like a current car traveling at a set speed of 55 mph using a conventional Cruise Control Accessory. There are, HOWEVER, two very important exceptions--(1) our driver's hands are off the wheel as well as having his foot off the accelerator and (2) this car has a laser and a radar system which will be watching for us to come up on any slower moving traffic ahead of us and then automatically respond to that situation. As you will see in a few minutes, the programmed response to that situation is to slow down to match the speed of the preceding vehicle and then maintain a safe distance back from it. [PAUSE] OK, our vehicle has detected the slower moving car ahead and is starting to slow down. [PAUSE] Now, our vehicle has slowed down to match the speed of the vehicle (Grandma) ahead of us and is following it at a distance of about 40 feet. This kind of function is sometimes referred to as an Intelligent Cruise Control function. [PAUSE] When our car reaches the area of the HOV lane where our radar reflective stripe is laid, the car will automatically switch over and track the stripe. [PAUSE] This switch over is occurring right now. [PAUSE] This particular sequence of the demonstration shows you that the lane-following guidance function may be accomplished using more than one technology. We feel that having two or more different methods available on a given car not only provides redundancy for enhanced safety, but provides flexibility in the way the vehicle can be used on different AHS and non-AHS roadways. [PAUSE]

3) Car #3 behind us is now under automatic control and is chasing us at a cruising speed of 60 mph. Car #3's equipment is identical to this vehicle. It will also be using it's vision system for lane-following (and switching automatically to its radar system when it comes to the stripe). Car #3 also has a laser system to sense it's distance to any slower moving traffic ahead of it (in this case, us). Just as our Car will slow down to match the speed of Car #1 and then follow it a distance of about 40 feet, Car #3 will decelerate to match our speed and then trail us with a separation of about a 40 feet. In fact the only difference between Car #3 and us is what we at Ohio State call "personality". This car has what our students fondly call the

"teenager" personality, that means it will check for the possibility of passing, before "Jack" behind us, does. [PAUSE]

4) OK, our vehicle has detected the slower moving car ahead and is starting to slow down. [PAUSE] Now, our vehicle has slowed down to match the speed of the vehicle ahead of us and is following it at a distance of about 40 feet. [PAUSE] At this time, if you will now look behind us, you will see that Car #3 is slowing down and taking up a position about 40 feet to our rear.

5) At this point, all 3 of our cars are on the stripe and proceeding at 40 mph. Our car has been programmed to pass slower vehicles and maintain the maximum safe speed of 55 mph if this is permitted local conditions. Accordingly, our car checks for proper conditions to permit a safe pass (for example, (A) the presence of a guide stripe in an adjacent lane serving traffic going in the same direction and (B) the absence of an adjacent car and/or passing car in the passing lane. Upon acquisition of the appropriate clear-to-pass information, our car will pass Car #1, get a safe distance ahead of it, check for the necessary clear space in front of Car #1, and then move back into its original lane. All "personalities" which decide on these conditions, are of course SAFE. Otherwise we wouldn't put it on the road. [PAUSE] Our double lane change passing maneuver is starting NOW. [PAUSE] Because, for this demonstration, Car #3's driver has elected non-passing programming, or a more sedative personality which matches his own. Car #3 will close up the gap between it and Car #1 to 40 feet and then follow it at that distance until we reach the end of the demonstration run. [PAUSE]

6) We are now approaching the end of the installed length of radar reflective stripe. This Car (and Car #3 behind us) will automatically switch back to their vision systems for lane following when the section of stripe ends. [PAUSE] We have now completed the demonstration. Our driver is resuming manual control. We will now exit the I-15 lanes and take you back to the control yard to catch the shuttle bus to the Exposition area.

<u>CAR #2</u>

<u>**POST RUN COMMENTS AND Q&A**</u>

In summary, what you just saw was a demonstration of several key functions that are generally expected of vehicles capable of automated highway system service. Specifically you saw a demonstration of ***hands-off driving, hands and feet-off driving, and fully automated driving.*** Elaborating on each of these a little bit . . .

1) For the lane-following capability (an example of "hands-off driving")—you saw this being done first with the use of a vision system which required no special preparation of the highway. You also saw lane-following being accomplished with the proprietary OSU radar reflective stripe technology. And , finally, you say an automatic return to vision based lane-when our car reached the end of the stripe—all seamlessly and transparent to the vehicle occupants. As partly shown in this part of the demonstration, lane-following capability can be used to provide drivers with a reduced stress and safer environment in an AHS setting. This basic capability could also be used a warning or intervention system to reduce the number and severity of run-off-the road accidents on non-AHS roadways.
2) When we were using the Intelligent Cruise Control capability in combination with lane-following capability (this was an example of "hands-off <u>and</u> "feet-off" driving). In this mode, our car was not only able to steer itself smoothly and safely along the center of the lane, but when it caught up with a slower car, it decelerated to the speed of the preceding car and then proceeded to follow it at a safe distance of 40 feet. As demonstrated, this capability provides the ability to have cars <u>safely</u> follow each other at closer distances and/or at higher speeds—thereby increasing throughput, reducing travel times, and reducing congestion. Other possible applications of these particular capabilities could extend to use on non-AHS roadways to perform such functions as (A) warning the driver of an obstacle in the roadway or (B) assisting the driver in parking in a tight area by providing him or her with information on the distance to a adjacent car or wall.

3) With regard to the automated double lane passing maneuver you witnessed—this was an example of fully automated driving. As demonstrated, the on-board intelligence of this car determined that it was safe to pass and then executed a passing maneuver. Subsequently, our car then checked for sufficient clear space in front of Car #1 and then re-entered the original lane. The same capabilities used to execute this maneuver, could also be used for accident avoidance (for example, detecting and maneuvering around a stalled vehicle or other obstacle).

We feel that the AHS capabilities you have just seen demonstrated will be especially helpful in the early stages of AHS deployment when there are relatively few AHS roadways and relatively few AHS capable vehicles. The flexible automation approach you just saw demonstrated is amenable to incremental deployment. In the early stages of AHS deployment, such flexible systems can provide several key benefits of dedicated automated highways while (1) minimizing the cost and modification impact on the highway infrastructure and (2) providing a number of valuable benefits on unmodified conventional highways and even on streets or in tight parking areas.

At this time I would be pleased to answer any questions you might have.

[PAUSE}

Well, here we are at the end of the ride. You will find the shuttle bus to take you back to the Expo area right in front of that red tent.

Once again, thank you for your interest in automated highway systems and OSU's involvement in this important work. I would like to underline again the educational and research contributions of The Ohio State University faculty, staff and students to the demonstration you have seen. The radar reflective stripe design is an OSU innovation. The stripe itself was manufactured by 3M. The cars were built by Honda for us, but all algorithms for sensing control, coordination, guidance were developed at OSU and tested at OSU and TRC, a nearby test facility. Please visit our booth at the Exposition and watch our mini-demo in the outdoor part of the Expo to learn more about what we are doing in this area of research, and the Engineering education students acquire at OSU.

4.2.7 <u>Evolutionary (Toyota Motor Corporation Japan)</u>

The Toyota scenario showcased technologies that may be used to support evolutionary deployment of an AHS. This scenario used two automated vehicles (1996 Toyota Avalon) and two conventional vehicles (1996 Toyota Camry). This scenario consisted of two parts with each part containing several segments. The first part of the demonstration showed how in-vehicle features of an Automated Highway System can assist the driver in maneuvering his or her vehicle on a non-AHS roadway. The second part of the demonstration showed fully automated driving in mixed traffic (AHS and non-AHS equipped vehicles). Figures 4.2.7.1-1 through 4.2.7.1-7 illustrate each of the different segments of the scenario.

4.2.7.1 <u>Scenario</u>

With all 4 vehicles in the staging area, manual vehicle #1 (hereafter designated as MV1) leaves the staging area first, traveling in the left lane, which is followed at a spacing of 100 meters by automated vehicle #1 (hereafter designated as AV1), traveling in the left lane, which is followed at a spacing of 100 meters by automated vehicle #2 (hereafter designated as AV2), traveling in the right lane, which is followed at a spacing of 100 meters by manual vehicle #2 (hereafter designated as MV2), traveling in the right lane. Once the vehicles enter the I-15 express lanes and stabilize at a speed of approximately 100 km/hr, the demonstration begins with Segment #1. During Segment #1, MV1 and MV2 maintains their speed and spacing in preparation for Segment #2.

<u>Segment #1 - Lane Departure Warning & Control</u>:
Lane departure warning and control is demonstrated in the first segment. The drivers of AV1 and AV2 maintains the position of their vehicles specified during the staging operation (left lane spaced 100 meters apart) as they enter

the I-15 express lanes and maintain a speed of approximately 100km/hr. The drivers change from their respective lane to the opposite lane and back to their original lane. No lane departure warnings occur. Once stabilized in the left lane, the drivers release the steering wheel and allow the vehicle to drift towards the lane boundary. As the vehicles approach the lane boundary, the lane departure warning occurs and the steering actuator is activated to steer the vehicles back into the proper lane.

- Driver Initiated Lane Change (no warnings)
- Driver Releases the Steering Wheel
- Lane Departure Warning Occurs
- Driver Manually Returns to Lane
- Lane Keeping by Steering Actuator

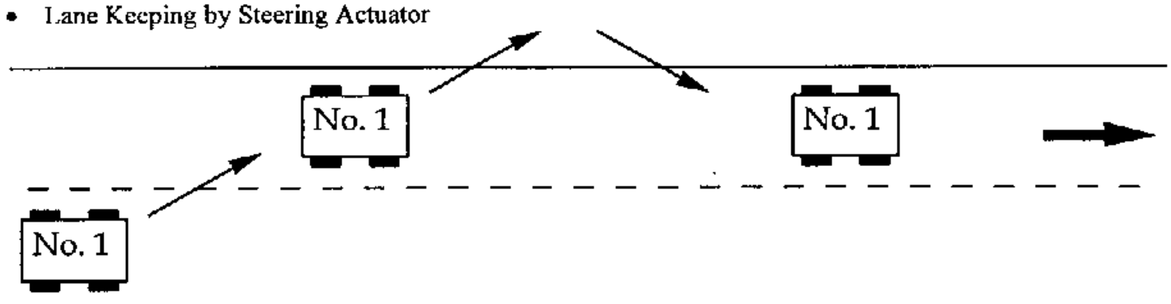


Figure 4.2.7.1-1 Lane Departure Control - Segment 1

Segment #2A - Adaptive Cruise Control:
The second segment demonstrates the smooth automatic control of vehicle spacing when the preceding vehicle's speed varies. Once all the vehicles have stabilized, and the drivers have reassumed manual control of the vehicles' steering, the vehicles continue traveling in the left lane. With the vehicles' speed at approximately 100 km/hr, with AV1 and AV2 traveling one behind the other with a gap of approximately 100 meters, the drivers of AV1 and AV2 activate their vehicle's Adaptive Cruise Control (ACC). The vehicles then approach MV1 from the rear. MV1 is also in the left lane and its speed is varying between 60 km/hr and 80 km/hr. AV1 and AV2 autonomously adjust their speed to that of MV1 and maintain a headway of approximately 50m.

- All Vehicles Are Steered Manually
- Vehicle No. 1 Approaches Manual Vehicle No. 1 in Left Lane
- Vehicle No. 1 Slows and Maintains a Safe Following Distance
- Manual Vehicle No. 2 Approaches from the Rear in the Right Lane and Cuts into the Gap Between the Two Vehicles in the Left Lane
- Vehicle No. 1 Slows to Accommodate the Vehicle Which Cut In

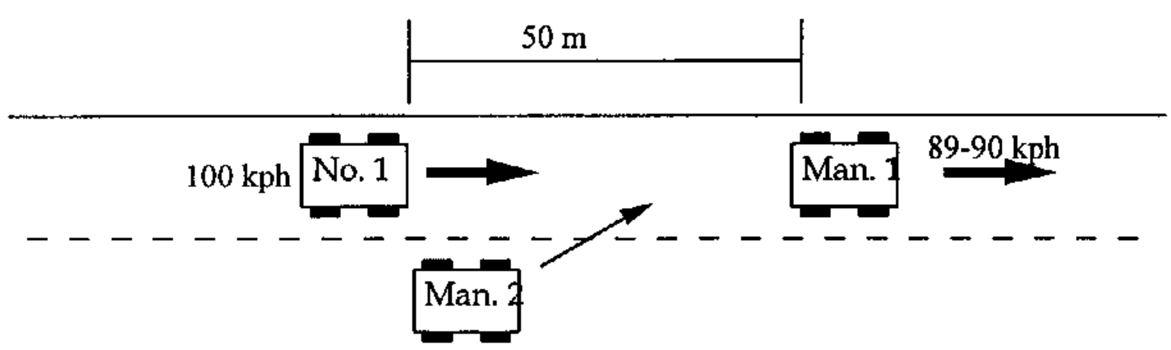


Figure 4.2.7.1-2 Adaptive Cruise Control - Segment 2A

Segment #2B - Headway Maintenance:
During this segment headway maintenance is demonstrated. MV2 passes AV2 and AV1 and after passing the automated vehicles, MV2 changes lanes, cutting into the 50 meter gap between the AV1 and MV1. AV1, realizing its headway has been decreased by the cut in of MV2, autonomously increases the headway back to the initial 50 meters.

- All Vehicles Are Steered Manually
- Vehicle No. 1 Follows Man. 2 at a Distance of About 50 meters at a Speed of About 40 kph
- Manual 1 Slows to a Stop Then Accelerates Back to 40 kph.
- Man. 2 Follows Man. 1 and Slows to a Stop Then Accelerates
- Vehicle No. 1 Automatically Slows to a Stop at a Distance of About 10 meters Then Accelerates Back to 40 kph
- This Process is Repeated Two More Times
- At this point MV1 has finished its portion of the demonstration. MV1 then changes to the right lane and slow to allow the other vehicles to pass. MV1 then follows the other vehicles to the end of the scenario.

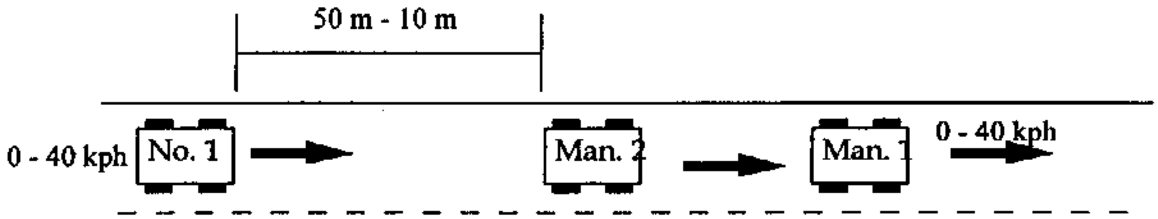


Figure 4.2.7.1-3 Headway Maintenance - Segment 2B

Segment #3 - Automated Control in Stop & Go Traffic:
This segment demonstrates the abilities of automated vehicles in congested stop and go traffic. With the vehicles stabilized in the left lane (vehicle order is: MV2 at the lead, followed by AV1, followed by AV2) at a speed of approximately 80 km/hr, the lead vehicle, MV2, slows to a stop, pause for 2 - 3 seconds, and then accelerates to 40 km/hr. This cycle is repeated two times (total of three stop and go maneuvers). AV1 and AV2 autonomously decelerates and accelerates based on the actions of MV2. During the stop & go portion of this segment, a gap of about 6 - 10 meters is maintained between the vehicles, dependent upon the speed of the vehicles.

Staging for Part 2:

At the end of Segment #3, the vehicles comes to a stop approximately 4.2 km into the route. Once the vehicles have come to a complete stop and the drivers have confirmed that all systems aboard all vehicles work properly, and the autonomous vehicles have established vehicle-to-roadside communications, the second part of the demonstration begins. Once the vehicles have confirmed that they are ready for the second part of the demonstration, the vehicles leave the staging area in the following sequence: AV1 positions itself in the right lane and leaves the staging area, followed at a distance of approximately 200 meters by the AV2, also in the right lane. The vehicles accelerate to 100 km/hr.

At this point, MV1 and MV2 will have completed their portion of the demonstration. These vehicles will now follow AV1 and AV2 at a safe distance as they complete the demonstration.

Section 2: Fully Automated Driving

Segment #4 - Lane Tracking Based on Machine Vision:
This segment demonstrates lane tracking. Once the vehicles have stabilized at a speed of approximately 100 km/hr, AV1 and AV2 follows the lane autonomously.

- Vehicles Change Lanes to Form Set Configuration
- Vehicles Engage Vision Based Lateral Control

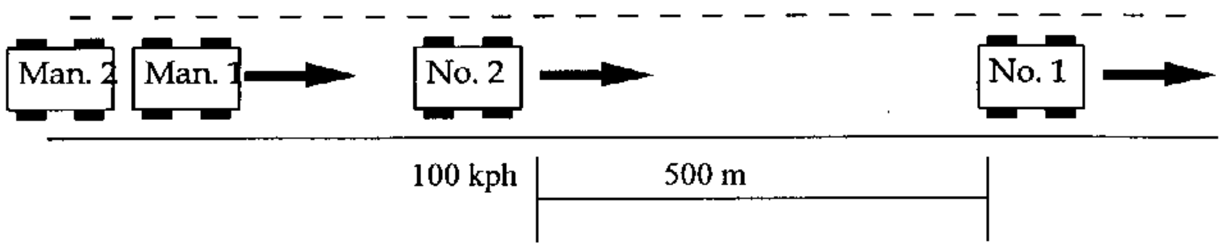


Figure 4.2.7.1-4 Lane Tracking Based on Machine Vision - Segment 4

Segment #5 - Automatic Lane Change & Return for Obstacle Avoidance:
This segment demonstrates the ability to detect an obstacle, notify other following near-by automated vehicles of the obstacle's location, and automatically change lanes to avoid the obstacle. AV1 is traveling in the right lane at approximately 100 km/hr, (NOTE: At the time this scenario was revised, the final speed for this segment had not been finalized, the 100 km/hr value is subject to change) followed at a distance of approximately 200 meters by AV2. The lead vehicle, AV1, detects an obstacle (highway construction barrel with reflective tape) in the right lane. AV1 then communicates the presence of the obstacle to AV2 via vehicle-to-roadside-to-vehicle communications system, and simultaneously check its surroundings for other vehicles and change lanes to the left lane to avoid the obstacle. AV2, after receiving and processing the data from AV1, checks for vehicles around it, and then executes a lane change to the left lane to avoid the obstacle. As the automated vehicles pass the obstacle, the vehicles confirms that the obstacle has been passed and the automated vehicles change lanes again to return to the right lane.

- Automatic Obstacle Detection Using Laser Radar
- Vehicle No. 1 Changes lanes and Returns
- Vehicle No. 1 Transmits Information Via V-V Communications
- Vehicle No. 2 Changes Lanes and Returns

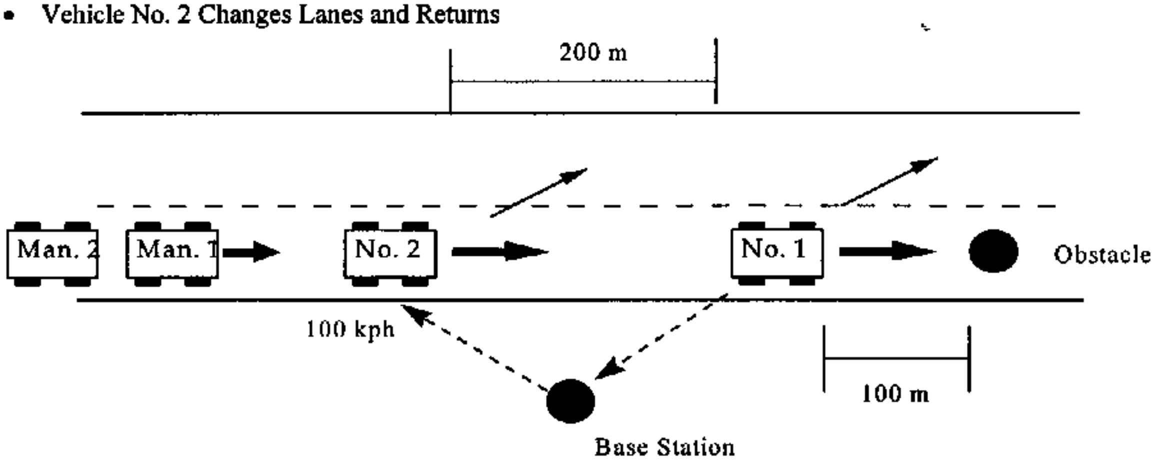


Figure 4.2.7.1-5 Automatic Lane Change & Return for Obstacle Avoidance - Segment 5

Segment #6 - Cooperative Vehicle Following:
This segment demonstrates cooperative vehicle following. AV1 decreases its speed and AV2 maintains its speed of 100 km/hr until the gap between the two vehicles has been decreased to approximately 100 meters. At that time,

AV1 and AV2 maintain their positions in the right lane and set their speeds to 80 km/hr. Once the automated vehicles have stabilized, AV2 decreases the gap between itself and the lead vehicle, AV1, and begins the cooperative vehicle following, while maintaining a headway gap of approximately 30 meters.

- Vehicle No. 2 Follows Vehicle No. 1
- Narrow Gap Control With Vehicle-Vehicle Communication
- Vehicle No. 2 Follows Vehicle No. 1

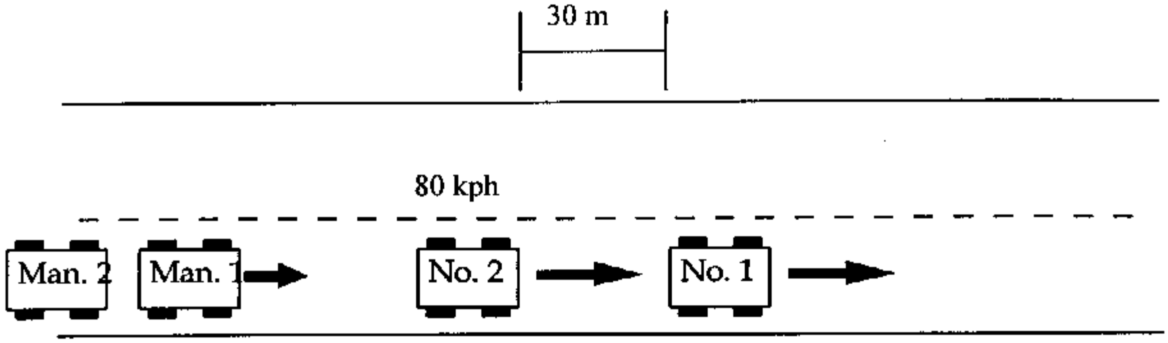


Figure 4.2.7.1-6 Cooperative Vehicle Following - Segment 6

<u>Segment #7 - Rapid Deceleration for Obstacle Avoidance</u>:
This segment demonstrates rapid deceleration to avoid striking an obstacle. After the automated vehicles have stabilized, they continues in the right lane at approximately 80 km/hr separated by a gap of 30m. AV1 detects obstacles (highway construction barrels with reflective tape) in both lanes and begins a rapid deceleration to a stop to avoid striking the obstacles. At the same time AV2 initiates braking, and AV2 decelerates to a stop.

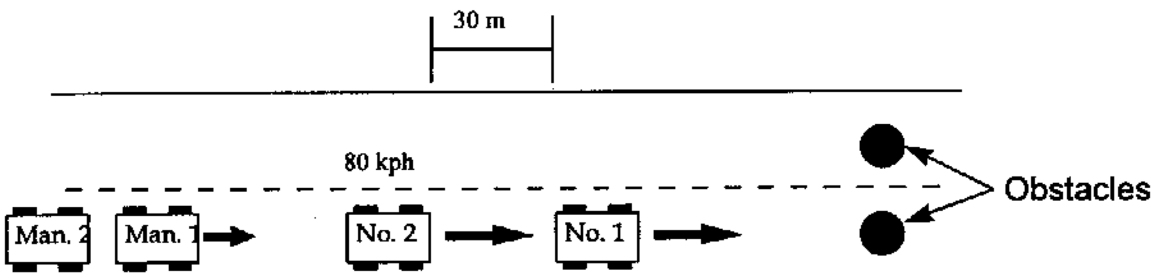


Figure 4.2.7.1-7 Rapid Deceleration for Obstacle Avoidance - Segment 7

<u>Wrap-up</u>
After the automated vehicles have completed Segment #7, the driver of AV1 communicates via voice communications to the other drivers that the demonstration has been successfully completed and for the other vehicles to proceed to the end of the course.

4.2.7.2 Associated Narration

4.2.7.2.1 A1 Driver

SEGMENT 0: Pre Demonstration Introduction

(1) Narrator: Continue with interior component Q&A and general discussion until receiving the approval to start. Then give the following narrative:

"That was our permission to begin the demonstration, so please check to make sure that your seat belts are securely fastened. I'd like to review the safety guidelines before we get started.

1) Please do not direct any questions or comments to the driver during a scenario run. I'll be happy to answer any questions you man have. The will allow (Driver's Name) to maintain his full attention on the vehicle operation.

2) Please do not touch any vehicle controls.

3) Unless you're instructed to do so, do not leave the automated vehicle for any reason until the demonstration has ended. (Driver's Name) can quickly and easily return the Avalon to manual control at any time should it become necessary. At the conclusion of the of the run, please leave the vehicle only when instructed to do so.

Next, I'd like to review the scenarios. In the first part of our demonstration we'll be featuring functions that assist people with the task of driving.

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We'll start with lane departure warning and control, which is designed to prevent accidents caused by drowsiness or lack of attention. The machine vision system watches the lane boundary lines to track the position of our car as it travels along the roadway. We'll begin by changing lanes intentionally to show how the system responds to normal driving conditions. The system will not react to our intentional lane change because it can sense (Driver's Name)'s purposeful movement of the steering wheel. Then we'll let the Avalon drift out of its lane. When the systems senses that the Avalon is wandering without (Driver's Name) intentionally turning the steering wheel, it will sound an alarm to alert him. A moment after the alarm goes off, and actuator will steer the Avalon back to the center of the lane. The alarm will continue to sound until (Driver's Name) resets the system. This isn't the same as automatic steering, so a driver should be alert at the wheel while using this type of assistance.

Next, we'll demonstrate adaptive cruise control, which allows you to follow another vehicle without having to use the accelerator and brake pedal. When the scanning laser radar sensor detects the presence of a vehicle up ahead, it monitors how close it gets. While an ordinary cruise control system keeps your car moving at a constant speed, and adaptive system uses actuators to automatically control the brakes and throttle in order to maintain a safe distance behind the vehicle you're following. We'll be using this function to match the speed of the vehicle in front of us as it speeds up and slows down. Other vehicles traveling in adjacent lanes are detected by the side laser sensors, and if one of these vehicles cuts in front of the Avalon, the system anticipates the lane change before it happens. This early information allows the system to brake more quickly and smoothly. One of the Camrys will be performing a cut-in maneuver to help demonstrate how the adaptive cruise control system reacts to this situation.

We'll end the first part of our demonstration by showing you automated control in stop-and-go traffic, which is another function that saves you the inconvenience of braking and accelerating. Starting form a stand-still, the two Avalons will follow one of the Camrys as it simulates rush hour traffic. Both Avalons' laser radar sensors will be detecting acceleration and deceleration at low speed, and the systems will follow this drive pattern by once again controlling the throttle and braking. Are there any questions?

(2) Narrator: Use the remaining time for Q&^A and general discussion.

SEGMENT 1: Lane Departure Warning and Control

(1) Narrator: When the vehicle starts moving, give the following narrative:

"First, we'll demonstrate Lane Departure Warning and Control. (Driver's Name) will begin by intentionally changing lanes. In doing so, notice that no alarm sounds as we cross the lane boundary."

(2) Narrator: Upon completion of the lane Change, give the following narrative:

"Now we'll allow the vehicle to drift toward the lane edge."

(3) Narrator: After the system warnings, give the following narrative:

"The system issues a warning, and the steering actuator brings the car back towards the center of the lane."

SEGMENT 2A: Adaptive Cruise Control

Status: Vehicles traveling at 100 km/h. M1 leads in the left lane. A1 follows M1 by 100 m in the right lane.

(1) Narrator: Give the following narrative;

"Next we'll demonstrate Adaptive Cruise Control, or 'ACC." As our car approaches the Camry in front of us, the forward looking laser radar will detect it's presence. Our car will then slow down to maintain a following distance of 50 m. The braking and throttle will be controlled automatically."

(2) Narrator: After the driver announces that A1 has locked on to M1, start the narrative for Segment 2B.

SEGMENT 2B: Headway Maintenance

Status: All vehicles traveling at 80 km/h. M1 leads in the left lane. A1 follows M1 (50 m behind). A2 follows A1 (50 m behind). M2 follows A2 in the right lane (50 m behind).

(1) Narrator: After the driver announces that A1 has locked on to M1, give the following narrative:

"The laser radar has locked onto the Camry, and now we'll demonstrate how the ACC system reacts to speed ups, slow downs, and vehicle cut-ins. The Camry in front of us will decelerate to 60 km/hr and then accelerate to 80 km/hr, and our vehicle will do the same, maintaining a distance of 50 m. The second Camry that's in the right lane behind us will then pass us and cut into our lane. Our vehicle will respond by automatically slowing down to maintain a 50 m spacing."

(2) Narrator: When M2 is positioned alongside your vehicle, the following narrative:

"Just behind us to our right is the Camry that will cut into our lane."

(3) Narrator: After M2 cuts in, give the following narrative:

"We'll slow down now to maintain a 50 m spacing."

Segment 3: Automatic Control in Stop-And-Go Traffic

Status: Remaining vehicles traveling in left lane at 80 km/h. Vehicle order is M2-A1-A2 at 50 m intervals.

(1) Narrator: Give the following narrative:

"Next, we'll show how the ACC system performs in stop-and go traffic. Keep in mind that (Driver's Name) will continue to steer the car while letting the ACC system take care of the throttle and braking. To simulate congested traffic, the Camry in front of us will come to a complete stop. It will then accelerate to 40 km/hr before slowing down and stopping again. It will go through 3 stop-and go cycles while our car follows at a distance of 6-10 m. This distance will vary with vehicle speed. Once again, the forward-looking laser radar sensor is detecting the closing rate of the car op ahead, and the throttle and brake actuators respond to maintain a safe following distance."

(2) Narrator: Answer any questions, being careful to begin the next narrative after your last stop in Segment 3.

(3) Narrator: After the last stop in Segment 3, begin the narrative for Segment 4 & 5.

4.2.7.2.2 A2 Driver

SEGMENT 0: Pre-Demonstration Introduction

Status: Holding in the staging area.

(1) Narrator: Continue with component Q&A and general discussion until receiving the approval to start. Then give the following narrative:

"That was our permission to begin the demonstration, so please check to make sure that your seat belts are securely fastened. I'd like to review thesaf3tyi guidelines before we get started.

1) Please do not direct any questions or commented to the driver during a scenario run. I'll be happy to answer any questions you may have. This will allow (Driver's Name) to maintain his full attention on the vehicle operation.

2) Please do not touch any vehicle controls.

3) Unless you're instructed to do so, please do not leave the automated vehicle for any reason until the demonstration has ended. (Driver's Name) can quickly and easily return the Avalon to manual control at any time should it become necessary. At the conclusion of the run, please leave the vehicle only when instructed to do so.

Next, I'd like to review the scenarios. In the first part of our demonstration we'll be featuring functions that assist people with the task of driving.

We'll start with lane departure warning and control, which is designed to prevent accidents caused by drowsiness or lack of attention. The machine vision system watches the lane boundary lines to track the position of our car as it travels along the roadway. We'll begin by changing lanes intentionally to show how the system responds to normal driving conditions. The system will not react to our intentional lane change because it can sense (Driver's Name)'s purposeful movement of the steering wheel. Then we'll let the Avalon drift out of its lane. When the system senses that the Avalon is wandering without (Driver's

Name) intentionally turning the steering wheel, it will sound an alarm to alert him. A moment after the alarm goes off, an actuator will steer the Avalon back to the center of the lane. The alarm will continue until (Driver's Name) resets the system. This isn't the same as automatic steering, so a driver should be alert at the wheel while using this type of assistance.

Next, we'll demonstrate adaptive cruise control, which allows y0ou to follow another vehicle without having to use the accelerator and brake pedal. When the scanning laser radar sensor detects the presence of a vehicle up ahead, it monitors how close it gets. While an ordinary cruise control system keeps your car moving at a constant speed, an adaptive system uses actuators to automatically control the brakes and throttle in order to maintain a safe distance behind the vehicle you're following. We'll be using this function to match the speed of the vehicle in front of us as it speeds up and slows down. Other vehicles traveling in adjacent lanes are detected by the side laser sensors, and if one of these vehicles cut in front of the Avalon, the system anticipates the lane change before it happens. This early information allows the system to brake more quickly and smoothly. One of the Camrys will be performing a cut-in maneuver to help demonstrate how the adaptive cruise control system reacts to this situation.

We'll end the first part of our demonstration by showing you automated control in stop-and-go traffic, which is another function that saves you the inconvenience of braking and acceleration. Starting from a stank-still, the two Avalons will follow one of the Camrys as it simulates rush hour traffic. Both Avalons' laser radar sensors will be detecting acceleration and deceleration low speed, and the systems will follow this drive pattern by once again controlling the throttle and braking. Are there any question?

(2) Narrator: Use the remaining time for Q&A and general discussion.

SEGMENT 1: Lane Departure Warning and Control

Status: All vehicles in the left lane, in the following order: M1, A1, A2, M2.

(1) Narrator: Give the following narrative:

"First, we'll demonstrate Lane Departure Warning and Control. (Driver's Name) will begin by intentionally changing lanes. In doing so, notice that no alarm sounds as we cross the lane boundary."

(2) Narrator: Upon completion of lane change, give the following narrative:

"Now we'll allow the vehicle to drift toward the lane edge."

(3) Narrator: After the system warnings, give the following narrative:

"The system issues a warning, and the steering actuator brings the car back towards the center of the lane."

SEGMENT 2A: Adaptive Cruise Control

Status: Vehicle traveling at 100km/h. M1 leads in the left lane. A1 follows M1 by 100 m in the left lane. A2 follows A1 in the left lane by 100m. M2 follows A2 by 100m in the right lane.

(1) Narrator: Give the following narrative:

"Next we'll demonstrate Adaptive Cruise Control, or 'ACC.' As our car approaches the Avalon up ahead, the forward looking laser radar will detect it's presence. Our car will then slow down to maintain a following distance of 50 m. The braking and throttle will be controlled automatically. We'll then see how the ACC system reacts to speed ups, slow downs, and vehicle cut-ins. The Avalon in front of us will decelerate to 60 km/hr and then accelerate to 80km/hr, and we'll do the same, maintaining a distance of 50 m. The Camry in the right lane behind us will then move up and cut in front of the other Avalon. We'll respond by automatically slowing down to maintain our 50 m spacing."

(2) Narrator: After the driver announces that A2 has locked on to A1, start the narrative for Segment 2B.

SEGMENT 2B: Headway Maintenance

Status: All vehicles traveling at 80 km/h. M1 leads in the left lane. A1 follows M1 (50 m behind). A2 follows A1 (50 m behind). M2 follows A2 in the right lane (50 m behind).

(1) Narrator: After the driver announces that A2 is locked on to A1, give the following narrative:

"The laser radar has locked onto the Avalon in front of us, and as that car speeds up and slows down, our vehicle will do the same.

(2) Narrator: When M2 pulls alongside A1, give the following narrative:

"Notice that the Camry is preparing to cut in front of the Avalon we're following."

(3) Narrator: When the Camry cuts in, give the following narrative:

"We'll slow down now to maintain a 50 m spacing."

SEGMENT 3: Automatic Control in Stop-And-Go Traffic

Status: Remaining vehicles traveling in left lane at 80 km/h. Vehicle order is M2-A1-A2 at 50 m intervals.

(1) Narrator: Give the following narrative:

"Next, we'll show how the ACC system performs in stop-and-go traffic. Keep in mind that (Driver's Name) will continue to steer the car while letting the ACC system take care of the throttle and braking. To simulate congested traffic, the Avalon in front of us will come to a complete stop. It will then accelerate to 40 km/hr before slowing down and stopping again. It will go through 3 stop-and go cycles while our car follows at a distance of 6-10 m. This distance will vary with vehicle speed. Once again, the forward-looking laser radar sensor is detecting the closing rate of the car up ahead, and the throttle and brake actuators respond to maintain a safe following distance."

(2) Narrator: Answer any questions, being careful to begin the next narrative after your last stop in Segment 3.

(3) Narrator: After the last stop in Segment 3, begin the narrative for Segments 4 & 5.

SEGMENTS 4 & 5: Automatic Lane Keeping / Automatic Lane Change for Obstacle Avoidance

Status: A1 and A2 are stopped in the right lane.

(1) Narrator: You began the following narrative after the last stop in Segment 3:

"That concludes our Driver Assistance demonstration. (Driver's Name) will now move into the right lane and activate the AHS driving mode, allowing the Avalon to become completely automated. In the AHS mode, the video image processing system determines the position of the vehicle on the roadway, and the laser radar system watches out for obstacles. The AHS system will be controlling the brads, throttle, and the steering. We'll be following along about 150 meters behind the Avalon accelerated to 100 km/hr, its laser radar system will detect two construction barrels up ahead in the center of the lane..The lead Avalon will then make a lane change to avoid them, and it will warn our automated vehicle of their presence. Our vehicle will use this information to change lanes as well. As we change lanes, notice that the car is steering by itself."

(2) Narrator: When A1 starts to make its lane change, give the following narrative:

"The lead Avalon has detected the barrels and is making its lane change. Our vehicle will receive its warning and do the same."

(3) Narrator: After your vehicle announces that it is returning to the right lane, give the following narrative:

"After spotting the obstacle, the lead Avalon transmitted a warning to our car through a cellular phone link. Its broadcast range makes cellular technology a potential media candidate for important messages sent to nearby vehicles. This kind of early information gives an automated vehicle more time to avoid an obstacle it hasn't spotted yet.

Because we're participating in an organized demonstration, there was no need for our vehicle to check the adjacent lane before making a lane change. In reality, and automated vehicle needs to make sure that it's safe to change lanes, and that's why our car has optical flow cameras integrated into the side view mirrors. These cameras help to provide additional information that's used to determine the appropriate action to take after an obstacle has been detected."

(4) Narrator: Begin the narrative for Segment 6.

SEGMENT 6: Cooperative Vehicle Following

Status: A1 leading A2 at 100 km/h in the right lane separated by 150 m, both in AHS mode.

(1) Narrator: Give the following narrative:

"now we'll demonstrate cooperative vehicle following. Using its vision and radar systems, our car will recognize that the Avalon in front of us is an AHS vehicle,, and it will close to a distance of 20-25 m. Our car will recognize its high-mounted stop lamp, which is larger than those found on conventional vehicles. In a more real world approach,, we would provably use vehicle-to-vehicle communications to recognize AHS capability. Once our vehicle has established a cooperative following mode, the laser system will lock on to the Avalon and imitate its pattern of driving. The vision system can detect when its stop lamps are illuminated, and this helps the system to provide a quicker response in braking situations. You can picture a number of vehicles traveling as a group in this cooperative mode, and the addition of a vehicle-to vehicle communications system would allow a lead vehicle to let those following behind it know about any problems in the roadway up ahead. The more robust the communications system, the more compact a cooperative vehicle group can travel together, and this would help to reduce traffic congestion by increasing vehicle throughput.

Upgrading vehicles with improved technology is the basis behind the Light AHS evolutionary concept. As newer, more refined sensing, computing, and communicating systems are added, vehicles will come closer to the day when they can become fully automated. This vision of progressively evolving automated highway system would allow vehicles to maintain closer and closet gaps between each other and help to increase traffic capacity without adding special infrastructure to the roadway. Our first step is to recognize what can be achieved over the long term, and today's demonstration helps us to see some of the possibilities for the future of roadway transportation."

SEGMENT 7: Automatic Stopping for Obstacle Avoidance

Status: A2 is following A1 at a distance of 30 m at 80km/h, both in AHS mode.

(1) Narrator: Give the following narrative:

"For our last segment, we'll demonstrate automatic braking for obstacle avoidance. The Avalon in front of us will encounter four construction barrels blocking both lanes up ahead. Its laser radar will detect their presence, and the central computer will determine that to avoid them, the only choice is to stop.

After it starts the braking process, our automated vehicle will detect its deceleration and come to a stop as well. As I mentioned before, our vision system can recognize brake light illumination on the vehicle we're following, and this helps to AHS system to respond more quickly when it needs to apply the brakes."

This is a collision avoidance maneuver, so the rate of braking can be substantial. Please be prepared."

(2) Narrator: After the vehicle comes to a stop, gibe the following narrative:

"Ladies/gentlemen, that concludes Toyota's AHS Demonstration. (Driver's Name) will now take us back to the staging area. I'll e happy to answer any questions."

(3) Narrator: Use the remaining time for Q&A and wrap-up. The passenger's opinions are useful information. Encourage an open discussion and remember to ask for their impression of NAHSC's overall event.

4.2.7.2.3 Shuttle

When the passengers board the shuttle van, the shuttle narrator will give them a brochure describing the Toyota Team demo. The brochure will provide illustrations of the maneuvers as well as explanatory notes to help them observe and understand the demonstration.

The following narrative is to be presented when the passengers board the shuttle van:

Shuttle Narrator: Give the following narrative as you hand out brochures:

"Good morning/Good afternoon. My name is _________, from (Company). I'll be providing you with an introduction to the Toyota AHS demonstration as we travel to the staging area. Before we begin, could you please introduce yourselves..."

After introductions, the Shuttle Narrator gives the following narrative (NAHSC safety message):

"In preparation for your ride today, I've been asked to say a few words regarding safety:

The National Automated Highway System Consortium has made every effort to ensure the safety of all those associated with Demo '97. The Consortium has conducted an extensive safety and performance certification program, during which the key safety features of all the automated vehicle scenarios were demonstrated. Safety certification included ensuring that all drivers are experienced in the operation of the AHS vehicles, as well as trained I emergency vehicle procedures. At any time during hr scenario run, your vehicle's "diver" can quickly and easily return the vehicle to manual control should it become necessary.

As passengers, you will be requested to help maintain a safe environment. Please follow all instructions that the Demo staff gives you: before, during, and after your ride. In addition, there are a few simple rules that we ask that you comply with:

1) Please do not direct any questions or comments to the driver of the AHS vehicle during a scenario run. The narrator sitting in the front passenger seat is available to answer any questions you may have. This will allow the driver to maintain his full attention on the safe operation of the automated vehicle.

2) Please do not enter any vehicle at the boarding point until requested to do so. After boarding, firmly secure your seat belt before the vehicle begin to move (the transit bus is an exception).

3) Please do not touch any of the vehicle control switches.

4) And finally, please do not leave the automated vehicle for any reason until instructed to do so.

After the NAHSC safety message, the Shuttle Narrator gives the following narrative:

"The brochures I've handed out describe the Toyota AHS demonstration. The Toyota Team consists of Toyota Motor Corporation, Toyota Technical Center, USA, AISIN SEIKI Co., and IMRA AMRICA. This group has developed two automated vehicles that are based on a concept called 'Light AHS' not only refers to the optical sensing devices that we'll be demonstrating, but to the idea of moving towards an automated highway system that is based on the Light Infrastructure, Light Vehicle concept. This concept is characterized by low cost, low complexity automated vehicle systems and maximum use of the existing roadway infrastructure.

Our demonstration today consists of two parts. The first part will featu8re driver support functions designed to assist people with the task of driving. We'll start by showing you lane departure warning and control, which is designed to prevent single vehicle road departure accidents caused by drowsiness or lack of attention. Next, we'll demonstrate adaptive cruise control, which allows a driver to follow a vehicle without having to use the accelerator and brake pedal. We'll conclude the first part of our demonstration by showing you automated speed control in stop and go traffic, which is another driver assist function that again reduces the inconvenience of braking and accelerating, this time under rush hour traffic conditions.

The second part of our demonstration showcases driving functions that are fully automated-meaning the two automated vehicles will be driving themselves. First we'll demonstrate an automatic lane keeping function that allows each vehicle to steer itself with the help of its machine vision system. Next our lead automated vehicle will encounter a stationary object on the roadway, construction barrels in this case, and the vehicle will then perform an automatic lane change for obstacle avoidance. The lead vehicle sill also use and existing public wireless infrastructure, a cellular link in this case, to warn the second automated vehicle of the obstacle. The second car will perform the same maneuver after receiving the warning. The two automated vehicles will than use their optical sensing and automated vehicle recognition to demonstrate cooperative vehicle following. During this demonstration segment, a gap of about 20 meters is maintained between the two cars as they travel down the highway. Finally, our lead automated vehicle will detect obstacles blocking both lanes in front of it, and it will come to a quick stop. The second automated vehicle will detect the lead car's rapid braking by way of large stop lamp, and it will brake to stop as well, completing our demonstration for automated stopping for obstacle avoidance.

The Shuttle Narrator will then describe Toyota vehicle technology and Light AHS details as time permits. Some points to consider:

Vehicle Characteristics

- *Lane and obstacle sensors*
- *Roadway curvature map database*
- *Brake, throttle, and steering actuators*
- *Vehicle-to-vehicle and vehicle-to-infrastructure communications*

Operational Characteristics

- *Uses existing highway infrastructure*
- *Driver controls except in 'AHS mode'*
- *'AHS mode' is user-friendly, automated, hands-off*
- *Vehicle AHS capability is verified while moving*
- *Vehicles fully in control as free agents*

The Shuttle narrator can use the remaining time for Q&A and general discussion. When the shuttle van arrives at the staging area, wish the passengers a pleasant ride.

4.2.7.2.4 Staging Area

This narrative is to be presented once the passengers arrive at the staging area:

Toyota Spokesman: Give the following narrative:

"Good morning/Good afternoon. Before we begin, let's take a moment to introduce ourselves..."

The Spokesman will introduce himself, the other narrator, and the drivers of the automated and manual vehicles. He will then ask the passengers to introduce themselves.

After introductions, the Spokesman gives the following narrative:

"We have a few minutes before we get started. At this time we would like to review the vehicles and the technologies they use. We have four cars in the Toyota demonstration, two Avalons which are fully equipped and AHS capable, and two Camrys without AHS capability. The Camrys will interact with the Avalons in the same manner that ordinary vehicles would interact with AHS vehicles on the roadway. Our Avalons use two different types of optical systems to sense the environment around them. Laser radar sensors are used to detect objects in front of and alongside the car, while video image processing technology through machine vision determines the position of the car on the roadway. Both Avalons also have a map database stored in CD ROM-this helps the car to anticipate the curvature in the roadway up ahead. A cellular link is used to allow the Avalons to communicate with each other. All of these systems work in harmony to assist the driver with the driver with the task of driving, and their combined input allows our AHS vehicle to drive all by itself down a highway."

The Spokesman goes on to describe vehicle equipment in the following order, remaining aware of time constraints:

- *Laser units (front and side)*
- *Cameras (rear view mirror)*
- *Antennas (DGPS and cellular on trunk lid)*
- *CHMSL (bigger design for distinguishing an AHS vehicle)*

After completing his description of these peripheral components, the Spokesman gives the following narrative:

"We'll divide now into two groups so that we can show you the interior components. (Second Narrator's Name) will describe the components in our lead automated vehicle, and I'll be describing a set of identical components in the second automated vehicle, which will be following the lead vehicle throughout the demonstration. If you could take the back seats of the two Avalons, we'll review the passenger compartment.

Once the passengers are settled, the Narrators describe interior equipment in the following order, remaining aware of time constraints:

- *LCD display (a Japan-market navigation display that we've modified)*
- *Interface panel (provides system status)*
- *AHS disengage switch (on the center console)*
- *Indicator panel (tells the driver when obstacles are sensed by radar)*

The Narrators can use the remaining time for Q&A.

4.2.8 Scenario Sequences and Control

For the details of the scenario sequence and control of the Demonstration, refer to Appendix B, Vehicle Operations Procedures.

4.2.9 Control Center Operations

For the details of the control center operations, refer to Appendix B, Vehicle Operations Procedures.

4.2.10 North and South End Staging Operations

Reference Appendix B

4.3 Exposition Center

The Exposition Center is the center of activity for the 1997 Demonstration. The "Exposition Center" includes, but is not limited to: the exhibit hall, any operating demonstrations, i.e. "mini-demos" to be held outside in a parking lot environment, the DPC, and technical presentations associated with highway and vehicle automation.

4.3.1 Demonstration Presentation Center (DPC)

The AHS Demonstration Presentation Center will be displayed at the center of the exhibit hall. The DPC is central to the exhibit and will be used to show that the benefits of an Automated Highway System (AHS) fulfill the entire range of much needed and improved transportation services. The DPC will be a cooperative effort of several Core NAHSC participants and the Caltrans District 11 TMC organization. In addition to showcasing the live demonstration to exhibition attendees, the AHS DPC will provide insight into how AHS control and informational services can be integrated into a variety of existing TOC capabilities. Through prerecorded video footage, graphical depiction, traffic simulations, and narration, the DPC will guide the audience through transportation management information system and control tools designed to optimize AHS operations. The DPC will also incorporate real-time data transfer and video feed from the I-15 demonstration scenarios into overhead presentations for the exposition audience. Reference the D2D DPC Statement of Work for more details.

4.3.2 Displays

Both national and international participation similar to other major international conferences is expected. By controlling the location of each exhibit, a synergy between adjacent booths and neighboring groups of booths will be created. There will be a concerted effort to involve all key stakeholders. The booths will be both static and dynamic with demonstrations, models, hardware, computer simulations, etc. The exhibition hall group will screen all candidate exhibitors by reviewing individual proposals to insure quality and AHS/ITS relevancy. The exhibition production group, along with supporting contractors, will develop a schedule with milestones that will include floor layout, exhibit screening process and criteria, utility requirements (power, lighting, telephone, Fax, modems, plants, chairs, backdrops, TV monitors, VCRs, etc.), maps, security, registration, etc. Logistics information will be printed in the handout materials. The exposition center will be the site for other activities (cocktail reception, NAHSC post-party, etc.) as well as other technical activities such as the SAE/AHS FTT technical conference.

4.3.3 Mini Demonstrations

Side demonstrations may be conducted in one of the parking lots of the exposition center. These demonstrations may be used to validate the technical feasibility of specific components of an AHS. These demonstrations will typically be too large, or incompatible with the exhibition hall, but not meeting the requirements of an I-15 demonstration. (For example: the PATH lateral control system through traffic cones, and the Battelle driving simulator.)

4.3.4 Technical Conference

4.3.5 Demonstration Outreach Activities

A category of AHS stakeholders is the extended technical community, which includes public and private research groups, commercial entities, and universities. The Consortium, in its on-going efforts to create awareness and support for the AHS Program and Demonstration '97, emphasizes the involvement of the extended technical community by sponsoring activities that encourage public involvement. The purpose for NAHSC sponsorship is to work with technically astute audiences to help create awareness of automation, obtain feedback gathered about the AHS Program, and set the stage for the 1997 Demonstration and Expo center. More specifically, the Demonstration Team working with the Consortium's Stakeholder Relations and Public Affairs (SRPA) Task is committed to fostering the development of the AHS Program and the 1997 Demonstration by establishing strategic communications channels with a wide array of stakeholders and constituents.

4.3.5.1 NAHSC Autonomous Ground Vehicle Competition

The 5th Annual International Autonomous Ground Vehicle will be held earlier in the summer. The NAHSC may sponsor the top 3-5 vehicle teams to run at Miramar as Mini-Demos.

5.0 PARTITIONING OF WORK

For the details of the partitioning of work for the Demonstration, refer to Appendix B, Vehicle Operations Procedures.

6.0 INTEGRATION PLAN

The integration plan is the coordination of many parallel efforts: from individual companies, teams or groups of companies/institutions, or a mix of groups. The established demonstration efforts include:

- integration team,
- vehicle team,
- infrastructure team,
- vehicle production
- expo production
- public education
- communications, and the
- Demonstration Presentation Center.

These working groups are an indication of the demonstration team's efforts based on the Work Breakdown Structure and the expected level of effort required to perform the 1997 Demonstration. Functionally, the demonstration can be represented by location of activity with the exhibition hall and the live-vehicle portion of the demonstration on I-15. The major portion of the vehicle work and the infrastructure work supports the live-vehicle portion of the demo. Figure 6-1 illustrates the subsystems that need to be integrated in order to achieve a successful demonstration. Public Education, production, and integration cut across and support the entire demo. The Expo Production group also takes responsibility of the exhibition hall and the DPC that will reside at the center of the exhibition hall. However, it is the communication system that ties all the various pieces together. Communications make it possible for the vehicles to talk to each other, to the infrastructure, as well as to the DPC. It should be understood that for Demo '97, there are two types of communication: the technical communication for an actual AHS and production communications that support the presentation of the demonstration to the audience. It is conceivable that these two systems could be one in the same, but it is very unlikely. There could be instances were they share some common equipment, i.e. a temporary infrastructure camera or common microwave link.

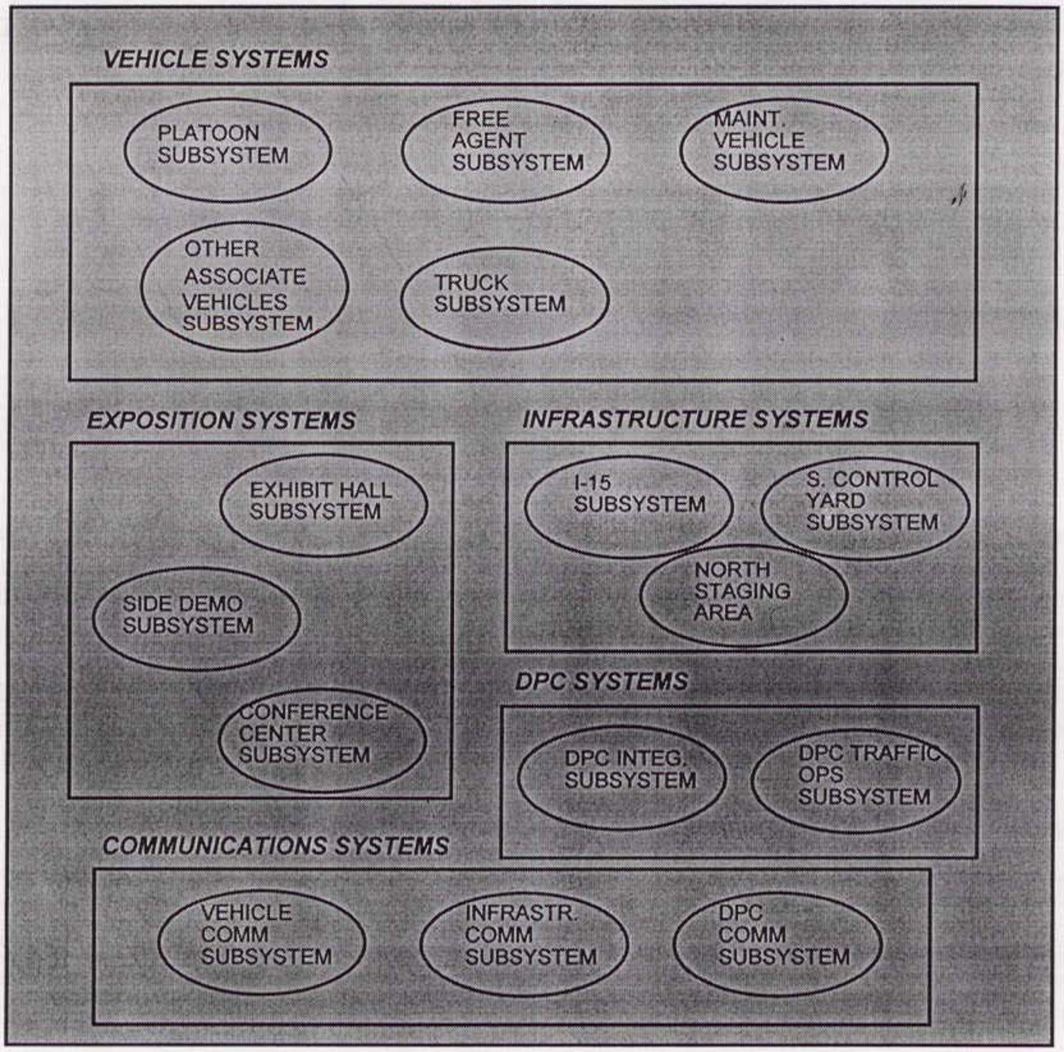


Figure 6-1 Demonstration Subsystems

There are both close and loose associations between the many working groups and functions. Some efforts are independent, while others are closely-knit arrangements. All of these parallel and inter-related activities constitute the Demonstration '97 system. Another important resource that must be interwoven with the Core demonstration is the participation of the Associates, both for the live-vehicle demonstration and at the exhibition hall. System integration is not the work of one group in particular, but rather the conscious effort of everyone involved. Integration happens at all levels and as such, it must all be managed systematically such that the effort of the entire team reaches closure to meet our final goal.

System integration supports all the various parallel efforts that were previously mentioned. As stated earlier, many of these efforts are independent or start-off as independent efforts until they are each folded into the final Demonstration '97. Some of the interactions between the various efforts are intimately entwined, while others may be non-existent. System integration verifies the interfaces between parallel efforts with analysis and documentation such that the pieces fit together. This requires up front planning to help the transitions that are critical to the integration effort.

System integration looks at the demonstration as a whole and takes a top down approach. By taking a global look at the demonstration, there are areas that encompasses all the pieces that must be approached from the top: interfaces, risk assessment, a traffic mitigation plan, safety, system-level test and validation, and insurance. Demonstration integration will be done through the accomplishment of the following:

a. Define the integration tasks and interfaces between the various demonstration elements.
b. Integrate the various organization's roles, responsibilities, activities, and constraints.
c. Integrate the facilities, services, equipment, and documents necessary to support the planned demo.
d. Coordinate the schedules, meetings, reviews, and open items through the Demonstration team.

6.1 Risk Assessment

The working reviews for the Demonstration will status and document the technical progress of the vehicles, communication system, infrastructure (installation of the magnetic markers, striping, variable message signs), and DPC. Even with such a systematic approach to integration, minor details may still go unattended.

With proper planning and foresight, system integration is used to identify the majority of the foreseeable problems and develop contingencies that can reduce possible risk. Risk can be both technical as well as schedule. For example, the integration plan uses working reviews with the appropriate vehicle groups or organizations to ensure that progress is on schedule and according to the plan. The level of detail (which will vary) of the various working reviews will be sufficient to ascertain some common understanding that satisfies the team that there are no unaddressed problems. As part of the system integration process, a Risk Mitigation Plan is being developed that maps out the possible risks to the Demonstration and construct alternatives that will serve as risk mitigators. The risk mitigators will answer the "what if" questions. Every high risk item must have a corresponding mitigation plan.

The Risk Mitigation Plan will be updated on a regular basis leading up to the demonstration in 1997.

6.1.1 Introduction

Feasibility and risk management play a key role in the implementation of an AHS). Early definition of the situations, processes, or events that have the potential for impeding the implementation of key elements of the AHS is a critical element to the success of that implementation.

The following is a process for identifying the risks associated with the Demonstration, and for mitigating the risks. Risk assessment is an iterative process and as technical and design reviews are held for each element of the Demonstration, new risks may be identified.

6.1.2 Risk Management Process

6.1.2.1 Risk Identification

The Demonstration plan, all scenarios, and the PSA issues data base will be reviewed and potential risks identified. These could be technical risks or risks due to cost, schedule, or societal and institutional issues.

6.1.2.2 Category

Each risk should be assigned to one or more Demonstration elements. These are: Vehicle, Infrastructure, DPC, Integration, and Production.

6.1.2.3 Description

A concise description of the risk to provide a stand-alone, non-technical description generated by the risk identifier.

6.1.2.4 Risk Rating

Rating identifies the potential of the risk to impact the AHS goals. It comes as a response to the question - *What is the severity of the impact on the AHS if a risk is allowed to take place.* The purpose of this task is to classify previously identified risks on the basis of severity of impact on the system architecture. Three classifications will be used to denote degree of risk; Red (High), Yellow (Moderate), and Blue (Low).
To accomplish the risk rating the following approach will be used:
Determine the Probability of Risk occurrence. Determine the Consequences of occurrence which will address three categories which are performance, cost, and likelihood of implementation. Determine the summary risk rating for each risk identified.

6.1.2.5 Risk Mitigation Plan

Once the risks have been identified and categorized, mitigation plans need to be developed. Mitigation establishes a plan which reduces or eliminates risk impact to the AHS deployment. The question is - *What should be done, and whose responsibility it is to eliminate or minimize the effect of the risk?* Options available for mitigation are: control, avoidance, or transfer. This task will initially address risks in the Red (or High) category to determine mitigation actions which could be taken to reduce or eliminate risk impacts. Each risk will be evaluated against the categories of risk control, risk avoidance, risk transfer, and risk assumption. Once mitigation plans have been developed, progress will be monitored by the Demonstration team and the PMC.

The Figure 6.1.2.5-1 illustrates the process by which risk mitigation is carried out.

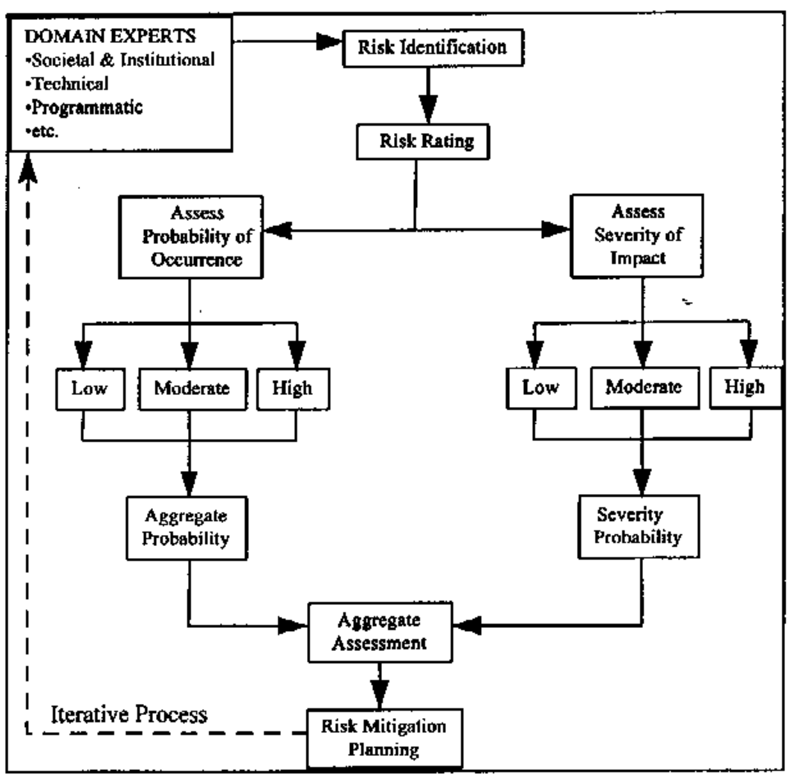


Figure 6.1.2.5-1 Risk Mitigation Process

6.1.3 Instructions for Filling Out the Risk Evaluation Form

1. Identify the type of risk: Technical, Schedule, Cost, Programmatic, or Societal/Institutional
2. Identify what Demonstration elements are impacted by the risk; Vehicle, Infrastructure, TMC, Communication, Integration, Production.
3. Assign a probability of occurrence for each risk in each time frame. This is the probability that the risk will actually happen. Ratings should be High, Medium, or Low (probability of occurrence).

   Low: 0-9% likelihood of occurrence
   Moderate: 10-29%
   High: 30-100%

4. Assign a degree of seriousness of consequences, provided the risk occurs, for each risk in each time frame. This is the seriousness of the consequences. Ratings will be High, Medium, or Low (serious, moderate, or minor consequences).
5. Establish an overall risk value for each risk area. Ratings will be Red (high overall risk), Yellow (moderate overall risk), and Blue (low overall risk). These will be determined from the accompanying table.

Probability of Occurrence (High, Medium, Low)	Seriousness of Consequences (High, Medium, Low)	Overall Risk (Red, Yellow, Blue)
High	High	Red
High	Medium	Red
Medium	High	Red
High	Low	Yellow
Medium	Medium	Yellow
Low	High	Yellow
Medium	Low	Blue
Low	Medium	Blue
Low	Low	Blue

Mitigation establishes a plan which reduces or eliminates risk impact to the AHS deployment. The question is - *What should be done, and whose responsibility it is to eliminate or minimize the effect of the risk?* Options available for mitigation are: control, avoidance, or transfer. This task will address risks in the Red (or High) category to determine mitigation actions which could be taken to reduce or eliminate risk impacts.

A recommended course of mitigation needs to be identified for each risk area. These include: Change Requirement, (For example, if driving the demonstration vehicles on conventional roadways poses too great a risk, a requirement may be added that states that all vehicles shall be trailered to and from the demonstration facility. The impact to cost would need to be evaluated and the logistics of obtaining, using, and storing trailers would need to be examined.); Add Money, (For example, if the steering actuators had an unacceptable failure rate and other, more expensive actuators were available, procuring the more expensive actuators might be adequate mitigation to resolve the risk.); Add Time, (For example, if better actuators may be available from another vendor, but the vendor may need a 30 day lead time.); and Other. Substantiating information as to why the recommended mitigation should work should be included. This information should contain as much detail as possible. This detail should include: how the change mitigates the risk, what is the impact to cost, schedule, performance or audience perception, and does this mitigation increase risk to another Demonstration element.

Demo Element
☐ Infrastructure
☐ DPC
☐ Vehicle
☐ Expo
☐ Comm

Figure 6.1.3-1 Risk Mitigation Form

Title of Risk : ______________________

Description of Risk (Why is this a risk?) : ______________________

____

____

____

Submitted by : ____________ **Domain Expert:** ____________

Scenario
☐ Free Agent
☐ Platoon
☐ Maint
☐ Truck
☐ Other

	Description/Rationale
Risk Area	
☐ Tech ☐ Schedule ☐ Cost ☐ Programmatic ☐ S & I	
Risk Assessment	
Probability of Occurrence (H,M,L) (O_p)	☐
Seriousness of Consequences (H,M,L) (O_c)	☐
Overall Risk (R,Y,B)	☐ Red ☐ Yellow ☐ Blue
Mitigation	
	Detailed Description
☐ Change Requirement ☐ Increase Funding ☐ Modify Schedule ☐ Other ________	
Final Resolution	

H - high level of risk
M - medium level of risk
L - low level of risk

R - Red overall risk
Y - Yellow overall risk
B - Blue overall risk

6.2 Traffic Management Plan

The demonstration will be held on the High Occupancy Vehicle (HOV) Express Lanes of Interstate 15 in San Diego. Currently, these lanes are heavily used by local traffic for a specific period in the morning and in the afternoon. When testing occurs and especially during demonstration week, business as usual on I-15 could be greatly affected. In order to reduce the inconvenience to the normal users of this thoroughfare, a traffic mitigation plan must to be developed which will be a subset of the total program risk mitigation plan of the previous section. The traffic management report will include recommendations and several options to mitigate the traffic impact, i.e. pre-demonstration media campaign, incentives for carpooling during this period, staggered working hours for those affected, alternate routes, extra highway patrols to alleviate congestion, or the adjustment of flow upstream of the affected area. The traffic management plan is being developed by PB in conjunction with the Caltrans-San Diego office. The draft will be available in March of 1997.

6.3 Safety Plan

Safety, of both the participants and the audience, is paramount to the success of this demonstration. The Safety Plan will be utilized to produce Safety Procedures that detail specific facets of the demonstration. There will be overall safety guidelines for everyone to follow. In addition to the general safety concerns, there will be specific plans for the live-demonstration and for the exhibition hall. The program is very susceptible to safety issues and concerns based on having high speed and closely spaced automobiles. Final versions of each Safety Procedure will be readied in time to perform Safety Reviews prior to the shipment of vehicles to the San Diego site. The results of these independent safety reviews will be presented to the NAHSC safety board for certification. Everyone working on the vehicles or infrastructure must be certified and safety trained. Calspan has been contracted to develop both a draft safety plan as well as a draft vehicle safety certification procedure. The draft version of both documents will be available on January 15th 1997.

6.3.1 Safety Reviews

The Safety Review Team reviews and evaluates the technical data, the safety program and provides documented approval/concurrence or recommends actions to the Safety Board who gives final approval of scenario participation.

The initial safety review is to assess the system safety program, to review the demonstration concept for safety concerns, review the preliminary hazards lists for completeness and assess preliminary planning for Demonstration site operations.

The preliminary safety review is to assess the preliminary design of the Demonstration to ensure all design and operational hazards have been identified, and to determine if suitable means of hazard control have been identified and are planned to be implemented. It will also evaluate proposed safety verification methods.

Critical Safety Review - The purpose of this review is to ensure all hazards existing in the Demonstration system, associated support equipment, and operations have been identified and that the hazards are adequately controlled by design and operations features. It will also ensure appropriate means of verifying hazard control implementation and effectiveness have been defined.

6.3.2 Safety Plan

The safety plan defines the safety program roles and responsibilities, describes the approach to performing and integrating hazards analysis and risk assessments, and performing independent safety verification including tool descriptions. The safety plan defines the management controls for the hazardous tasks to be accomplished in preparation for demonstration site operations. This plan contains details on safety inputs to training program for all personnel, with particular attention given to operations and interfaces relating to the qualification and certification of personnel required to perform hazardous functions.

Hazard type, causes, effects, preventative and control measures
Safety procedures and safeguards inherent in the system
Monitoring and safety devices.

6.4 Test/Validation Plan

All the parallel efforts (or subsystems) must perform to some demonstration requirement or derived performance specification. Independent validation and verification is necessary such that the same mistakes or errors do not keep reoccurring. Different eyes will get other perspectives on that same hardware, software, or subsystem. Independent verification and validation of vehicle, communication, infrastructure, and the DPC software will be accomplished to checkout performance specifications (i.e. trajectory of vehicle path, etc.).

When subsystems are brought together, there will be a test and validation plan for the entire system (Integration Test Plan) as well as individual plans for each of the subsystems (vehicle or whatever). The major portion of the Integration Test Plan (ITP) will cover the vehicles and the integrated-1-15 demonstration. The individual test plans and procedures prepared by each subsystem (free-agent vehicle, platooning vehicles, infrastructure, Transportation Management Center, communications) will be used as input to the ITP. The ITP will be used for conducting system level tests and rehearsals leading up to the Demonstration'97. The plan will be generated by the Integration team.

6.5 System Interfaces

A major role of system integration is to verify and validate that all the pieces fit and work together. Integration may include hardware, software, and/or functional verification and validation. For each subsystem (hardware or software), there are interfaces with the other subsystems that constitute the system. These interfaces must be well understood and well documented to serve its purpose. The integration plan uses working reviews to understand each interface. Each interface must be controlled tightly with exact details that cannot be misinterpreted. This comprehensive interface document must be continuously maintained. For example, the system interface control document will develop and validate interface specifications between the vehicles, infrastructure, and the communication system. It is critically important that subsystems delivered from individual organizations into another organization's vehicle (i.e. check-in functionality software delivered to Delco for incorporation into the man-machine interface), be adequately documented.

6.6 Development Plan

The specific details for the preparation of the infrastructure and for the development of the vehicles are contained in the D2D Statement of Work, in APPENDIX H. The configuration indices identify the specific organizations that are responsible for the different facets of infrastructure and vehicle development.

6.6.1 Infrastructure Modifications

The infrastructure group consists of Caltrans and Bechtel, with support for requirements coming from both the vehicle group and the Transportation Management Center. The infrastructure group has responsibility for magnetic markers, stripes, check-in gates and variable message signs, interfacing with the vehicle-to-infrastructure communications, TBD checkout requirements, maneuverable cameras on posts or similar roadway structures, lighting, possible differential Global Positioning System (GPS) correction station, etc. In addition to the roadway improvements, there will be production-types of improvements in support of the I-15 demonstration such as production communications, prepping the staging area, set-up for the I-15 demonstration as well as for the VIPs, controlling internal traffic, boundary and secured area barricades, signs, portable generators, portable restroom, fuel storage, parking, on-site vehicle storage, area for the press, etc. The infrastructure group will have to interface with the marketing/production group. If required, the infrastructure group may have to support a small repair shop to assist with vehicle fine tuning (example: minor repair, changeout of components, or maintenance). Larger scale vehicle work (i.e. transmission repair) will be done under warranty at a nearby dealer equipped to do such work.

6.6.1.1 Infrastructure Configurations

6.6.1.1.1 Configuration Index

Infrastructure for Demonstration

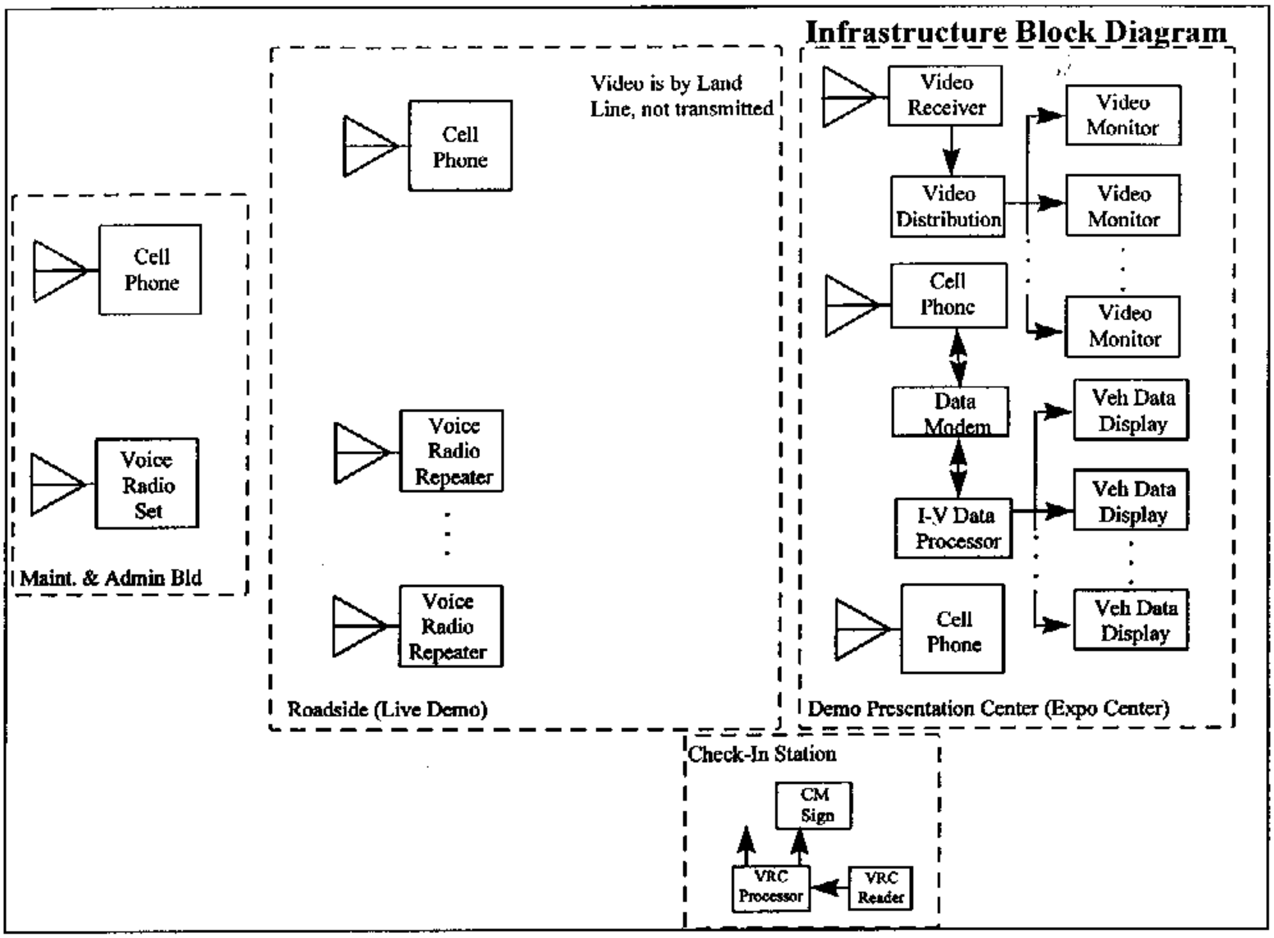
Ind Lvl	Description	Qty this Index	Part Number	Responsibility	Function	Mfg, make, model	Comments
0	**Automated Highway System, '97 Demo**						
1	**Roadway Subsystem**						
2	**Roadway**	1	-1	Caltrans	AHS Feasibility Demo		I-15 Express lanes North of San Diego
3	**Magnetic Marker Set**						
4	Magnetic Marker, Rare Earth, Pos Polarity	TBD	-1	Caltrans	Lateral control		
4	Magnetic Marker, Rare Earth, Neg Polarity	TBD	-1	Caltrans	Lateral control		
4	Magnetic Marker, Ceramic, Pos Polarity	TBD	-1	Caltrans	Lateral control		
4	Magnetic Marker, Ceramic, Neg Polarity	TBD	-1	Caltrans	Lateral control		
3	**Roadway Striping**	1	-1	Caltrans	Lateral control		for vision systems
3	**Barrier Set**						
4	I-15 Southbound Off-Ramp	.5 mi	TBD	Caltrans	I-15 So. off-ramp		temporary K-rail
4	I-15 Northbound Off-Ramp	.5 mi	TBD	Caltrans	I-15 No. off-ramp		temporary K-rail
4	163 Southbound Off-Ramp	.5 mi	TBD	Caltrans	163 So. off-ramp		temporary K-rail
4	I-15 Median	2 mi	TBD	Caltrans	I-15 median		
3	**Check-In Station**						
4	VRC Reader	2	-1	Hughes	Check-in		
4	VRC Processor	2	-1	Hughes	Check-in		includes data modem for cell phone
4	Cell Telephone	2	-1	Hughes	Check-in data to DPC		
4	Cell Telephone Antenna	2	-1	Hughes	Check-in data to DPC		
4	Changeable Message Sign	2	-1	Caltrans	Check-in		
4	Gate, Electrical Operated	2	-1	Caltrans	Check-in		
3	**Maint. & Admin. Bld. Comm. Group**						
4	Voice Radio Set	1	-1	Hughes	Demo coordination		
4	Cell Telephone	1	-1	Hughes	Demo coordination		
4	Cell Telephone Antenna	1	-1	Hughes	Demo coordination		

6.6.1.1.1 Configuration Index (Continued)

Infrastructure for Demonstration

Ind Lvl	Description	Qty this Index	Part Number	Responsibility	Function	Mfg, make, model	Comments
3	**Roadside Communications Group**						
4	Voice Radio Repeater	1	-1	Caltrans	Voice communications		
4	Voice Radio Repeater Antenna	1	-1	Caltrans	Voice communications		
4	Cell Telephone	1	-1	Hughes	Demo coordination		
4	Cell Telephone Antenna	1	-1	Hughes	Demo coordination		
4	In-Vehicle Video Repeater	TBD	-1	PB	Spectator Video		
4	In-Vehicle Video Repeater Antenna	TBD	-1	PB	Spectator Video		
4	Roadside Video Transmitter(s)	TBD	-1	PB	Spectator Video		
4	Roadside Video Camera(s)	9	-1	Caltrans	Spectator Video		
4	Roadside Video Antenna(s)	TBD	-1	PB	Spectator Video		
4	Roadside Equipment Installation Kit	1		Caltrans	Equipment Installation		
2	**Demonstration Presentation Center**						Mock TMC at Expo Center
3	**DPC Comm & Display Group**						
4	Cell Phone	2	-1	LMC	I-V data & Demo Coord		
4	Cell Phone Antenna	2	-1	LMC	I-V data & Demo Coord		
4	Data Modem	TBD	-1	LMC	Digital data to DPC		
4	I-V Data Processor	1	-1	PB/LMC	I-V data processing		
4	I-V Data Display	TBD	-1	PB/LMC	I-V data display		also Check-in display
4	Video Receiver	1	-1	PB/LMC			
4	Video Receiver Antenna	1	-1	PB/LMC			
4	Video Distribution	1	-1	PB/LMC	Spectator video		
3	**Computer Software, DPC**	1	-1	PB/LMC	DPC Operation		
4	Video Monitor	TBD		PB/LMC	Spectator video		
3	**DPC Facility**	1	-1	PB/LMC	DPC equipment		e.g. tables, chairs, etc.
1	**Demo Support Facility**						
2	Maintenance & Admin Building	1	-1	Caltrans	Maint. & admin facilities		
2	Storage Building	1	-1	Caltrans	Storage		
2	Trailer	6	-1	Caltrans	Water/sewer		
2	**Paving**						
3	Parking Area	1	-1	Caltrans	Parking		
3	Site Access Lane	1	-1	Caltrans	Site access		
3	HOV Access Lane	1	-1	Caltrans	AHS veh access to I-15		

6.6.1.1.2 *Block Diagram*



6.6.1.1.3 *Interfaces*

6.6.1.2 *Magnetic Markers*

Magnetic Marker installation was completed in September, 1996.

6.6.1.3 *Barriers*

The installation of two miles of barrier was completed in September, 1996, in parallel with the magnetic marker installation.

6.6.1.4 South Control Yard Facility

A section of land adjacent to the Route 163 entrance ramp has been set aside to be utilized as a staging and storage area. This site has come to be known as the South Control Yard and will serve as the vehicle "staging area" for the 1997 Demonstration. The South Control Yard will also serve as the maintenance and storage area during the testing stage prior to the actual demonstration.

The site is configured such that access is possible via Kearny Villa Road, an arterial road which crosses Route 163. Miramar Naval Station has allowed temporary use of their driveway which connects to Kearny Villa Rd., plus temporary egress across a section of land that they own adjacent to the site. A new stretch of pavement will be constructed across the egress path to create a paved access road into the South Control Yard area. The benefit of this arrangement is that direct access is not required from Route 163 and safety becomes less of a concern. Caltrans has agreed to install a new finished coat of asphalt over this driveway as part of their infrastructure modifications.

The general configuration of the South Control Yard includes two functional buildings, a portable restroom trailer, several service trailers and general parking for twenty automobiles. The access road, which will be constructed across the Miramar egress, provides a path of travel into the staging area. The direct path of this road continues through the parking structure and onto the devoted entrance ramp for the demonstration roadway. This new entrance ramp will be protected by a barrier to ensure that vehicles traveling on Route 163 will not have access to the demonstration roadway, plus provide safety for the demonstration vehicles. Site security will be ensured by providing a new 1.83 meter chain-link fence around the entire site. Gates will be provided at the roadways, which will be locked when the site is not in use.

Two structures will be situated on the site for use before and during the demonstration. The Temporary Service Building has been designed as a 567 square meter pre-engineered steel structure, with a concrete foundation. This building will accommodate an office, an electronic lab, a mechanical lab, a storage room, six automotive garage bays and one bus/garage bay. The intention of this arrangement is to provide adequate working space for the Consortium members as they test the vehicles in advance of the demonstration. The Temporary Parking Structure is currently assumed to be a 1115 square meter structure, with roll-up doors at each end. The sprung-type structure will consist of an aluminum framework with a PVC canopy overlay. The interior of this building will accommodate several drive-through aisles, as well as covered parking space. (NOTE: The occupancy code for this structure is for PARKING only, not "storage.")

The Temporary Service Building will be equipped with a heat pump which provides heating and cooling to all areas except the garage bays. This building will be supplied with an electrical system consisting of a 208/120 volt distribution system, including a step down transformer, a main switchboard and power & lighting panels. Telephone and telecommunications will also be accommodated. The Temporary Parking Structure will not be climate controlled, but will be supplied with lighting and minimal electrical power.

6.6.1.5 General Lane Preparation and Restoration

General Lane Preparation

Restriping, Remarking, Shoulder Paving
Litter Pickup, Sweeping the Lane
Graffiti Removal on the lanes and along the route to the Exposition Center
General and Demonstration Signage

This portion of the project is has three parts:

1) The restriping, remarking, and shoulder paving will enhance the operation of all the vision systems, as well as other technologies using current lane markings as a guidance mechanism. The shoulders will be pave with open-graded asphalt concrete to increase the coefficient of friction to that comparable to the PCC lanes.

2) General cleanup of the lanes and the route to the exposition center. This portion, although small in dollar value, is extremely important, considering the intended audience.

3) Early discussions implied that some special signage would be needed. This still needs input and direction from the marketing and production team.

Support of the Exhibit Hall and Parking Lot Demonstrations can include sweeping, restriping, and so forth as required for minimal cost.

Remediation, Removal, Restoration

Removal of Barrier, Temporary Paving, Temporary Striping, Temporary Signage, other restoration as needed.

This portion of the project is the cleanup and restoration of the lanes and adjacent properties to the same condition as before we began the project. This will include, but is not limited to, removal of all non-standard paint striping and markings, removal of all gates, signals, and signage used for the demonstration, and full restoration of operation of all gates, popups, and other items used during the demonstration.

Additionally, this project will remove the temporary ramp and barrier from the south control yard to the entry to the express lanes.

This project will restore, as requested by Caltrans District 11, the south control yard property to a condition satisfactory to District 11. This may include removing one or both buildings, or moving them to another location, at Caltrans' discretion. Scope of this portion of the project may be limited by availability of funds after the demonstration.

6.6.1.6 North End Staging Area

A parcel of land adjacent to the northbound exit from the I-15 HOV Express Lanes will be developed to use as a staging area during the live vehicle demonstration. The construction work will include grading, paving, fencing, and installation of power for lighting. The fencing will divide the area roughly in half to provide and "AHS" area and a "Public Area " area. The work will include installation of electrical service for a rest area trailer for the drivers (provided by others). Conduit and wiring for telephone service will be installed. The paving will include a loop for automated traffic loading and unloading and a small fence enclosed work area for the vehicles. The vehicle work areas will have 120 volt electrical power with GFCI protection. The paving will include a turn around loop and parking area for vehicles bringing passengers to the public area via Sabre Springs Parkway. A gate will be provided between the I-15 off-ramp and the property to provide security when the area is not in use. A chain gate will close the access to Sabre Springs Parkway when not in use.

6.6.2 Vehicle Development

All participants in the I-15 portion of the 1997 Demonstration must comply with the following requirements.

a. All Associate participants must identify any resources/support/services required from the Consortium to ensure the conduct of proposed demonstrations.

b. Vehicles in the demonstration must have "production" quality appearance. (No bulky equipment bolted to the roof or trunk. Nice overall appearance.)

c. Vehicle developers must work with the Consortium Marketing & Production team to coordinate public relations activities. They shall also adhere to the Consortium Media Contact guidelines as documented by the Program Office. Associate Participants should contact the NAHSC Program Office Public Affairs Manager on overall Public Relations/Media activities.

d. Vehicle developers must participate in dry runs on the I-15 corridor for the purposes of high level functional requirements verification. The Demonstration Vehicle Test Manager and Production Manager will determine the number of dry runs required for each vehicle developer.

e. Vehicles must be capable of staying in scenario scripted lane(s) with sufficient stability to prevent excessive weaving, for the duration of the Demonstration.

f. Vehicles must provide passenger ride comfort comparable to that of manually controlled vehicles.

g. Participants must be able to demonstrate safety capabilities as documented in applicable safety certification procedures.

h. Vehicle developers must successfully pass the certification process as defined in the Safety Certification Plan or provide comparable documentation of having accomplished such certification during their own development activity.

i. Vehicle developers must provide spare parts to accommodate unforeseen component failures during demonstration week. This may include a spare vehicle.

j. All vehicles in the demonstration must have in-vehicle voice communications compatible with the 1997 Demonstration voice communications system.

k. Vehicle developers must participate in a Consortium sponsored "Dress Rehearsal" as per the enclosed schedule.

6.6.2.1 Configuration Index's

Ind Lvl	Description	Quantity Per Veh	Config Number	Responsibility P 1& 2	Responsibility P 3-12	Function	Mfg, make, model	Comments
0	**Automated Highway System, '97 Demo**							
1	**Vehicle Subsystem, Platoon Demo**							
2	Vehicle	10	1	GM	GM	Platoon Demonstration	GM, H Car, MY '96 & '97	Buick LeSabre, SN 10 & 11 deleted
3	**Actuator Group**							
4	Steering Actuator Assy	1	1	GM	GM	Lateral control	Saginaw Steering	
4	Steering Actuator Controller	1	1	Delco	Delco	Lateral control	Delco	
4	Brake Actuator Assy	1	1	GM	GM	Longitudinal control	Delphi Chassis	
4	Brake Actuator Controller	1	1	GM	GM	Longitudinal control	Delphi Chassis	
4	Stepper Motor, Throttle Actuator	1	1	PATH	GM	Longitudinal control		
4	Electric Translator, Throttle Actuator	1	1	PATH	GM	Longitudinal control		
3	**Vehicle Control Group**							
4	Longitudinal Computer	1	1	PATH	GM	Longitudinal control		7415-23V, 15 slot, w/fan kit
5	SB 586P/166 CPU	1	1	PATH	GM	Longitudinal control		PATH Keyboard Interface
5	Cache SIMM, 256K, 66M, Sync	1	1	PATH	GM	Longitudinal control		
5	850 MB Hard Drive	1	1	PATH	GM	Longitudinal control		
5	1.44 MB Floppy Drive	1	1	PATH	GM	Longitudinal control		
5	16 MB RAM	1	1	PATH	GM	Longitudinal control		
5	CCA, 2 Serial Ports	1	1	PATH	GM	Data Modem & Mouse Intf		
5	CCA, AT-MIO-16	1	1	PATH	GM	Veh Sensor Interface		
5	CCA, DFEX-2 Card	1	1	PATH	GM	V-V Comm & HMI Interface		
5	CCA, Ethernet	1	1	PATH	GM	Laptop & Lat Cmtr Interface		
5	CCA, PCT-IO-10	1	1	PATH	GM	Veh Sensor Interface		
5	CCA, Throttle Actuator Board	1	1	PATH	GM	Electric Translator Interface		
5	CCA, Video Card	1	1	PATH	GM	PATH Flat Panel Display		
4	Lateral Computer	1	1	PATH	GM	Lateral Control		9200-10, 10 Slot, w/fan fit
5	SB 586P/166 CPU	1	1	PATH	GM	Lateral Control		PATH Keyboard Interface
5	Cache SIMM, 256K, 66M, Sync	1	1	PATH	GM	Lateral Control		
5	850 MB Hard Drive	1	1	PATH	GM	Lateral Control		
5	1.44 MB Floppy Drive	1	1	PATH	GM	Lateral Control		
5	16 MB RAM	1	1	PATH	GM	Lateral Control		
5	CCA, 2 Serial Ports	1	1	PATH	GM	PATH Mouse		

Ind Lvl	Description	Quantity Per Veh	Config Number	Responsibility P 1& 2	Responsibility P 3-12	Function	Mfg, make, model	Comments
5	CCA, AT-MIO-16	1	1	PATH	GM	Magnetometer Interface		
5	CCA, CAN Bus	1	1	PATH	GM	Brake, Steering, Radar Intf		
5	CCA, Ethernet	1	1	PATH	GM	Laptop & Lon Cmtr Interface		
5	CCA, Video Card	1	1	PATH	GM	PATH Flat Panel Display		
4	Lap Top Computer	1	1	PATH	GM	Lat/Longitudinal Control		used for controller interface
4	Front Magnetometer Assy	1	1	GM	GM	Lateral Control		
5	Magnetometer Mounting Bar	1	1	GM	GM	Lateral control		
6	Magnetometers	3	1	PATH	GM	Lateral control		
5	Magnetometer Cover	1	1	GM	GM	Lateral control		
4	Rear Magnetometer Assy	1	1	GM	GM	Lateral control		
5	Magnetometer Mounting Bar	1	1	GM	GM	Lateral control		
6	Magnetometers	3	1	PATH	GM	Lateral control		
5	Magnetometer Cover	1	1	GM	GM	Lateral control		
4	Forward Radar	1	1	PATH	GM	Lateral control		modified for platooning
4	PCM Software Modifications	1	1	Delco	Delco	Longitudinal control		
3	**Communications Group**							
4	Voice Radio Set	1	1	Hughes	Hughes	Voice communications	Motorola	Includes microphone and speaker
4	Voice Radio Antenna	1	1	Hughes	Hughes	Voice communications		
4	V-V Radio Set	1	1	Hughes	Hughes	Longitudinal control	Utilicom	
4	V-V Radio Antenna	1	1	Hughes	Hughes	Longitudinal control		
4	VRC Transponder	1	1	Delco	Delco	Check-In/Out		
4	Data Modem	1	1	Hughes	Hughes	V-I Data to DPC		
4	Cell Telephone	1	1	Hughes	Hughes	V-I Data to DPC		
4	Cell Telephone Antenna	1	1	Hughes	Hughes	V-I Data to DPC		
3	**Inertial Unit**							
4	Accelerometer, 3-axis	1	1	PATH	GM		Summit Instruments	
4	Rate Gyro, Pitch	1	1	PATH	GM		Systron Donner	
4	Rate Gyro, Yaw	1	1	PATH	GM		Systron Donner	
3	**Vehicle Interface Group**							
4	Actuator Control Module	1	1	GM	GM	Actuator Interface		
4	Actuator Enable Switch Assy	1	1	GM	GM	Actuator Control		
4	Manual Override Switch	1	1	GM	GM	Actuator Control		
4	Sensor Interface Unit	1	1	GM	GM	Veh Sensor Interface		

Ind Lvl	Description	Quantity Per Veh	Config Number	Responsibility P 1& 2	Responsibility P 3-12	Function	Mfg, make, model	Comments
5	CCA, Sensor Interface	1	1	GM	GM	Veh Sensor Interface		
4	Magnetometer Interface Unit	1	1	GM	GM	Magnetometer Interface		
5	CCA, Magnetometer Interface	1	1	GM	GM	Magnetometer Interface		
3	**Equipment Power Group**							
4	Instrument Battery	1	1	GM	GM	Auxiliary Power		
4	Alternator	1	1	GM	GM	Auxiliary Power		
4	Power Inverter	1	1	GM	GM	Auxiliary Power		
3	**Human/Machine Interface**							
4	Driver Interface Controller	1	1	Delco	Delco	HMI		
5	Hard Drive	1	1	Delco	Delco	HMI		
5	Floppy Drive	1	1	Delco	Delco	HMI		
4	Driver Controls, Steering Wheel	1	1	GM	GM	HMI		Direct interface to Vehicle Controller
4	In Dash Display/Controls	1	1	Delco	Delco	HMI		AMLCD and FPD Buttons
4	Video Splitter	1	1	Delco	Delco	HMI		Input for alternate video source
4	Rear Seat Display	1	1	Delco	Delco	HMI		AMLCD
4	Audio Amplifier	1	1	Delco	Delco	HMI		
4	Audio Annunciator	1	1	Delco	Delco	HMI		
4	Heads Up Display	1	1	Delco	Delco	HMI		
4	HUD Controller	1	1	Delco	Delco	HMI		
3	**Installation Kit**	1	1	PATH	GM	Component installation		
3	**Wiring Kit**	1	1	PATH	GM	Component Interconnection		

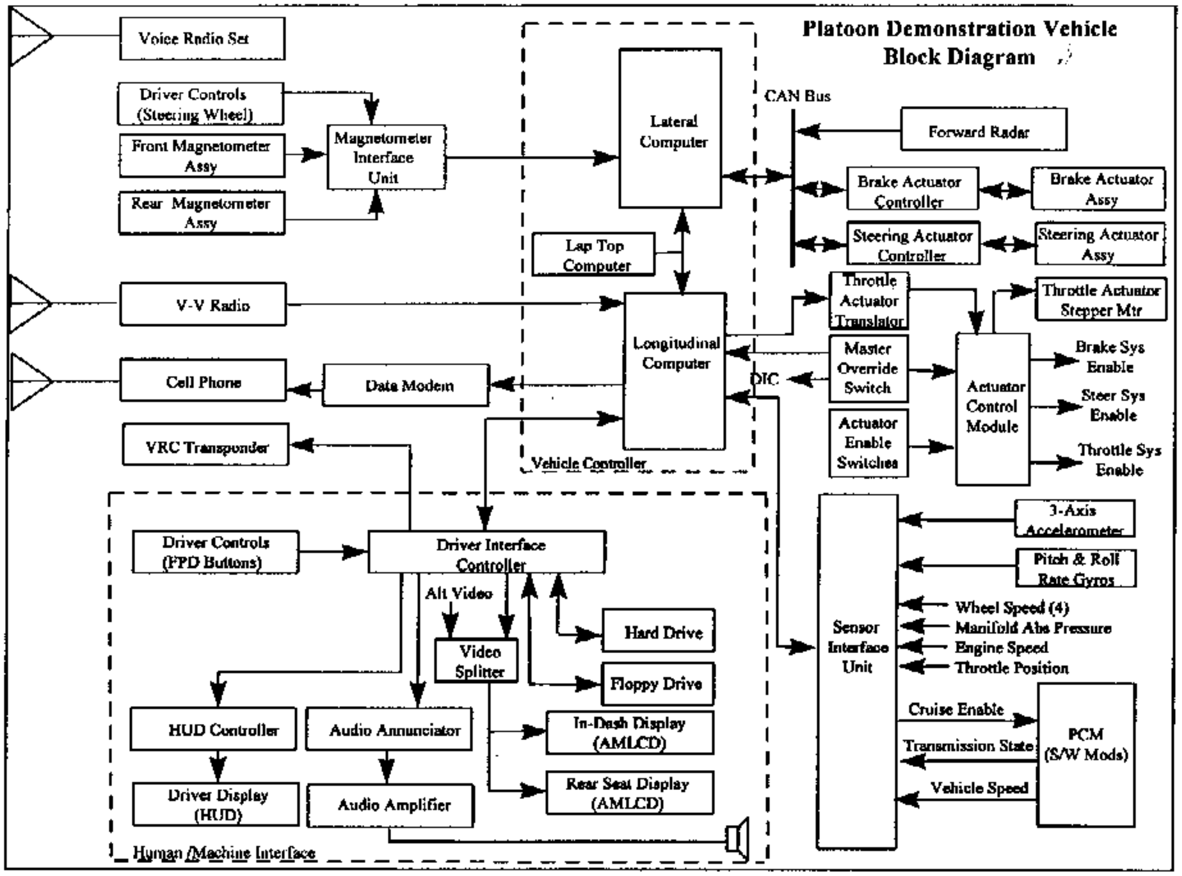
Ind Lvl	Description	Quantity Per Veh	Config Number	Responsibility C 1& 2	Responsibility C 3	Function	Mfg, make, model	Comments
0	**Automated Highway System, '97 Demo**							
1	**Vehicle Subsystem, Free Agent Demo**							
2	Vehicle	3	2, 3	GM	GM	Free Agent Demonstration	GM, H Car, MY '96	C-1 & 2 Pontiac Bonneville
3	**Actuator Group**						GM, H Car, MY '96	C-3 Oldsmobile 88 LS
4	Steering Actuator Assy	1	1	GM	GM	Lateral control	Saginaw Steering	
4	Steering Actuator Controller	1	2	Delco	Delco	Lateral control	Delco	
4	Brake Actuator Assy	1	2	GM	GM	Longitudinal control	Delphi Chassis	
4	Brake Actuator Controller	1	2	GM	GM	Longitudinal control	Delphi Chassis	
4	Throttle Actuator Board	1	1	GM	GM	Longitudinal control	Delphi-E	
3	**Vehicle Control Group**							
4	CPU #1	1	1	CMU	CMU	Lat/Lon control		
5	Computer Accessories	TBD	1					
5	I/O Boards	TBD	1					
4	CPU #2	1	1	CMU	CMU	Lat/Lon control		
5	Computer Accessories	TBD	1					
5	I/O Boards	TBD	1					
4	Lap Top Computer	1	1	PATH	GM	Lat/Longitudinal Control		
4	CCD Camera	1	1	GM	GM	Lateral Control		
3	**Communications Group**							
4	Voice Radio Set	1	1	Hughes	Hughes	Voice communications	Motorola	Includes microphone and speaker
4	Voice Radio Antenna	1	1	Hughes	Hughes	Voice communications		
4	V-V Radio	1	1	CMU	CMU	Longitudinal control		
4	V-V Radio Antenna	1	1	CMU	CMU	Longitudinal control		
4	VRC Transponder	1	1	Delco	Delco	Check-In/Out		
4	Data Modem	1	1	Hughes	Hughes	V-I Data to DPC		
4	Cell Telephone	1	1	Hughes	Hughes	V-I Data to DPC		
4	Cell Telephone Antenna	1	1	Hughes	Hughes	V-I Data to DPC		
3	**Navigation Unit**							
4	GPS Receiver	1	1	CMU	CMU			
4	GPS Receiver Antenna	1	1	CM	CMU			
4	Rate Gyro, Pitch	1	1	CM	CMU			
4	Rate Gyro, Yaw	1	1	CM	CMU			

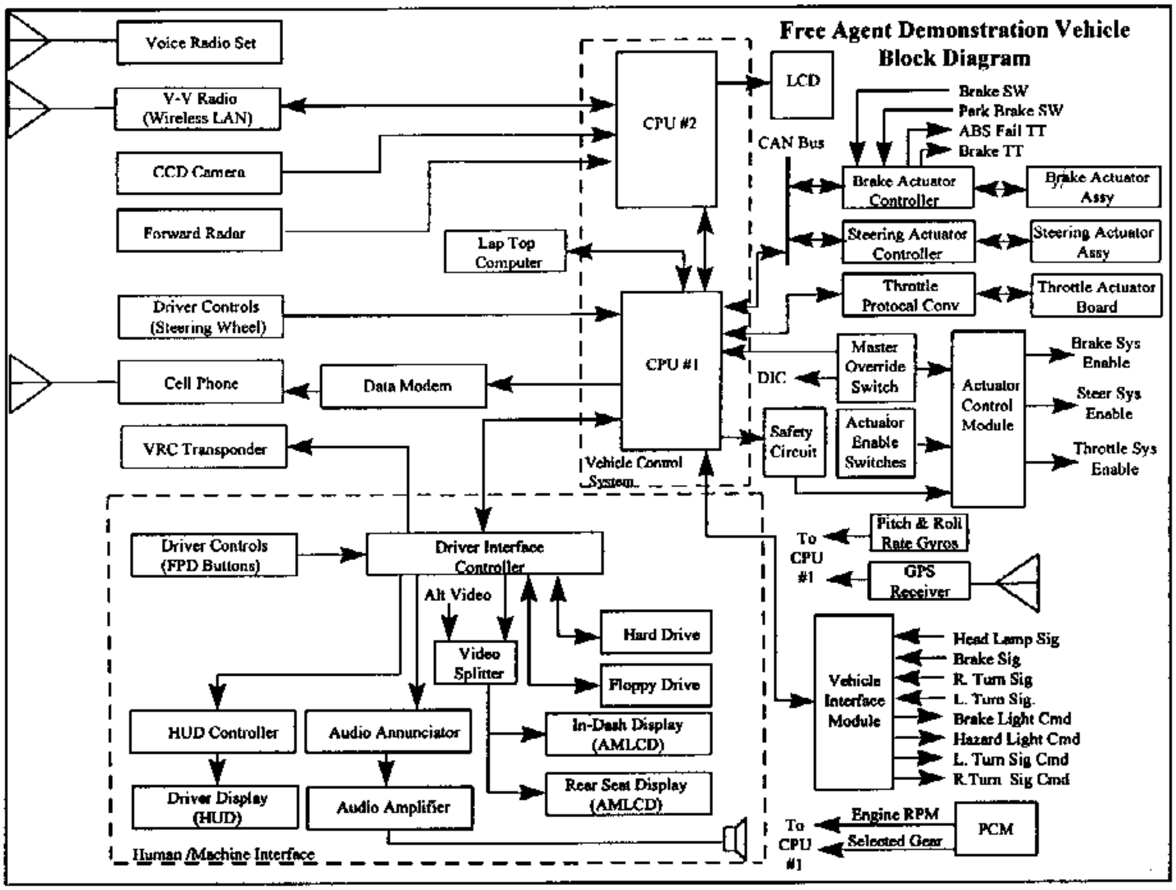
Ind Lvl	Description	Quantity Per Veh	Config Number	Responsibility C 1& 2	C 3	Function	Mfg, make, model	Comments
3	**Vehicle Interface Group**							
4	Actuator Control Module	1	1	GM	GM	Actuator Interface		
4	Actuator Enable Switch Assy	1	1	GM	GM	Actuator Control		
4	Manual Override Switch	1	1	GM	GM	Actuator Control		
4	Vehicle Interface Module	1	1	GM	GM	Veh Sensor Interface		
3	**Equipment Power Group**							
4	Instrument Battery	1	1	GM	GM	Auxiliary Power		
4	Power Supply	1	1	GM	GM	Auxiliary Power		
4	Power Inverter	1	1	GM	GM	Auxiliary Power		
3	**Human/Machine Interface**							
4	Driver Interface Controller	1	2	Delco	Delco	HMI		
5	Hard Drive	1	1	Delco	Delco	HMI		
5	Floppy Drive	1	1	Delco	Delco	HMI		
4	Driver Controls, Steering Wheel	1	1	GM	GM	HMI		Direct interface to Vehicle Controller
4	In Dash Display/Controls	1	1	Delco	Delco	HMI		AMLCD and FPD Buttons
4	Video Splitter	1	1	Delco	Delco	HMI		Input for alternate video source
4	Rear Seat Display	1	1	Delco	Delco	HMI		AMLCD
4	Audio Amplifier	1	1	Delco	Delco	HMI		
4	Audio Annunciator	1	1	Delco	Delco	HMI		
4	Heads Up Display	1	1	Delco	Delco	HMI		
4	HUD Controller	1	1	Delco	Delco	HMI		
3	**Installation Kit**	1	2	GM/CMU	GM/CMU	Component installation		
3	**Wiring Kit**	1	2	GM/CMU	GM/CMU	Component Interconnection		

Ind Lvl	Description	Qty this Index	Part Number	Responsibility M-1	Function	Mfg, make, model	Comments
0	**Automated Highway System, '97 Demo**						
1	**Vehicle Subsystem, IDV. Demo**						
2	Vehicle	1	-1	Caltrans	Maint Demonstration	GM, U Van, MY '96	Make Chevrolet Lumina Mini-van
3	**Actuator Group**						
4	Steering Actuator	1	-1	GM	Lateral control	Saginaw Steering	
5	Steering Actuator Controller	3	-1	Delco	Lateral control		
3	**Lateral/Longitudinal Control Group**						
4	Vehicle Controller	1	-3	LMC	Lat/Longitudinal control		includes cpu's & I/O devices
5	Lap Top Computer	1	-3	LMC	Lat/Longitudinal control		used for controller interface
4	Vehicle Control/Sensors	1	-3	LMC	Lat/Longitudinal control		e.g. throttle position, engine speed, etc
4	CCD Camera	1	-2	LMC	Lateral control		
4	Inertial Unit	1	-3	LMC			
3	**Communications Group**						
4	Voice Radio Set	1	-1	Hughes	Voice communications		
4	Voice Radio Antenna	1	-1	Hughes	Voice communications		
4	Beacon Tag	1	-1	Delco	Check-In	Supply by Delco	
4	Data Modem	1	-1	Hughes	V-I Data to DPC		
4	Cell Telephone	1	-1	Hughes	V-I Data to DPC		
4	Cell Telephone Antenna	1	-1	Hughes	V-I Data to DPC		
4	Video Camera/Transmitter	as req	-1	PB	Spectator video		to be added to veh at Demo site
4	Video Camera Antenna	as req	-1	PB	Spectator video		to be added to veh at Demo site
3	**Maintenance Instrumentation Group**						
4	Magnetic Marker Unit	1	-1	Caltrans	Mag marker inspection	Supplied by UC Davis	
4	ALTS Unit	1	-1	LMC	Infr inspection	Supplied by LMC	
5	GPS	1	-1	LMC	Infr inspection		
3	**Human/Machine Interface**						
4	Driver Interface Controller	1	-1	LMC	HMI	Supply by LMC	
4	Driver Controls	1	-1	LMC	HMI	Supply by LMC	
4	Driver Display/Controls	1	-1	LMC	HMI	Supply by LMC tentative	HUD
4	In-Dash Display	1	-1	LMC	HMI	Supply by LMC tentative	AMLCD
4	Rear Set Display	1	-1	Delco	HMI	Supply by Delco tentative	AMLCD

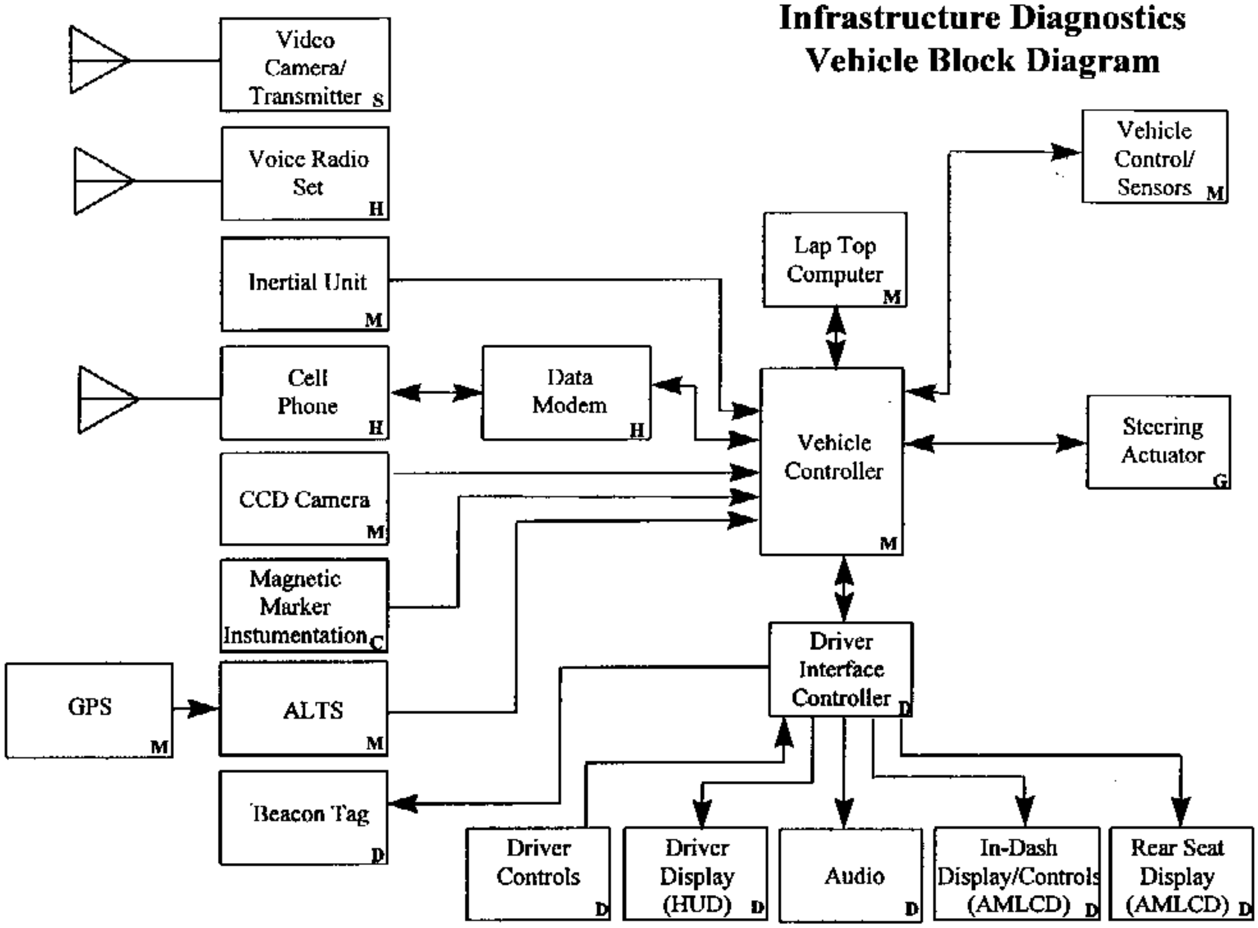
Ind Lvl	Description	Qty this Index	Part Number	Responsibility M-1		Function	Mfg, make, model	Comments
3	**Installation Kit**	1	-3	LMC		Component installation		
3	**Wiring Kit**	1	-3	LMC		Subsystem operation		
2	**Computer Software, Vehicle**	1	-3	LMC		Subsystem Operation		
3	Operating System Function			LMC		Subsystem Operation		
3	Lateral Control Function			LMC		Lateral control		
3	Demo Script Function			LMC		Vehicle control		
3	Magnetic Marker Inspection			Caltrans		Mag marker inspection	Supplied by UC Davis	
3	ALTS			LMC		Infr inspection		

6.6.2.1.2 Block Diagrams




Free Agent Demonstration Vehicle
Block Diagram
Voice Radio Set
V-V Radio
(Wireless LAN)
CCD Camera
Forward Radar
Driver Controls
(Steering Wheel)
Cell Phone
Data Modem
VRC Transponder
CPU #2
LCD
CAN Bus
Lap Top
Computer
CPU #1
Vehicle Control
System
Brake SW
Park Brake SW
ABS Fail TT
Brake TT
Brake Actuator
Controller
Brake Actuator
Assy
Steering Actuator
Controller
Steering Actuator
Assy
Throttle
Protocol Conv
Throttle Actuator
Board
Master
Override
Switch
DIC
Actuator
Control
Module
Brake Sys
Enable
Steer Sys
Enable
Throttle Sys
Enable
Safety
Circuit
Actuator
Enable
Switches
Pitch & Roll
Rate Gyros
GPS
Receiver
To
CPU
#1
Driver Controls
(FPD Buttons)
Driver Interface
Controller
Alt Video
Video
Splitter
Hard Drive
Floppy Drive
HUD Controller
Audio Annunciator
In-Dash Display
(AMLCD)
Rear Seat Display
(AMLCD)
Driver Display
(HUD)
Audio Amplifier
Human/Machine Interface
Vehicle
Interface
Module
Head Lamp Sig
Brake Sig
R. Turn Sig
L. Turn Sig.
Brake Light Cmd
Hazard Light Cmd
L. Turn Sig Cmd
R.Turn Sig Cmd
Engine RPM
Selected Gear
PCM

Infrastructure Diagnostics Vehicle Block Diagram



6.6.2.1.3 *Interfaces*

The Interface Control Document (ICD) contains the system level interfaces for Demo'97.

6.7 Marketing

The marketing activity will address the following questions with respect to the 1997 Demonstration:

1) What is our message?

2) Who are our audiences (demographics)?

3) What is the current perception of our audiences re: benefits of the AHS Demonstration?

4) What perception do we wish our audiences to have regarding the AHS program?

5) How do we most effectively communicate our message? What mediums do our audiences respond to? What spin must our message carry for each audience?

6) Who are our competitors? For media attention? For public support? For capital investment dollars?

7) What messages from other sources are our audiences receiving regarding the 1997 Demonstration and AHS program in general?

To address these issues, a preliminary marketing plan has been drafted. This plan will be further revised such that it can serve as a statement of work for contracting a Marketing / Media / Public Relations firm or supplementing the statement of work for an exhibition / demonstration management firm. Substantial input to the statement of work will be obtained from experienced exhibition and demonstration management firms along with organizations involved with marketing events utilizing public resources. The marketing plan is divided into these six areas:

a) Media Relations - Identifying the local, national, and international trade and general media; educating the media regarding the benefits of AHS and the Demonstration in San Diego (prior to any stories/events planned), preparing media kits and releases, preparing B-roll, monitoring and analyzing reports, any necessary follow-up with reports, preparing for the events, educating Consortium personnel in dealing with the media, and coordinating activities and requirements with the production firms, Demonstration Team and NAHSC Program Office.

b) Public Relations - Assisting with analyzing the presentation of the Demonstration to the public, reactions from the public as a result of media events, support the project at public forums and local government meetings such as SAN DAG, input for the NAHSC Home Page, etc.

c) District / Government Relations - Working in concert with the Caltrans District 11 Community Affairs Officer, San Diego Association Of Governments, members of the California Senate and Assembly, and other appropriate local/ municipal organizations. Developing the materials and providing any information necessary for local government officials to support the Demonstration program by communicating effectively with their constituents and the media.

d) Associate Participant Relations - Working with the Outreach Team, the Demonstration Marketing effort is involving Associates in supporting activity areas, leveraging the Consortium's resources.

e) Develop Transportation Mitigation Plans - In conjunction with Caltrans District 11, the Demonstration Team, any appropriate Associate Participants, and I-15 demonstration production managers, develop and publicize a mitigation plan for users of I-15 and concerned citizens and organizations.

e) Develop Demonstration Mitigation Plans - In conjunction with the Vehicle, Infrastructure and Systems Integration Groups, provide media and public relations strategies in the event that Demonstration plans are revised due to any variety of circumstances.

The marketing activity is also responsible for selling exhibit space and attendee marketing (admission tickets) to the Demonstration. Plans have been developed to successfully market the Demonstration in this regard. The plan includes elements defining exhibit sales and goals, components needed for attendee marketing, logistics of fee collection and disbursement, and competitive analysis.

6.8 Production

A detailed plan will be developed which addresses preparing for the live vehicle demonstrations on I-15, other mini-demos, the exposition center activities, and all logistic activities such as catering and accommodations. Additional scope of the plan and the responsibilities are defined below. A requirements analysis with respect to the exposition center, scheduling, budget, planning and layout, and sponsor prospects will be performed. Due to the nature of having both an exposition center and an on-road live vehicle demonstration, distinct specialized firms may need to be contracted.

Other similar events will be studied as part of the production and marketing planning process. International demonstrations such as the Japan AHS and Prometheus Final Demonstration will be studied. Participants, organizers, and contractors will be interviewed for input to the NAHSC production and marketing plans.

In conjunction with the Marketing, Production, and Integration Group, an exposition management firm(s) will be tasked to execute the exposition and I-15 logistic components:

a) Operations and Logistics (decorations, freight handling, signage, move-in, on-site, move-out details, contract negotiations with subs, accommodations, security, catering, etc.)

b) Sales (execute the entire sign-up, contracting, payment for exhibitors)

c) Marketing (work with the Marketing firm to develop the promotional materials for the exposition and if applicable, technical conference and student competition)

d) Sponsorships (develop relationships with organizations interested in sponsoring portions of the event, contract, accept payment, and establish advertisement requirements)

e) Exposition Configuration (layout the exposition center to arrange the exhibitors booths)

f) Mini-Demos (layout the exposition center parking lot or any other available areas to conduct planned mini-demos)

g) The exposition management contractor will develop an event schedule and deadlines checklist for the exhibitors. This will contain key dates for payment, labor authorizations, badging, rental material forms, electric and telephone service requests, etc.

h) The exposition management contractor will develop the Demonstration and Exhibitor registration guides and forms along with all the necessary general information such as location, show hours, installation and dismantling plans, security and safety information, insurance, etc..

i) The exposition management and if applicable, demonstration management firm will define the appropriate rule and regulations of the Demonstration such as age restrictions, equipment removal passes, work permits, lighting and sound restrictions, Americans with Disabilities Act requirements, compliance with any Occupational and Safety Administration Act regulations, use of exposition center equipment, photography regulations, literature disbursements, music licensing, display rules , etc.

j) The exhibition management firm will develop the shipping and material handling plans for demonstrations, exhibitors, and support organizations.

k) Installation and Dismantling hours, crate removal, storage, and return procedures will be established by the management firm.

l) All necessary forms will be developed and provided by the exhibition management firm or designated contractor.

m) The demonstration and exposition management firms(s) will generate a list of required or recommended contractors for the exhibitors.

6.9 Communications Plan

The communications plan describes the implementation of communications to support live vehicle functions. The communications plan defines the functionality of the vehicle-vehicle communications selected to support longitudinal headway maintenance for the platoon scenario, vehicle-roadside communications to support the check-in function, vehicle-roadside communications to support telemetry data transfer to the DPC, and voice communications to support live vehicle staging and coordination. The communications plan is contained in APPENDIX D.

6.10 Communications Operating Guidelines

The communications operating guidelines address the voice communication operating procedures that will be implemented during test, certification, dry run, and execution of the demonstration. The guidelines provide a summary of the wireless and landline communications facilities that will be needed to support performance of demonstration functions such as staging, loading, and execution of scenarios.

6.11 Vehicle Operations Procedure

This manual provides a step-by-step integrated check list of all system operations from the start of the live demonstration through the completion. In addition, it provides contingency procedures for recycle and backout in the event of a problem. Includes demonstration event chain of command (decision making for go/no-go for the demo, etc.) This document is contained in Appendix B.

7.0 SCHEDULE

The summary schedule is contained in Figure 7-1. For detailed schedules, refer to the Program Office.

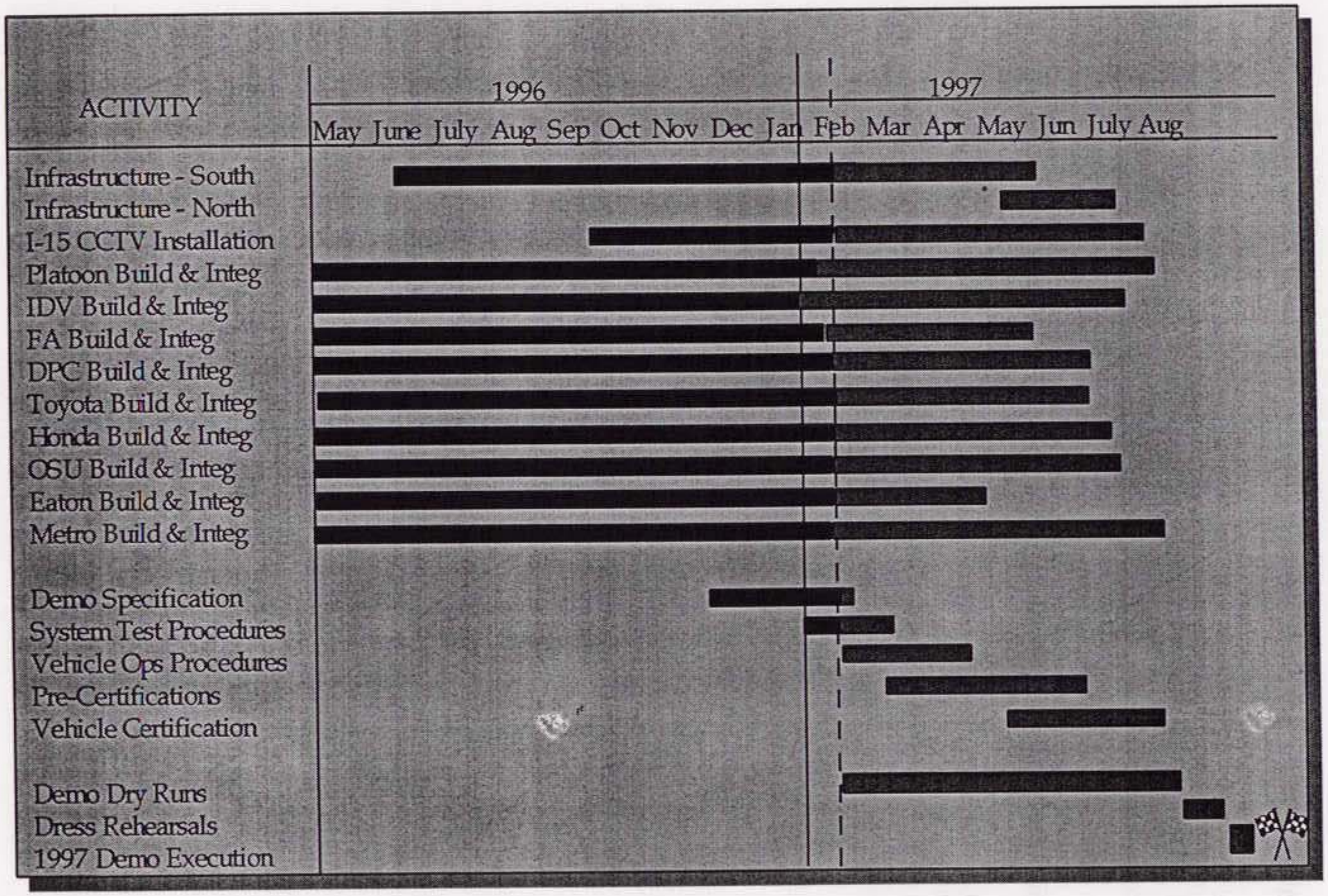


Figure 7-1 Summary Schedule

8.0 BUDGET D2D

For details on the budget for different aspects of the Demo, refer to the combined D2D Statement of Work.

APPENDIX A References

APPENDIX B Vehicle Operations Procedures

National Automated Highway System Consortium Technical Feasibility Demonstration Vehicle Operations Procedures Manual

August, 1997

National Automated Highway System Consortium

**3001 West Big Beaver Road , Suite 500
Troy , MI 48084**

NAHSC

Sign-Off

Terry Quinlan
Demonstration Task Lead

Patrick McKenzie
Integration Lead

Robert Smilgis
Infrastructure, Vehicle Production Lead

Ron Colgin
Vehicle Lead

Victoria Dewey
Expo Production Lead

Aimee Cochran
Communications Lead

Tommy Viner
Program Office Integration

Pat Langley
Technical Integration

Roger Booth
Public Education Lead (San Diego)

Celeste Speier
National Public Education

Foreword

This manual documents the operational procedures used to execute the Live Vehicle Production portion of Demonstration '97. If there is a discrepancy between information contained in this document and other documents, this document shall take precedence.

Please provide comments to:
Patrick Langley
Lockheed Martin
P.O. Box 179
Denver, Co. 80201
Phone (303) 977-6761
Fax (303) 971-4093
E-Mail pat.langley@lmco.com

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1 Pre-Demo Procedures

1-1 Infrastructure

See Section 2-1

1-2 Communications Ready

_____ Perform radio check

Call Sign	Function	Assignment	Radio Net
Production	Lead	Bob Smilgis	NAHSC
Operations	Operations	Pat Langley	NAHSC
Vehicle Control	Lead	Ron Colgin	NAHSC
Vehicle Safety	Vehicle Safety Officer	Dan Grigsby	NAHSC
Corridor Safety	Corridor Safety Officer	Tarbell Martin	NAHSC
Site Lead	Lead	Randy Woolley	NAHSC OES SCY
Site EMS	EMS Coordinator	Stan Slavin	NAHSC OES SCY
South Site	SCY Site Manager	Rebecca Mowry	NAHSC OES SCY
South Lead	SCY Coordinator	Fred Mangarelli	NAHSC OES SCY
South Dispatch	SCY Dispatcher	Larry Baumeister	NAHSC OES SCY
Comm South	SCY Communications	Bob Battersby	NAHSC OES SCY
North Lead	NSA Coordinator	Tommy Viner	NAHSC OES NSA
North Site	NSA Site Manager	Joy Pinne	NAHSC OES NSA
North Dispatch	NSA Dispatcher	John Castro	NAHSC OES NSA
Comm North	NSA Communications	Aimee Cochran	NAHSC OES NSA
DPC Ops	DPC Lead	Tony Rubner	NAHSC
Video Ops	Video Camera Operator	Sean Campbell	NAHSC
Passenger	Passenger Coordinator	Ed Vanover	NAHSC OES Expo OES Mini

1-2 Communications Ready (Continued)

_____ Perform radio check

Call Sign	Function	Assignment	Radio Net
OV 1	Obstacle Placer	D11	NAHSC
OV 2	Obstacle Placer	D11	NAHSC
OV 3	Obstacle Placer	D11	NAHSC
OV 4	Obstacle Placer	D11	NAHSC
OV 5	Obstacle Placer	D11	NAHSC
OV 6	Obstacle Placer	D11	NAHSC
CHP	California Highway Patrol		NAHSC
TOW 1	Tow Truck 1		NAHSC
TOW 2	Tow Truck 2		NAHSC
EMS	Ambulance		NAHSC
Gray 1	Evolution Vehicle 1 Narrator		NAHSC
Gray 2	Evolution Vehicle 2 Narrator		NAHSC
Gray 3	Evolution Vehicle 3 Narrator		NAHSC
Gray 4	Evolution Vehicle 4 Narrator		NAHSC
Red 1	Multi Bus 1 Narrator		NAHSC
Red 2	Multi Vehicle 2 Narrator	John Kozar	NAHSC
Red 3	Multi Bus 3 Narrator		NAHSC
Red 4	Multi Vehicle 4 Narrator	Dave Duggins	NAHSC
Red 5	Multi Vehicle 5 Narrator	Bala Kumar	NAHSC
Blue 1	Control Vehicle 1 Narrator		NAHSC
Blue 2	Control Vehicle 2 Narrator		NAHSC
Orange 1	IDV Narrator	Bill Kennedy	NAHSC
Orange 2	ORV Narrator	John Kaula	NAHSC
Green 1	Platoon Vehicle 1 Narrator	Sei-Bom Choi	NAHSC
Green 2	Platoon Vehicle 2 Narrator	Rajesh Rajamani	NAHSC
Green 3	Platoon Vehicle 3 Narrator	Benedicte Bougler	NAHSC
Green 4	Platoon Vehicle 4 Narrator	Jay Kniffen	NAHSC
Green 5	Platoon Vehicle 5 Narrator	Han-Shue Tan	NAHSC
Green 6	Platoon Vehicle 6 Narrator	Juergen Guldner	NAHSC
Green 7	Platoon Vehicle 7 Narrator	Chieh Chen	NAHSC
Green 8	Platoon Vehicle 8 Narrator		NAHSC
Green 9	Platoon Vehicle 9 Narrator		NAHSC

1-2 Communications Ready (Continued)

_____ Perform radio check

Call Sign	Function	Assignment	Radio Net
Purple 1	Target Vehicle Driver		NAHSC
Purple 2	Truck Narrator (lead)	James Gonzales	NAHSC
Tan 1	Alternative Vehicle 1 Narrator		NAHSC
Tan 2	Alternative Vehicle 2 Narrator		NAHSC
Tan 3	Alternative Vehicle 3 Narrator		NAHSC
Tan 4	Alternative Vehicle 4 Narrator		NAHSC

1-3 Control Center Ready

1-4 Weather Acceptable

Wind

Use the Internet to locate the weather for Miramar under the CNN web site.

_____ Wind speed less than 30mph. Run Demo.

_____ If wind speed is 30-50 mph then each scenario lead must be contacted to determine their ability to operate.

_____ If the wind speed is greater than 50 mph, the demonstration will be postponed.

Rain

No standing water on the lanes, NSA, or SCY. Any precipitation will require that all scenario leads be contacted to determine their ability to operate.

_____ Drive one direction on I-15 or the HOV lanes and inspect for water. Dry

_____ North End Coordinator inspects the staging area. Dry.

_____ Controller inspects the South Control Yard. Dry

Fog

Visibility at least 1500 feet at both the NSA and SCY.

_____ Eastern support column of the northbound entrance ramp to the HOV lanes visible from the restroom trailer (1800 feet). Operations

_____ Southern support column of northbound ramp visible from NSA (1400 feet). North End Coordinator.

1-5 Staff Ready

Verify by voice communications that the following personnel are in place and ready to begin:

	Name	Position
X	Bob Smilgis	Production Lead
	Pat Langley	Operations Manager
	Ron Colgin	Vehicle Manager
	Vince Byrnes	Scheduler
	Tommy Viner	North End Vehicle Coordinator
	John Hearn	North End Dispatcher
	D11	Traffic control NSA
	D11	Traffic control NSA
	D11	Traffic control NSA
	D11	Traffic control NSA
	D11	Obstacle placer
	D11	Obstacle placer
	D11	Obstacle placer
	D11	Obstacle placer
	D11	Obstacle placer
	Linda Buys	North End Host
	Ron Hearne	Loader
	Brian Hughes	Unloader
	Karl Saur	North End Stager
	Fred Mangerelli	South End Vehicle Coordinator
	Larry Baumeister	South End Dispatcher
	D11	Traffic control SCY
	D11	Traffic control SCY
	D11	Traffic control SCY
	D11	Traffic control SCY
	Greta Haung	South End Host
	Nick Jigalin	Loader
	Eric Reichert	Unloader
	Ernie Gomes	South End Stager
	Randy Woolley	Lead Site Manager
	Joy Pinne	NSA Site Manager
	Rebecca Mowry	SCY Site Manager
X	Stan Slavin	Security/EMS/Fire/Tow Coord.
X	John Castro	Service Contract Coordinator
X	Bob Battersby	Communications (South)
X	Aimee Cochran	Communications (North)
X	Eric Reichelt	Communications
X	TBD	CHP
	Ed Vanover	Passenger Coordinator
	Jim Lewis	Shuttle Loader
	Gabrielle Stevens	Passenger Check-In
	TBD	Passenger Check-In
	TBD	Mentor Coordinator
	Lynn Barton	Shuttle Dispatch

1-6 Baseline Procedure

The baseline procedure for the execution of the demonstration is contained in Appendix B. For operations on Thursday and Friday the procedure is truncated at the break.

2 Baseline Infrastructure

2-1 Closing of the Lanes (Woolley)

		NOTE: Use SOLEDAD Frequency until Tan Clears
Target TIME	Responsibility	*ACTIVITY*
1535	OV7	When Orange Scenario Departs, OV7 proceeds to CMS, connects truck, waits for Tan departure
1535	Site North/ Vince	Contractor staged at ramp closure after Orange Scenario Departs
1545	Site EMS	NSA tow truck load OSU vehicle to go to Expo
1555	Control	**Last Automated Vehicle leaves NSA southbound (Tan Departed)**
1555	Site North/ Vince	Prepare to close detour
1555	Site North	Cone Truck (NT25), leave NSA, pick up NSA west driveway cones
1556	Site Lead	**Notify HOV to begin closure at Gate 5**
1556	Barbara	CT HOV Unit at Gate 5 - HOV opens gate, verified
1557	Karen/Barbara	HOV Closes Location 4 Popups - Verified by CT HOV Unit, Proceeds South on Lanes
1557	Site North	Cones removed NT 25 return to NSA
1558	OV7	CMS retrieval truck secures CMS, drives south on HOV, retrieve both Check Point Signs
1558	Site North	**Set Ramp Closed Sign in driveway, West Gate Closed, Report NSA Site Secured by Radio**
1558	Site North	**Tell Contractor to start removing off ramp closure by Radio**
1559	Vince	Start removal of Off ramp closure (CMS must be removed prior to opening of T.W. ramp)
1559	3X	3X follows CMS truck south on the HOV Lanes
1601	Vince	**Complete removal of Off ramp closure, report completion by Radio**
1602	Vince	Begin detour removal
1606	Vince/North Site	**End detour removal, North Site Report by Radio**
1606	Vince/ North Site	Begin cover signs
1605	Barbara	CT HOV Unit at Location 3, Close Popups when Tan has passed
1610	Control	**Last automated vehicle into SCY (Radio Call is Tan Clear)**
1611	OV1	Leave SCY and pick up 163 Cones
1611	OV2	Leave SCY and pick up I-15 Cones
1611	OV3	Leave SCY and move barrels at location 2
1612	OV7	CMS Truck exits to SCY
1616	OV1	163 cones removed - vehicles back at SCY
1616	OV2	I-15 cones removed - vehicles back at SCY
1616	OV3	Barrels removed - vehicles back at SCY
1616	Karen/Barbara	Open Gate at Loc. 1, Verified by HOV Unit
1616	Site North	**Report Ted Williams Ramp & Detour secure, Detour Signs Covered**

2-1 Closing of the Lanes (Woolley) (Continued)

Target TIME	Responsibility	*ACTIVITY*
1617	Karen/Barbara	Raise Loc. 2 Transverse Popups, verified by HOV Unit
1617	Barbara	Exit to SCY
1617	North Site	**Report NSA Secure by Radio or Cell phone**
1617	3X	**Corridor Safety Officer exits to SCY and reports by Radio lanes are clear**
1618	Site South	**Close and lock north gate at SCY, Report SCY Secure by Radio**
1618	Site Lead	**Report to TMC lanes are clear**
1630	Site Lead	Release Navy Guard at Ammo Rd & Miramar Way call Navy Security Officer

2-2 Opening of the Lanes (Woolley)

Corridor Open/Close Schedule- Sunday 8-10

Target TIME	Responsibility	*ACTIVITY*
0700	Site Lead	Post Colors at Tank Battalion
0700	Comm South	South CMS setup complete
0730	Comm South	North CMS setup complete
0730	Site Lead	Send OV6 north on I-15 then South on HOV to look for disabled vehicles, report any found
0745	EMS	Send one (1) CHP unit to Ted Williams Parkway Off-ramp to assist with off-ramp closure
0745	CHP	Enroute to NSA, check for disabled vehicles in median
0800	Vince	Start Ted Williams off ramp closure and detour open
0800	Site Lead	Give Safety Briefing at morning Briefing
0810	Site Lead	Radio Check with TMC on Soledad
0820	Site South	Send OV1, OV2, OV3, OV4, OV5 to NSA
0820	Site Lead	Cell Phone Comm Check with TMC, verify corridor, disabled vehicles?
0822	Site Lead	Verify Navy Guard at Ammo Rd & Miramar Way in place call Miramar Security Officer
0830	Vince	End off ramp closure and detour open
0850	Site North	NSA (North Staging Area) verifies CHP & EMS on site
0900	Barbara	**Start HOV Closing -- CT HOV Unit**
0901	Barbara	Location 5 Popups - Verify Closed
0901	Barbara	HOV closes Location 5 Gate - Verified
0901	Barbara	HOV Opens Location 4 Popups - CT HOV Unit Sweeps SB on HOV
0901	OV6	Set Barrels in-between Loc. 2 Popups - Verified by 3X
0902	OV1	1st vehicle starts south to set both check point signs
0902	OV2	2nd vehicle starts south to set cones at SB 163 Off ramp
0902	OV3	3rd vehicle starts south to set cones at SB 15 Off ramp
0902	OV4	4th vehicle starts south to sweep east shoulder for debris
0902	OV5	5th vehicle starts south to sweep west shoulder for debris
0902	3X	3X follows all vehicles south
0902	Site North	Start to set cones at North Staging Area (NSA) west gate

2-2 Opening of the Lanes (Woolley) (Continued)

Target TIME	Responsibility	*ACTIVITY*
0905	Site Lead	**Ten minute warning to Vehicle Developers to Start T1**
0907	OV1	North Check Point Set by OV1
0907	Site North	End set cones at NSA west gate
0907	Site North	**NSA Ready, Call Site Lead on Radio or Cell Phone**
0909	Barbara	SB Sweep Completed by CT HOV Unit, stops at Location 3, in view of location 2
0909	Barbara	HOV Opens Location 2 Gate - Verified
0909	Barbara	HOV Opens Location 3 Popups - Verified
0909	OV2	2nd vehicle set cones at SB 163 Off ramp
0909	OV3	3rd vehicle set cones at SB 15 Off ramp
0910	OV1	South Check Point Set by 2nd OV1
0910	Barbara	Verify Gate 1 and Location 1 Popups are closed
0910	South Lead	**Move Gray Scenario to Release Line**
0910	3X	**Verifies Navy Guards in place at Miramar Way and Ammo Road, report by Radio**
0911	Barbara	HOV Return to Location 2, Opens Transverse Popups, Verify Open
0912	Barbara	CT Maint Unit exits toward SCY, drives down dirt road to I-15, continues to check CMS signs
0913	OV1	1st vehicle Check Point Set vehicle clear of lanes
0913	OV2	2nd vehicle (163 cones) clear of lanes
0913	OV3	3rd vehicle (I-15 cones) clear of lanes
0914	OV4	4th vehicles (east debris) clear of lanes
0914	OV5	5th vehicle (west debris) clear of lanes
0914	Karen	**TMC Confirms corridor clear of incidents**
0915	3X	**3X south sweep complete, lanes ready**
0915	Site South	**SCY (South Control Yard) Ready**
0915	Site Lead	**Declare Facility Ready for Demo**
0915		**Target First Automated Vehicle enters Lanes**

2-3 Weather (Langley)

See 1-4

3 Baseline Passengers

Refer to Appendix D for Passenger Management Plan and procedures.

4 Baseline Miscellaneous

Working at the South Control Yard is a privilege for all involved individuals. Any person unwilling to abide by the safety and work rules will have the privilege suspended.

General Rules

a. The Caltrans Site Manager is the point of contact at the South Control Yard, will assist in resolving problems at the yard. In the event of a dispute involving safety issues, the Caltrans Site Manager will have the final authority to resolve the issue.

b. Personnel working at the South Control Yard must observe all safety rules. Any consortium worker or visitor unwilling to observe the posted safety rules will first be advised of the rule and that he/she is not observing the rule. Any person unwilling to comply with the safety rules will be escorted off the property and the appropriate developer lead worker must resolve the problem with the Caltrans Site Manager prior to that worker being allowed to return.

c. The speed limit on the South Control Yard property is five (5) miles per hour for all vehicles at all times.

d. The posted speed limit on the Express Lanes is 65 miles per hour and must be observed.

e. All personnel must observe the privacy of the other developers. Most developers have items on the cars that are proprietary and others must respect this.

YOU MAY NOT ENTER ANOTHER DEVELOPER'S AREA WITHOUT PERMISSION AND AN ESCORT.

Personnel violating this courtesy will be asked to leave and escorted off the property. The developer lead for the offending individual must contact the Caltrans Site Manager to obtain permission for that individual to return.

Safety/ Work Rules

4-1. Entry/ Exit

a. Entry to the South Control Yard (SCY) requires a photo ID badge. Additionally, each scenario lead is required to provide to the Caltrans Site Manager a list of their personnel authorized entry into the SCY. When an individual arrives at the SCY, that person will be required to show their photo ID to the security guard and sign in on a log sheet showing their name, and time of entry. This process may be computerized using bar code or other identification on the ID badge.

b. Exiting the SCY, check out with the security guard to log your time of departure when leaving for the day. If your are only leaving for lunch and returning the same day, checking out (and checking back in) are not required. If you are leaving and are unsure if you will return, check out. Entry/ Exit rules apply 24 hours a day. If the gate is locked and the guard is on rounds, you must wait until the guard returns to enter or exit. The gate will normally be locked after hours (8 pm to 7 am weekdays, 5 pm to 8 am weekends), and the hours may change depending on the test schedule. Contact the Caltrans Site Manager if you will be having workers needing access during hours when the gate is locked.

c. Scenario leads expecting visitors at the SCY must notify the Caltrans Site Manager in advance, and will be required to provide an escort for the visitor while on the SCY. If that visitor will become an authorized worker at the SCY, the scenario lead must request in writing that Caltrans Site Manager add that person's name to the authorized worker list.

d. Visitors to the SCY must sign in with the security guard and must have a photo ID card. Visitors will be given a visitor badge and will be required to wait at the security station until their escort arrives. Unescorted visitors are not allowed at the SCY.

4-2. Parking

Caltrans will provide a covered parking facility with "clamshell" type doors on both ends at the South Control Yard. This building is for parking the demonstration vehicles, and for staging during the dress rehearsals and demonstration. Personal vehicles may NOT be parked in this building.

a. Workers and visitors may park their personal vehicles at the SCY as space permits, during the test and development time frame. Workers are highly encouraged to carpool to and from the SCY. Workers may park around the perimeter of the SCY, but must insure the normal routes for test vehicles are kept open. Private vehicles may NOT be parked inside the work building or parking structure. Associates may park in their own areas if approved by their scenario leads, prior to dress rehearsals.

b. During the dress rehearsals and demo time frame, only demonstration and support vehicles will be at the SCY and NO PARKING of personal vehicles will be allowed. The live demo team is working on obtaining off-site parking and transportation to/from the SCY.

Individuals who abuse the limited parking at the South Control Yard will not be allowed to park private vehicles at the yard.

4-3. Demonstration Vehicle Refueling

a. Caltrans has arranged a gasoline refueling truck that will come to the SCY on a regular schedule. Members needing fuel may purchase fuel from the truck operator using a credit card. The fuel truck will be scheduled in the evening. That way, a delay in fueling will not cause a delay in the daily test/ rehearsal/ demonstration routine.

b. It is anticipated that a specific location on the SCY will be set up for refueling with a containment system in the event of a fuel spill. This may simply be a line of sand bags. Each developer desiring fuel will need to bring the cars, one at a time to be fueled at that location. Refueling can either be scheduled or on a first come, first served basis, depending on the number of cars needing fuel. This procedure may be simplified or modified by agreement with the refueling company.

4-4. Storage/ Use of Petroleum, Antifreeze, and Flammable Products

a. The SCY has NO running water, and no drain system for containing fuel or petroleum spills. Additionally, there are no storage facilities for petroleum and flammable products. Therefore, the following restrictions are necessary:

b. No bulk storage of petroleum, antifreeze, or flammable products.

c. You may store and use small amounts of items such as engine oil, transmission fluid, power steering fluid and the like, only in the normal consumer size original containers. Examples are oil in one quart containers (plastic with resealable caps preferred), transmission and power steering fluid in one pint containers (again, plastic with resealable caps preferred). Other vehicle consumable fluids (antifreeze, for example) may be kept and used in the normal consumer size original containers. (Antifreeze in one gallon resealable plastic bottles).

d. You may store on site one (1) consumer purchasable case (for example, twelve quarts of oil, four gallons of antifreeze), and each developer is responsible for obtain, storage, use, and proper disposal of such consumables. Failure of a developer to responsibly handle these items will result in forfeiture of the privilege of keeping and using these items on site. Associates with individual work areas will need to store these items in their own areas. Storage for those core and associates working in the work building is being developed, and members storing such items in the work building may be required to help purchase any necessary storage lockers or facilities (TBD).

You may store one (1) five gallon or smaller container of gasoline for the contingency that one of your vehicles runs out of gas. It must be stored in a commercially available metal or plastic vented storage can designed for storing gasoline.

DO NOT STORE A GASOLINE CONTAINER IN A VEHICLE TRUNK.

DO NOT STORE A GASOLINE CONTAINER OUTDOORS IN DIRECT SUN.

Associates with individual work areas will need to store these items in their own areas. Storage for those core and associates working in the work building is being developed, and members storing such items in the work building may be required to help purchase any necessary storage lockers or facilities (TBD).

e. Provisions are being made to contain small spills of these items (~ one quart or so) using sweeping compound or "cat sand" to be available in the work building. Members with individual work areas will need to provide similar means to contain a small spill.

f. Due to the permitting of the building and facilities (it is NOT a maintenance station), and the close proximity of the environmentally sensitive areas, use, storage, and potential spills of these items is being closely watched, and No disposal of these products on site. (Carry your own off site, and arrange for proper disposal with a local vendor.)

g. No vehicle washing on site that causes water run off. Dry cloth cleaning, or cleansing with damp cloths is permitted, but no soap or other water borne chemicals can be allowed to run off into the drains or evaporate on site.

Groups abusing Storage/ Use of Petroleum, Antifreeze, and Flammable Products will forfeit the privilege of having and/or using these products on the property.

4-5. Restroom

Caltrans is providing a functional restroom facility at the South Control Yard with male and female facilities starting when the SCY is available and continuing until approximately Sep 30, 1997. Users should be advised that if work is done that will leave people's hands greasy or very dirty, each group will need to provide their own hand cleaner and shop rags for initial cleanup. The restroom trailer has only COLD water available for cleanup, and only standard white china sinks. There is no provision for heavy shop cleanup, and NO PARTS WASHING in the restroom.

a. The restroom trailer is open 24 hours a day and is provided with water and sewage removal. While potable water is delivered to the tanks, Caltrans cannot guarantee the potability of the water, so DO NOT DRINK THE WATER IN THE RESTROOM TRAILER, and do not use the water for making coffee or other drinks. Drinking water is provided in the work building.

b. Please show a little courtesy in the restroom trailer. The janitorial service will clean daily as needed, but they should not be expected to clean up your mess. If you make a mess, clean it up just as you would have to at home. If the consumables run out, either replace them, or notify the Caltrans Site Manager so they can be replaced.
c. This is a restroom, not a mechanics wash area.

DO NOT dispose of flammable or petroleum products in the restroom trailer.

4-6. Drinking Water

Caltrans is providing drinking water service for all workers at the SCY, and will be housed in the temporary service building. Users with other space at the SCY will NOT be allowed to take the water bottles to their area. If associates or others with their own "company trailer" facility want a private water cooler, each must make their own arrangements. Water bottles are expected to be stored in the storage room.

4-7. Janitorial Service/ Trash removal

a. Caltrans is providing janitorial service for the restroom, temporary work building, conference trailer, and guard station. This will include sweeping, emptying trash cans, cleaning and sanitizing the restroom, and restocking the consumables in the restroom. .The Caltrans janitorial service is for Caltrans provided buildings only.
b. Additionally, Caltrans will provide a dumpster for paper and similar trash. All developers may use the dumpster, however, Petroleum and flammable products may NOT be disposed of using the dumpster. Each vehicle developer is responsible for disposing of petroleum and flammable products for themselves.

4-8. Temporary Work Building

a. The Temporary Work Building is provided for all developers, core and associate, to share during the development and testing, as well as during the demonstration. Several associates are bringing additional facilities during dress rehearsal and the demo, but this does not restrict them from using the Caltrans provided facility.

b. The Temporary Work Building contains six (6) auto bays, two equipped with fixed vehicle lifts, and one truck or bus bay, with no lift available. The truck bay can also be used for two additional auto bays when not needed for truck or bus use.

c. The work bays are intended for light maintenance of the vehicles and electronic systems, and are not intended for major vehicle maintenance or overhaul. Major work should be accomplished at a local garage or dealership. Lighting, electricity, and compressed air are provided, along with a minimal number of work benches. Storage lockers will be provided either in the work bay area, or in the storage room. Additional shelving space will be provided in the locking storage room as well as space to park rolling tool cabinets. If developers need to change oil, you will need to obtain and use disposable capture systems that can be purchased at the local auto supply houses, as there is no central liquid capture or disposal system. Additionally, there are no drains or oil/water separator facilities due to the permitting of the facility. Portable exhaust capture systems are provided for running the automobiles inside the building, but there is no central exhaust ventilation system. Additionally, also due to the permitting, there is not sufficient ventilation to allow welding or open flames inside the building. A single welding outlet is provided on the outside of the building on the east end, and no welding, or use of any open flame or arc device is allowed inside the building. The work bay area has ceiling ventilation as required by the permitting, but the shop area is neither heated nor cooled. Portable fans may be needed if the temperatures climb too high.

Shared Office Space. Caltrans will provide one room in the South Control Yard temporary work building for use as shared office space during the testing, development, and early dry run time. This space will have some desks and table space along with telephone service described later. This is to be used on a first come, first served, temporary desk space, and is not available for any member or person to use as a personal or private office space. Personnel needing long term office space in the San Diego area should look to their own company to provide that type office space.

Shared Storage Room One room within the SCY temporary work building has no windows and is a shared storage room. Shelving and some locking cabinets will be provided in this room, however core and associate members using this room must be aware that space is very limited, and is shared. This room is NOT designed to be a long term or large volume storage of vehicle parts or large quantities of tools. This room will also need to be used for storage of drinking water bottles.

Shared Electronics/Computer Lab. One room within the SCY temporary work building will be set up as an electronics and computer laboratory. It will have several electronics type benches for test equipment, and one soldering bench with a vent hood. One or more of the benches may be used to set up computer workstations for software development. This room may also be used as general office room if space is not needed for computer workstations, but may not be used for tool or parts storage.

Command Center. Caltrans will dedicate one room in the South Control Yard for use as the Command and Control Center starting late in the time of dry runs, through dress rehearsals, and for the demonstration. This area will be dedicated to this use when the need begins, but prior to that time will be a shared office space for any and all members testing on the lanes and using the South Control Yard Facility.

4-9. Base Radio

This radio will be provided by Caltrans and located in the SCY temporary work building. This radio will used in the command center. This radio will be used for the "Demo" and "Soledad" frequencies. Additionally, there will be eight (8) hand held radios on these frequencies for shared use during the testing and development time. These radios have designated users during the dress rehearsals and demo.

4-10. Conference Room Trailer.

This will likely be a double wide x 40 ft trailer with conference room table, white boards, and bulletin boards. It is intended to be used for daily safety briefings and after test debriefings. During dress rehearsal and the demonstration, it will likely be used as a driver lounge and/or VIP reception area. It may also serve as short term (a few hours at time) work space, but will not contain office space.

4-11. Guard Station

Caltrans is providing a guard station near the south entry gate. This facility will have telephone with intercom service, and will be the primary duty station for the security guard. This is the location where all workers and visitors will sign in and out.

4-12. Smoking

a. The State of California does not allow smoking inside, or within 15 feet of the doors of state buildings, or in state owned vehicles. At the SCY, this includes the temporary work building, the restroom trailer, the conference room trailer, and the guard station. Ash trays will be provided outside the temporary work building for your convenience.

b. Smoking is also not permitted within 25 feet of any refueling operation, or any other location where flammable liquids are in use. A little common sense needs to prevail here, as it is not possible to list all flammable items, and all conditions where this should apply.

4-13. Alcohol

Consumption of alcoholic beverages on State of California property is not allowed. Additionally, the NAHSC has imposed a rule that workers may not consume alcohol within 8 hours of participating in consortium activities. (Party after work!)

4-14. Telephones

Caltrans will provide incoming and local outgoing telephone service, and will arrange for the agreed number of special service lines requested by core members. Caltrans will provide one FAX line for general use. Caltrans will provide the necessary POTS and T1 lines to operate the command center. Long distance outgoing calls will be made using individual credit cards.

4-15. Associate Phones Caltrans will arrange for installation of the previously agreed number of phone, FAX, and modem lines for associates. Associates will be required to fund installation, service and monthly charges for their lines.

4-16. Fax Machine Caltrans will provide one FAX machine for general use at the SCY.

4-17. Electrical Service Caltrans is providing all needed electrical service for the temporary work building. Additionally, Caltrans will provide electrical service for associate yard locations as previously agreed during dry runs, dress rehearsal, and during the demo.

4-18. Check In Station Caltrans is providing the infrastructure portions of the check in facility at both the north and south yards as previously agreed. This includes a land line connection from installation through the demo.

4-19. Furniture Caltrans will provide a reasonable number of desks, chairs, workbenches, shelving units, storage lockers and tables for use in the SCY temporary work building and the conference trailer. This will include some white boards and bulletin boards.

5 Live Vehicle Demonstration Contingencies

Protocol

A response to an incident occurring within the limits of the live demonstration facilities will typically be initiated by a scenario vehicle operator. A scenario vehicle operator could either be the vehicle driver or the communications/narrator for the particular vehicle. The scenario vehicle operator will contact the Command Center via on-board radio communications and relay the information relating to the incident. (The Command Center is located at the South Control Yard). If necessary, the command center will notify all vehicles to halt demonstration activities and pull over to the right hand shoulder of the roadway. In some instances, the Command Center may direct certain demonstration vehicles to complete travel to the respective north or south exit areas from the I-15 Express Lane Facility. The on-site California Highway Patrol (CHP) will be dispatched to the response location. The CHP will lead the appropriate response vehicles to the site. Staffed response vehicles to be located at the South Control Yard include a fire truck, ambulance, and AAA towing service.

Should an incident on the demonstration facility occur, the scenario vehicle operator shall assess the situation. The nature of the incident shall be reported to the Command Center whether the incident involves a roadside hazard, a separate vehicle, or exclusively the occupants of the driver's vehicle. The Command Center shall determine the appropriate course of action. The Command Center shall notify the TMC of all incident reports. If the Command Center determines that assistance is required, the Command Center shall notify the on-site CHP to make the necessary deployments e.g. fire truck, ambulance, tow service.

Emergency

If a vehicle occupant requires immediate medical attention, the driver shall radio the Command Center immediately. The driver shall identify him/herself, state the approximate location, state the nature of the problem, and await instruction from the command center. The Command Center shall initiate the necessary deployments with the on-site CHP. In an extreme case where radio or cellular phone contact is not possible, A 911 operator should be contacted by using the nearest roadside call box. The 911 operator should also be requested to contact the Traffic Management Center (TMC) for emergency vehicle access to the I-15 HOV area.

For Medical Attention:

INDUSTRIAL MEDICAL CENTER
8798 COMPLEX DRIVE
SAN DIEGO, CA 92123

Monday - Friday 7 a.m. to 7 p.m.
(619) 565-1300
(SEE ATTACHED MAP)

Mechanical/Technical

If the incident only involves a vehicle failure, demonstration activities may temporarily be halted as per the Command Center to allow tow service to be dispatched from the South Control Yard. Once the incident is cleared, demonstration activities may resume as per the Command Center.

Voice Communications

Voice Communications requesting a response to an incident will take place between the vehicle operator and the Command Center via radio communications. Alternate voice communications include the use of cellular phones. If neither radio or cellular telephone communications are functioning, call boxes located periodically on either shoulder of the 7.6 mile facility are available to contact roadside assistance or a 911 operator. In either case, the telephone operator should also be requested to contact the Traffic Management Center (TMC) for emergency vehicle access to the I-15 HOV area.

5-1 Instructions for Demo'97 Drivers

In reporting any incident or collision, give an accurate report of the location, its lane or shoulder, left or right in the direction of the scenario (or east or west side), and a local landmark or cross street name. This will aid in response by whomever is dispatched to render assistance. USE PLAIN ENGLISH. SPEAK AS SLOWLY AND CALMLY AS POSSIBLE.

For a Vehicle Collision (Impact)

Stop Vehicle
Contact Control Center - "Notify of Collision"

Injury

Check for serious injuries (requires EMS response to site)
If "Yes" report "EMS needed"
If "No or Minor" report "EMS Not Needed"

No or Minor Injury

If no or minor injury then:

Instruct passengers to remain in vehicle.
Driver don vest and helmet
Visually inspect vehicle

Damage

Can the vehicle can move safely under it's own power?

Minor Damage (Vehicle can move safely)

Report "No Tow Needed"
Proceed as instructed

Major Damage (Vehicle cannot move safely)

Report "Tow Truck Needed"
STAY IN VEHICLE and wait for instructions.

Smoke

Report "Smoke"
Dispense safety equipment (vests and/or hats) prior to evacuation (if appropriate)
Evacuate Vehicle and direct passengers to stand on shoulder
Attempt to extinguish fire with on-board extinguishers (if appropriate)
If successful
- Notify Control
- Wait for Instructions

If not successful
- Report "Fire" (if able)
- Maintain safe distance from vehicle on shoulder
- Wait for instructions

For an Incident (non-collision)

Report Condition
Proceed with caution at the discretion of the driver
Receive response from Control Center
Acknowledge response

5-2 Instructions for Demo'97 Controller

For a Vehicle Collision (Impact)

Receive "Collision" report
Acknowledge "Collision"
and
Issue "Stop" to Demo personnel
Wait for Update from Vehicle

Serious Injury
Receive Request for EMS
Acknowledge Request for EMS
Dispatch TMC
Inform our local CHP
Kill Video
Contact Terry (Cell Phone/Pager 913-2948)
Contact Celeste
Update all scenarios of "Stop" as needed
Signal indefinite hold.

If "Stop" exceeds 30 minutes
Initiate lane evacuation. (at the discretion of the control center)
If "Stop" is less than 30 minutes.
Update all scenarios of "Stop"

No or Minor Injury
If no then:
Receive "EMS Not Needed"
Acknowledge "EMS Not Needed"

Damage
Wait for damage assessment

Minor Damage (Vehicle can move safely)
Receive "No Tow Needed"
Acknowledge "No Tow Needed"
Instruct all vehicle(s) on lanes (including other scenarios) to proceed at a safe speed not to exceed (35mph) under manual control.
Continue holding vehicles in staging areas
Once lanes are clear, dispatch surveillance sweep vehicle(s)
Wait for clear from Corridor Safety Officer
Resume runs (at the discretion of control center)

Major Damage (Vehicle cannot move safely)
Receive "Tow Truck Needed"
Acknowledge "Tow Truck Needed"
Instruct all passengers to STAY IN VEHICLE and wait for tow and/or transport vehicles
Dispatch tow
Dispatch transport vehicle(s)
Update all scenarios of "Stop"

If "Stop" exceeds 30 minutes
Initiate lane evacuation.

If "Stop" is less than 30 minutes.
Wait for tow and transport vehicles to clear lanes
Once lanes are clear, dispatch surveillance sweep vehicle(s)
Wait for surveillance sweep vehicles to clear lanes
Wait for clear from Corridor Safety Officer
Resume runs (at the discretion of control center)

Smoke

Receive "Smoke"
Acknowledge "Smoke"
Notify other vehicles in the collision scenario of "Smoke"
Receive confirmation of evacuation (from collision or other scenario vehicles)
Acknowledge evacuation results
Direct vehicle passengers to stand on shoulder until all scenarios on lanes report coming to a stop
Receive confirmation of extinguishing efforts (from collision or other scenario vehicles)
If successful, wait for damage assessment
Acknowledge damage assessment
Confirm damage and go to Major/Minor damage as appropriate

If not successful go to "Fire" condition

Fire

Receive "Fire" condition
Notify other vehicles in the collision scenario of Fire condition (if appropriate)
Notify TMC
Confirm evacuation from other vehicles in the scenario
Update all scenarios of "Stop"
If "Stop" exceeds 30 minutes
Initiate lane evacuation. (at the discretion of the control center)

If "Stop" is less than 30 minutes.
Wait for tow and transport vehicles to clear lanes
Once lanes are clear, dispatch surveillance sweep vehicle(s)
Wait for surveillance sweep vehicles to clear lanes
Wait for clear from Corridor Safety Officer
Resume runs (at the discretion of control center)

For an Incident (non-collision)

Receive report of incident
Acknowledge receipt of report
If the following:
- Debris in lane (at discretion of control center)
- Disabled vehicle on mainline shoulder
- Vehicle fluid in lane
- Accident in mainline lanes

Notify all scenarios of a *Caution* condition.
- Continue scenarios under automated control with heightened awareness.
- All scenarios, with the exception of the Green scenario may be released to the lanes. Green scenario will be released under manual control.

Notify reporting vehicles of appropriate response
Dispatch appropriate response vehicle, as necessary (CHP, sweeper)
Update all scenarios on status of Caution
Wait for response vehicles to clear lanes
Wait for clear from Corridor Safety Officer and/or CHP
Resume runs (at the discretion of control center)

If the following:
- Debris in lane (at discretion of control center)
- Pedestrian in lane
- Inclement weather

Notify all scenarios of a *non-automated* condition.
- All scenarios on lanes revert to non-automated control and continue at a speed not to exceed 35 mph.
- Hold all other scenarios in staging areas

Notify reporting vehicles of appropriate response
Dispatch appropriate response vehicle (CHP, sweeper)

If the following:
- Debris in lane (at discretion of control center)
- Disabled or intruding vehicle in lanes

Notify all scenarios of a *stop* condition.
- All scenarios on lanes immediately stop on lanes.
- Hold all scenarios in staging areas

Notify reporting vehicles of appropriate response
Dispatch appropriate response vehicle (CHP, sweeper, tow)

5-4 Vehicle Failure (Colgin)

On a short day (Aug 7 & 8) we have 6 runs
- T1 is a trial run, with no passengers, Northbound from the SCY
- T2 is a trial run, with no passengers, Southbound from the NSA
- R1 is a passenger run, Northbound from the SCY
- R2 is a passenger run, Southbound from the NSA
- R3 is a passenger run, Northbound from the SCY
- R4 is a passenger run, Southbound from the NSA

On a long day (Aug 9 & 10) we have 8 runs
- T1 is a trial run, with no passengers, Northbound from the SCY
- T2 is a trial run, with no passengers, Southbound from the NSA
- R1 is a passenger run, Northbound from the SCY
- R2 is a passenger run, Southbound from the NSA
- R3 is a passenger run, Northbound from the SCY
- R4 is a passenger run, Southbound from the NSA
- Break, for 1hr 15 min nominally
- R5 is a passenger run, Northbound from the SCY
- R6 is a passenger run, Southbound from the NSA

Vehicles can fail
- in the SCY
- Northbound on the lanes
- in the NSA
- Southbound on the lanes

Scenarios that have spare vehicles are
- Platoon (P)
- Alternative Technology (A)
- Spare vehicles trail along with their scenario (as an autonomous vehicle) on T1, and are parked in the NSA

Scenarios that can reconfigure are
- Platoon (run platoon with less vehicles)
- Multi-Platform Free Agent (F) (run without a bus or a sedan)
- Multi-Platform Free Agent (run with a non automated car replacing the mini-van)
- Maintenance (M) (run without the ORV)

Scenarios with no spare vehicles are
- Evolutionary (E) (could run with one less automated vehicle?)
- Control Transition (C) (could run with one less automated vehicle?)
- Truck (T)

Spare passenger seats (for diverting passengers in case of a vehicle failure)
- 1 in each of the Platoon vehicles (total of 8)
- 1 in each of the Multi-Platform Free Agent sedans (total of 2)
- 4 in each of the Multi-Platform Free Agent buses (total of 8)
- 1 in the IDV (total of 1)

SHORT DAY

If failure is at SCY, on short day

Condition S1
If failure is in Scenario E, C, M_{IDV} or T, prior to run T1, R1 or R3
Then delete Scenario - Scenario is out for the day
- Notify Control
- Move failed vehicle to repair area
- Repair Vehicle
- Test Scenario 7:00-9:00 PM on lanes
- IF failure corrected, then run Scenario during T1 next day
- Else, continue to repair, and test scenario 7:00-9:00 PM on lanes next evening

If failure is at SCY, on short day

Condition S2
If failure is in Scenario P, or A, prior to run T1
Then replace failed vehicle with spare vehicle
- Notify control
- Move failed vehicle to repair area
- Repair vehicle
- Test Scenario 7:00-9:00 PM on lanes
- IF failure corrected, then Scenario still has a spare vehicle
- Else, treat as Scenario without spare on next day

If failure is at SCY, on short day

Condition S3
If failure is in Scenario F or M_{ORV}, prior to run T1, R1 or R3
Then remove failed vehicle from Scenario
- Notify control
- Reconfigure Scenario
- Move failed vehicle to repair area
- Repair vehicle
- Test Scenario 7:00-9:00 PM on lanes
- IF failure corrected, then Scenario still has a spare vehicle
- Else, treat as Scenario without spare on next day

If failure is at SCY, on short day

Condition S4
If failure is in Scenario P, prior to run R1 or R3
Then remove failed vehicle
- Notify control
- Make run R1 or R3 with one less vehicle
- At NSA, replace failed vehicle with spare
- Move failed vehicle to repair area
- Repair vehicle
- Test Scenario 7:00-9:00 PM on lanes
- IF failure corrected, then Scenario still has a spare vehicle
- Else, treat as Scenario without spare (reconfigured Scenario) on next day

If failure is at SCY, on short day

Condition S5
If failure is in Scenario A, prior to run R1 or R3
Then remove failed vehicle
- Notify control
- Make run R1 or R3 with one less automated vehicle, and no passengers
- At NSA, replace failed vehicle with spare
- Move failed vehicle to repair area
- Repair vehicle
- Test Scenario 7:00-9:00 PM on lanes
- IF failure corrected, then Scenario still has a spare vehicle
- Else, treat as Scenario without spare (reconfigured Scenario) on next day

If failure is at NSA, on short day

Condition N1
If failure is in Scenario E, C, M_{IDV} or T, prior to run T2, R2 or R4
Then delete Scenario - Scenario is out for the day
- Notify Control
- Move failed vehicle to repair area, off the lanes
- Repair Vehicle
- Test Scenario 7:00-9:00 PM on lanes
- IF failure corrected, then run Scenario during T1 next day
- Else, continue to repair, and test scenario 7:00-9:00 PM on lanes next evening

If failure is at NSA, on short day

Condition N2
If failure is in Scenario P, or A, prior to run T2, R2, or R4
Then replace failed vehicle with spare vehicle
- Notify control
- Move failed vehicle to repair area, off the lanes
- Repair vehicle
- Test Scenario 7:00-9:00 PM on lanes
- IF failure corrected, then Scenario still has a spare vehicle
- Else, treat as Scenario without spare on next day

If failure is at NSA, on short day

Condition N3
If failure is in Scenario F or M_{ORV}, prior to run T2, R2 or R4
Then remove failed vehicle from Scenario
- Notify control
- Reconfigure Scenario
- Move failed vehicle to repair area, off the lanes
- Repair vehicle
- Test Scenario 7:00-9:00 PM on lanes
- IF failure corrected, then Scenario still has a spare vehicle
- Else, treat as Scenario without spare on next day

If failure is Northbound, on short day

Condition NB1
Complete Scenario in manual or restart automated operation.
Report problem to NSA Stager
If driver, Scenario Lead or Control declares vehicle failure has occurred, then
- If failure is in Scenario E, C, M_{IDV} or T, go to Condition N1
- If failure is in Scenario P, or A, go to Condition N2
- If failure is in Scenario F or M_{ORV}, go to Condition N3

If failure is Southbound, on short day

Condition SB1
Complete Scenario in manual or restart automated operation.
Report problem to SCY Stager
If failure is in Scenario E, C, M_{IDV} or T, go to Condition S1
If failure is in Scenario F or M_{ORV}, go to Condition S3
If failure is in Scenario P, go to Condition S4
If failure is in Scenario A, go to Condition S5

LONG DAY

If failure is at SCY, on long day

Condition S6
If failure is in Scenario E, C, M_{IDV} or T, prior to run T1, R1 or R3
- Then, notify Control
- Move failed vehicle to repair area
- Repair vehicle
- Test Scenario during break if possible on lanes
  - If failure corrected, then notify control
  - Run Scenario during R5
  - Else, Scenario is out for the day
  - Go to Condition S1
- If failure is after to run R4, then go to Condition S1

If failure is at SCY, on long day

Condition S7
If failure is in Scenario P, or A, prior to run T1
Then go to Condition S2

If failure is at SCY, on long day

Condition S8
If failure is in Scenario F or M_{ORV}, prior to run T1, R1 or R3
Then, notify Control
- Move failed vehicle to repair area
- Repair vehicle
- Test Scenario during break if possible on lanes
  - If failure corrected, then notify control
  - Run full Scenario during R5
  - Else, full Scenario is out for the day
  - Go to Condition S3
- If failure is after to run R4, then go to Condition S3

If failure is at SCY, on long day

Condition S9
If failure is in Scenario P, prior to run R1, R3, R5
Then go to Condition S4

If failure is at SCY, on long day

Condition S10
If failure is in Scenario A, prior to run R1, R3, or R5
Then go to condition S5

If failure is at NSA, on long day

Condition N4
If failure is in Scenario E, C, M_{IDV} or T, prior to run T2, R2 or R4
Then, notify Control
- Move failed vehicle to repair area, off the lanes
- Repair vehicle
- Test Scenario during break if possible on lanes
  - If failure corrected, then notify Control
  - Run Scenario during R5
  - Else, Scenario is out for the day
  - Go to Condition N1
- If failure is after to run R4, then go to Condition N1

If failure is at NSA, on long day

Condition N5
If failure is in Scenario P, or A, prior to run T2, R2, R4 or R6
Then go to Condition N2

If failure is at NSA, on long day

Condition N3
If failure is in Scenario F or M_{ORV}, prior to run T2, R2, R4 or N6
Then go to Condition N3

If failure is Northbound, on long day

Condition NB2
Complete Scenario in manual or restart automated operation.
Report problem to NSA Stager
If driver, Scenario Lead or Control declares vehicle failure has occurred, then
- If failure is in Scenario E, C, M_{IDV} or T, go to Condition N4
- If failure is in Scenario P, or A, go to Condition N5
- If failure is in Scenario F or M_{ORV}, go to Condition N6

If failure is Southbound, on long day

Condition SB1
Complete Scenario in manual or restart automated operation.
Report problem to SCY Stager
If failure is in Scenario E, C, M_{IDV} or T, go to Condition S6
If failure is in Scenario F or M_{ORV}, go to Condition S8
If failure is in Scenario P, go to Condition S9
If failure is in Scenario A, go to Condition S10

Failure occurs at SCY on Short Day

	Condition Code (Prior to Run)		
Scenario	(T1)	(R1)	(R3)
E	S1	S1	S1
C	S1	S1	S1
T	S1	S1	S1
M_{IDV}	S1	S1	S1
P	S2	S4	S4
A	S2	S5	S5
M_{ORV}	S3	S3	S3
F	S3	S3	S3

Failure occurs at NSA on Short Day

	Condition (Prior to Run)		
Scenario	(T2)	(R2)	(R4)
E	N1	N1	N1
C	N1	N1	N1
T	N1	N1	N1
M_{IDV}	N1	N1	N1
P	N2	N2	N2
A	N2	N2	N2
M_{ORV}	N3	N3	N3
F	N3	N3	N3

Failure occurs at Northbound on Short Day

	Condition (Prior to Run)		
Scenario	(T2)	(R2)	(R4)
E	N1	N1	N1
C	N1	N1	N1
T	N1	N1	N1
M_{IDV}	N1	N1	N1
P	N2	N2	N2
A	N2	N2	N2
M_{ORV}	N3	N3	N3
F	N3	N3	N3

Failure occurs at Southbound on Short Day

	Condition Code (Prior to Run)		
Scenario		(R1)	(R3)
E		S1	S1
C		S1	S1
T		S1	S1
M_{IDV}		S1	S1
P		S4	S4
A		S5	S5
M_{ORV}		S3	S3
F		S3	S3

Failure occurs at SCY on Long Day

	Condition (Prior to Run			
Scenario	(T1)	(R1)	(R3)	(R5)
E	S6	S6	S6	S1
C	S6	S6	S6	S1
T	S6	S6	S6	S1
M_{IDV}	S6	S6	S6	S1
P	S2	S4	S4	S4
A	S2	S5	S5	S5
M_{ORV}	S8	S8	S8	S3
F	S8	S8	S8	S3

Failure occurs at NSA on Long Day

	Condition (Prior to Run)			
Scenario	(T2)	(R2)	(R4)	(R6)
E	N4	N4	N4	N1
C	N4	N4	N4	N1
T	N4	N4	N4	N1
M_{IDV}	N4	N4	N4	N1
P	N2	N2	N2	N2
A	N2	N2	N2	N2
M_{ORV}	N3	N3	N3	N3
F	N3	N3	N3	N3

Failure occurs at Northbound on Long Day

	Condition (Prior to Run)			
Scenario	(T2)	(R2)	(R4)	(R6)
E	N4	N4	N4	N4
C	N4	N4	N4	N4
T	N4	N4	N4	N4
M_{IDV}	N4	N4	N4	N4
P	N5	N5	N5	N5
A	N5	N5	N5	N5
M_{ORV}	N6	N6	N6	N6
F	N6	N6	N6	N6

Failure occurs at Southbound on Long Day

	Condition Code (Prior to Run)			
Scenario		(R1)	(R3)	(R5)
E		S6	S6	S6
C		S6	S6	S6
T		S6	S6	S6
M_{IDV}		S6	S6	S6
P		S9	S9	S9
A		S10	S10	S10
M_{ORV}		S8	S8	S8
F		S8	S8	S8

5-5 An Obstacle Placer Vehicle Fails (Smilgis)

In Lane

_____ Notify NSA
_____ Notify SCY
_____ Dispatch Tow Truck
_____ Notify Passenger Manager
_____ Use Passenger Vehicle for Subsequent Obstacles
_____ Delay Sequence (5-9)

Off Lane

_____ Use back-up Obstacle Vehicle for Obstacle Placement

5-6 A Shuttle Bus Fails (Langley)

_____ Dispatch Alternate Shuttle Bus to Pick Up Passengers
_____ Notify N/S Coordinator that scenario will have no Passengers
_____ Contact Towing Service
_____ Passengers to Ride in Subsequent Scenario or Alternate Scenario (Sequence not Delayed)

5-7 A Shuttle Bus is Late at Drop-Off (Langley)

- _____ Dispatch Alternate Shuttle Bus to Pick Up Passengers
- _____ Notify N/S Coordinator that scenario will have no Passengers
- _____ Determine Cause of Lateness
- _____ Passengers to Ride in Subsequent Scenario or Alternate Scenario (Sequence not Delayed)

5-8 A Shuttle Bus is Late at Pick-Up (Langley)

- _____ Notify Hostess
- _____ Keep Passengers out of Way
- _____ Mentors to Answer Questions
- _____ Determine Cause of Lateness

5-9 Sequence Delayed (Langley)

5-9.1 Initiate Hold (Langley)

- _____ Stop the Relative Clock
- _____ Start the Hold Clock
- _____ Notify NSA Coordinator of Hold
- _____ Notify SCY Coordinator of Hold
- _____ Notify DPC of Hold
- _____ Notify Passenger Manager of Hold
- _____ Notify Scenario Leads of Hold
- _____ Determine Length of Delay
- _____ Notify DPC of Projected Continuation Time
- _____ Notify Passenger Manager of Projected Continuation Time
- _____ Notify Scenario Leads of Projected Continuation Time
- _____ Notify NSA Coordinator of Projected Continuation Time
- _____ Notify SCY Coordinator of Projected Continuation Time
- _____ Notify Mentor Coordinator

5-9.2 Restart (Langley)

- _____ Notify NSA Coordinator to Start
- _____ Notify SCY Coordinator to Start
- _____ Notify DPC to Start
- _____ Notify Passenger Manager to Start
- _____ Notify Scenario Leads to Start
- _____ Start the Relative Clock
- _____ Stop the Hold Clock

6 Infrastructure Contingencies

6-1 Delayed Opening of Lanes (Woolley)

_____ Start the Hold Clock at T=0
_____ Notify NSA Coordinator of Hold
_____ Notify SCY Coordinator of Hold
_____ Notify DPC of Hold
_____ Notify Passenger Manager of Hold
_____ Notify Scenario Leads of Hold
_____ Determine Length of Delay
_____ Notify DPC of Projected Continuation Time
_____ Notify Passenger Manager of Projected Continuation Time
_____ Notify Scenario Leads of Projected Continuation Time
_____ Notify NSA Coordinator of Projected Continuation Time
_____ Notify SCY Coordinator of Projected Continuation Time
_____ Notify Task Lead

6-2 Early Closing of the Lanes (Woolley)

_____ Notify NSA Coordinator of Hold
_____ Notify SCY Coordinator of Hold
_____ Notify DPC of Hold
_____ Notify Passenger Manager of Hold
_____ Notify Scenario Leads of Hold
_____ Notify Celeste (pager 893-3401)
_____ Notify Task Lead

6-3 Accident on Adjacent Lanes During the Demonstration (Langley)

_____ Notify CHP of incident and wait for their report.
_____ Notify scenarios of location of incident.

7 Passenger Contingencies

7-1 Escorted VIP (EVIP) with Secret Service (Langley)

- _____ Make determination as to which scenario the EVIP should ride in.
- _____ Do what we are told
- _____ Notify DPC

7-2 EVIP Delayed (Langley)

- _____ Continue with scenarios
- _____ When EVIP shows up, plug him/her in.
- _____ Delay sequence up to 20 minutes
- _____ Notify DPC

7-3 EVIP Announced 1 Hour in Advance (Langley)

- _____ Make determination as to which scenario the EVIP should ride in.
- _____ Plan for delay in sequence
- _____ Notify DPC

7-4 Passenger has Medical Emergency (Langley)

- _____ Return Vehicles to Manual Control
- _____ Dispatch Medical Vehicle to S/N end
- _____ Notify Celeste (pager 893-3401)
- _____ Notify Task Lead
- _____ Notify Passenger Manager

8 Other Contingencies

8-1 Available Emergency Vehicles Called to Another Emergency (Woolley)

We should avoid this if possible

_____ Have Numbers for Alternative Vehicles Available

8-2 Staff Medical Emergency On-Site (Woolley)

_____ Notify Control Center
_____ Notify Alternate and Activate Alternate
_____ Notify Task Lead

8-3 Visitor Medical Emergency On-Site (Woolley)

_____ Dispatch Medical Vehicle to S/N end
_____ Notify Celeste (pager 893-3401)
_____ Notify Task Lead

8-5 Fire at SCY (Woolley)

_____ Shut Down Video
_____ Dispatch, Fire, Medical Vehicles
_____ Notify Celeste (pager 893-3401)
_____ Notify Passenger Manager
_____ Notify DPC

8-6 Fire at North Staging Area (Woolley)

_____ Shut Down Video
_____ Dispatch, Fire, Medical Vehicles
_____ Notify Celeste (pager 893-3401)
_____ Notify Passenger Manager
_____ Notify DPC

8-7 Disabled Vehicle at South Control Yard (Woolley)

_____ Dispatch Tow Truck
_____ Determine Viability of Continuing Scenario
_____ Notify Passenger Manager
_____ Notify DPC
_____ Notify Task Lead

8-8 Disabled Vehicle at North Staging Area (Woolley)

_____ Dispatch Tow Truck
_____ Determine Viability of Continuing Scenario
_____ Notify Passenger Manager
_____ Notify DPC
_____ Notify Task Lead

9 Communications

The communications contingency plan is contained in Appendix C.

10 Security

10-1 Daytime Intruders in SCY (Woolley)

_____ Notify Security

10-3 Daytime Intruders in NSA (Woolley)

_____ Notify Security

10-5 Protesters (Woolley)

_____ Notify Security

10-6 Intruders on Lanes (Woolley)

_____ Initiate a Hold 5-9

11 Miscellaneous

11-1 A Passenger Vehicle Has to be Towed

_____ Initiate a Hold 5-9

_____ Dispatch Tow Vehicle

11-2 A Bus Has to be Towed (Woolley)

_____ Initiate a Hold 5-9

_____ Dispatch Tow Vehicle

11-3 A Truck Has to be Towed (Woolley)

_____ Initiate a Hold 5-9

_____ Dispatch Tow Vehicle

11-4 Weather Affecting Cars (Langley)

Initiate Hold (5-9)

11-5 Weather Affecting Staging Areas or Lanes (Langley)

Initiate Hold (5-9)

11-6 Weather Affecting Surrounding Area or Infrastructure (Langley)

Initiate Hold (5-9)

APPENDIX A General Roles and Responsibilities

1.0 PARTITIONING OF WORK

Approximately 150 NAHSC Core and Associate members and 200 contractors are expected to participate in the Demo. To ensure coordination of the Demo, specific tasks must be defined, allocated to individuals, and executed in a well orchestrated fashion.

1.1 Demo Roles and Responsibilities

The following is a list of top level tasks that need to be performed during the execution of the 1997 Demonstration. The tasks are identified in Figure 1.

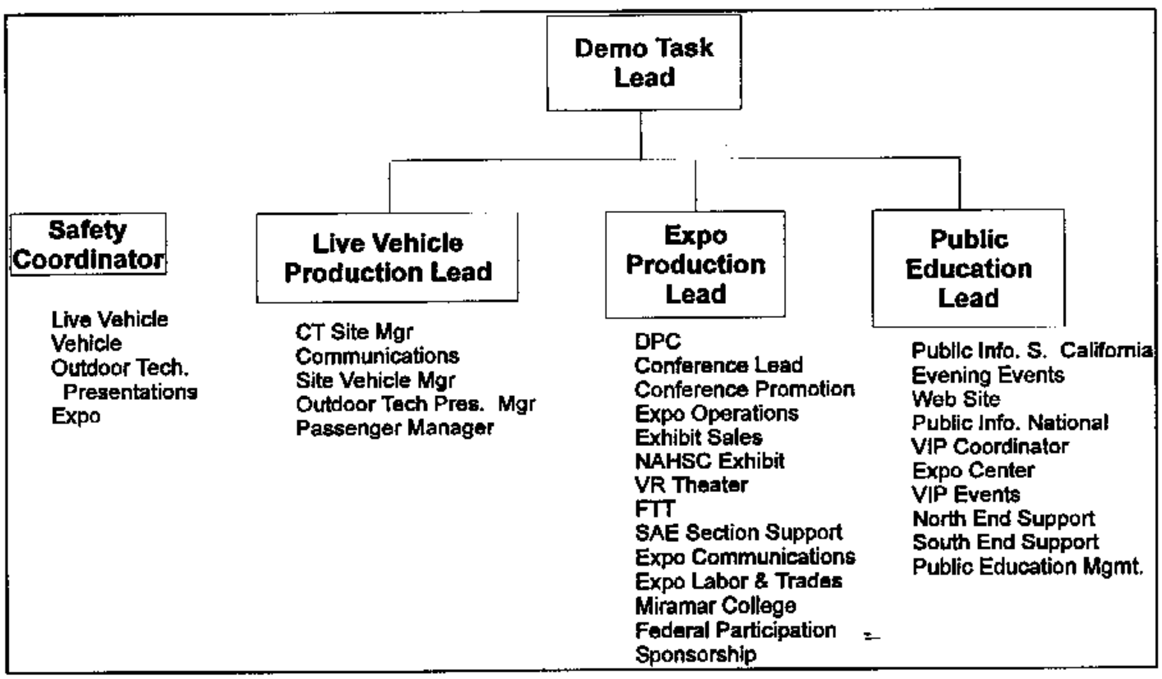

Figure 1 Demonstration Organization

1.1.1 Demonstration Task Lead - Terry Quinlan

Responsible for the successful execution of the overall Demo. Assures proper use of resources and is the primary interface to the PMC, Program Managers Oversight Committee (PMOC) and Program Steering Board (PSB). Will hold daily status meetings with the various sub-task leads in the weeks prior to and during the event. Meetings will be attended by sub-task leads or their deputies. Reports to PMC and Program Manager.

1.1.2 I-15 Live Vehicle Production Lead - Bob Smilgis

This person has overall responsibility for all live vehicle activities at the South Control Yard, the North Staging Area, and on the Express lanes, except for final approval or disapproval of the Safety Officer. Areas of responsibility include overall coordination of all live vehicle activities. Oversight of the execution of the scenario minute by minute schedule, coordination with the Exposition Center, all staging activities, and all of the Public Education activities. Leads traffic mitigation activities. Reports directly to the Demonstration Task Lead.

1.1.2.1 Caltrans Site Manager - Randy Woolley

This person ensures that the Demonstration facility is available, ready, and safe to begin executing scenarios. Interfaces with local law enforcement, Caltrans, and other agencies as required. Coordinates with the Caltrans TMC for opening and closing of the lanes for testing or demonstration, and is responsible for all activities at the South Control Yard, North Staging Area, and the Express lanes that are not vehicle specific. Responsibilities at the facility includes: Communications, Caltrans TMC Coordination, Opening/Closing the lanes, Site Services, Site Logistics, Site Visitors, Site Security, and Vehicle Storage. All personnel responsible for these individual areas report to the Site Manager. The Site Manager reports to the Live Vehicle Production Lead for all activities except safety. For safety, the Site Manager reports to the Corridor Safety Officer.

1.1.2.2 Communications Lead - Aimee Cochran(Data)/Bob Battersby(Voice)

Ensure the operability of demonstration communications links including; voice and data. Works with the Site Manager to resolve interference issues with Miramar Naval Air Station. Reports to the Caltrans Site Manager.

1.1.2.3 Vehicle Manager - Ron Colgin

Responsible for maintaining, publishing, and enforcing the test schedule in the weeks before the demonstration. Coordinates all vehicle testing, all dry runs, and all dress rehearsal vehicle activities. Responsible for participating in the Vehicle Certification process prior to dry runs and dress rehearsals, and verifying daily certification of vehicle safety and operational readiness. Has the authority to remove from testing, or from the demonstration, any vehicle which does not meet the stated operational or safety requirements. All decisions of vehicle safety shall be the responsibility of the Vehicle Manager in conjunction with the Vehicle Production Safety Officer. All other decisions regarding vehicle readiness, reliability, or suitability for the demonstration shall be the responsibility of the Vehicle Manager. Reports to the Vehicle Production Lead.

1.1.2.4 Passenger Manager - Jim Lewis

In conjunction with the passenger coordinator responsible for planning, layout, and overall operations at the passenger staging area. Assists in the shuttle loading process as required (call passengers to loading area, helps facilitate standby and walk-on plans, etc.)

Assists in conflict resolution for passengers who fail to get rides. Keeps passengers informed of schedule status. Maintains verbal communications with shuttle dispatcher, passenger coordinator, and check-in personnel

1.1.2.5 Outdoor Technology Presentations Lead - Marty Turner

Coordinates all on-site vehicle testing. Responsible for all Mini-Demo vehicle logistics. Implements final vehicle test and certification. Coordinates all parking lot dry runs. Reports to the Vehicle Production Lead.

1.1.3 Expo Production Lead - Victoria Dewey

Supervises and works with the production contractor(s) in all aspects of event marketing and Expo production. Responsible for coordinating the activities and events in and adjacent to the exhibition hall. Responsible for the logistics of all exhibitors. Overall responsibility for the following activities: Exposition Center, Demo Presentation Center, Technical Conference, Expo Marketing, Trade Show (including registrations), Expo Security, Expo Craft Services, Side Demos, Airport and Hotel Shuttle. Reports to the Demonstration Task Lead.

1.1.3.1 Demonstration Presentation Center (DPC)/AHS Demonstration Transportation Management Center (TMC) Lead - Pat McKenzie

Responsible for all hardware, software, video, and external interfaces within the DPC. Responsible for the successful execution of DPC and TMC scenarios as scripted to support various aspects of the I-15 demonstration. To include: slide presentations, history of AHS, videos, scenario lead-ins, coordinated live vehicle demonstrations, and fillers. Supervises the narrators and answers questions before and after scenario execution. Coordinates the on-site domain experts from each scenario. Responsible for showcasing AHS traffic management capabilities. Works with the Site Manager to interface with the Caltrans TMC. Coordinates handouts for visitors. Reports to the Expo Production Lead.

1.1.3.2 Expo Marketing - J. Hoff (NTP)

Responsible for coordinating the event sponsorship as well as developing attendee and exhibitor lists. Responsible for coordinating registration and hospitality. Reports to the Expo Production Lead. Assistant - T. Christian (NTP)

1.1.3.3 NAHSC Exhibit - A. Lubliner

Responsible for the coordination and operation of the NAHSC exhibit during the Demonstration.

1.1.3.4 Evening Events - J. Breckenridge

Responsible for the coordination of activities available to attendees. Will include day and evening activities to attractions in and around San Diego. These activities will be paid for by the attendees. Reports to the Public Education Lead.

1.1.3.5 VIP Events - J. Breckenridge

Responsible for the coordination of activities for the VIPs. Will include an opening evening reception, other evening activities, and activities during the day on Saturday and Sunday.. These activities will be hosted by the NAHSC and attendance will be by invitation only. Reports to the Public Education Lead.

1.1.4 System Integration Lead - Pat McKenzie

The System Integration Lead is responsible for ensuring that all preparations are made for the successful execution of the Demonstration. Responsibilities include the development and maintenance of the safety and risk plans. Tracks Demonstration schedules and coordinates the documentation of the Demonstration. Responsible for the development of the Interface Control Document as well as the test plans and procedures. Verifies that adequate insurance is in place for all participants.

1.1.4.1 Pre-Demo Responsibilities - Patrick McKenzie

a. Integration leadership, schedule tracking, resource allocation, action items, coordinate with other Demo Leads.

b. Risk Management - Manish Kothari / Ed Vanover
Maintain the Risk Management document for the '97 Demo. Solicits updates and inputs on a regular basis. Ensures mitigation activities associated with "top ten" risks are being carried out. Coordinates with Integration Lead and other demo leads to support a vigorous risk management effort.

c) Associates Interface - Pat Langley / Tommy Viner/ Stan Slavin
Serve as the primary interface for Associate vehicle developers regarding the '97 Demo. Communicate and work resolutions of issues the Associates may surface.

d. Demo Systems Specification - Pat Langley / Tommy Viner
Create, with input from demo developers, the overall demo requirements document. Work to categorize requirements based on relative criticality (identify those which must pass the test process in order for on-lane participation). Ensure demo requirements are adequately covered by related test procedures. Include safety requirements as they are developed.

e. Interface Control Document - Dan Brady / Pat Langley
Develop and maintain a system level Interface Control Document. Ensure data format & content for all interfaces is agreed upon by related Demo subsystems. Ensure appropriate interface requirements are included in the Demo Systems Specification and in test procedures. This activity will include Vehicle-to-DPC message format and content (coordinate status codes).

f. Communications Operating Guidelines - Aimee Cochran / Bob Battersby
Develop and publish a coordinated communications operating guideline for the '97 Demo. Update as needed prior to Demo week. Coordinate implementation of the guidelines with the designated Demo Week Communications Lead.

g. Vehicle Test (Safety & Performance) - Ron Colgin / Pat Langley
Take requirements defined in the Demo System Specification and create / review necessary test procedures. Negotiate and finalize pre-certification test dates for all vehicle developers. Prepare and finalize on-lane (I-15) dry runs and dress rehearsals. Interface with and support Demo Safety organization (TBD via the Calspan contract: safety officer, safety review board, etc.). Direct and coordinate any test support provided by Associate NAHSC members (such as the Aberdeen Proving Grounds person).

h. Safety Contractor Liaison - Pat Langley
Monitor the execution of the "Draft Safety Plan & Safety Certification Procedure" contract. Interface with the Calspan personnel as necessary. Work to ensure that the products support the work of the Vehicle Test and Demo System Specification efforts. Communicate progress to Demo Leads and PMC.

i. Demo Presentation Center development - Tony Rubner / Jim Reynold /Sean Campbell

Build the major components of the Demo Presentation Center to include Live-video feed, pre-recorded video integration, AHS theme presentation, AHS concepts as they apply to traffic management. Coordinate with the Expo Production team and the Public Education team to validate messages and logistical needs. Create test procedures and scenario scripts which verify
DPC performance. Work with Vehicle Production team to highlight live vehicle scenarios.

1.1.4.2 Demo Week Responsibilities:

Responsible for the successful execution of the overall Demo. Assures proper use of resources and is the primary interface to the PMC, Program Managers Oversight Committee (PMOC) and Program Steering Board (PSB). Will hold daily status meetings with the various sub-task leads in the weeks prior to and during the event. Meetings will be attended by sub-task leads or their deputies.

Serve as Demo Task Lead assistant. Assist Demo Task Lead in the communication with key lead personnel allowing Terry to concentrate on VIP and Media responsibilities. Support the Demo Task Lead during morning pre-briefs and evening out-briefs (lessons learned). Provide real-time "trouble-shooting" support to help keep daily demo activities on track. As Demo Task lead assistant, make rounds to all event locations and be available via pager, cell phone, and radio. Communicate items of critical importance directly to the Demo Task Lead for disposition. - Pat McKenzie (Allow coverage of multiple sites at one time, would facilitate "troubleshooting" without losing overall perspective, would provide a backup for Demo Task Lead on VIP & Media activities without diminishing other demo execution efforts).

1.1.5 Public Education Lead - Celeste Speier (Roger Booth)

1.1.5.1 Media Lead - Celeste Speier

1.1.5.2 Materials Lead - Celeste Speier

1.1.5.3 Community Relations

1.1.5.4 Theme - Celeste Speier

1.1.6 Demonstration Safety

1.1.6.1 Expo Production Safety Officer - TBD

The Expo Production Safety Officer is responsible for the safe execution of the Demonstration at the Exposition center. This includes safety within the Expo center, the Conference center, parking, shuttle service between the Expo center and hotels, and safety during evening events. This individual has the authority to shut down any Exposition operations if safety problems become apparent. This individual reports directly to the Demonstration Safety Lead.

1.1.6.2 Corridor Safety Officer - Tarbell Martin (Caltrans D11)

The Corridor Safety Officer will have full responsibility for the Demonstration corridor including both the north and south staging areas, the shuttle service to and from the lanes, as well as the lanes themselves. This person must have final authority and responsibility for ensuring that the corridor is safe prior to starting the demonstration each day, and authority to stop the demonstration in the event of an unsafe condition. The Corridor Safety Officer must oversee/insure the safety of the staging areas, and operational lanes. The Corridor Safety Officer must have coordination/communication with the Caltrans Traffic operations, Caltrans Maintenance Operations, and the California Highway Patrol. For all aspects of corridor safety, the Operations Manager, the Caltrans Site Manager, and the Vehicle Manager should report to this person. This person will coordinate with the Demonstration Task Lead, and all other Demonstration Leads, but does not report directly to any demonstration or consortium management person. This will leave the Corridor Safety Officer with the required authority to stop the demonstration if an unsafe condition exists. The Corridor Safety Officer needs to be available by radio/cell phone/pager if any unsafe condition develops. This person needs to be available during the final dress rehearsals and during the four days of the Demonstration.

1.1.6.3 Mini-Demo Safety Officer - Tom Clarkin

The Mini-Demo Safety Officer is responsible for the safe execution of the Mini-Demos. This includes vehicle, driver, passenger, and spectator safety. This individual has the authority to shut down any individual or group of Mini-Demos if safety problems become apparent. This individual reports directly to the Demonstration Safety Lead.

1.1.6.4 Vehicle Safety Officer - Ron Colgin

If any portion of the safety plan is not being executed according to the approved plan, this person has the responsibility and authority to stop the demonstration until the problem is corrected. This person will be responsible for the execution of the morning vehicle checks and coordinate with vehicle developer leads. The Vehicle Safety Officer needs to be physically on site to validate that all vehicles are ready and declare the vehicles safe to start. The Vehicle Safety Officer needs to be available by radio/cell phone/pager if any unsafe condition develops. This person needs to be available during the final dress rehearsals and during the four days of the Demonstration.

2.0 Control Center Roles and Responsibilities

2.1 Live Vehicle Production Lead - Bob Smilgis

Will be roaming the Demo facilities to ensure that the Demo is smoothly executed. Will fill in for any control center personnel as needed. Will have a radio for communications.

2.2 Operations Manager - Pat Langley

Responsible for the successful execution of all procedures that effect more than a single area (Passengers, Infrastructure, Vehicles). Solicits inputs from the CT Site Manager, Site Vehicle Manager, Site Safety Officer, and Passenger Manager. Gives the final go-ahead to begin the Demo. Must receive a green light from the CT Site Manager, Vehicle Manager, and Site Safety Officer prior to giving the go-ahead. Position will be in the Control Center. Responsible for tracking the procedures as they are executed. Documents procedure progress on a hard copy. Monitors the radio and validates that every component of the procedure has been executed. Responsible for initiating contingency procedures, as needed. Will have a radio for communications.

2.3 Caltrans Site Manager - Randy Woolley

Responsible for the successful execution of all procedures at the North end, South End, and the express lanes that are not vehicle specific, including those relating to safety, security, and logistics in the staging areas. Responsible for insuring that all facilities are ready to support sequence, scenario, and vehicle operations. Must notify the Live Vehicle Production lead that the Infrastructure is ready, before vehicles can be released to the lanes. Will have a radio for communications.

2.4 Site Vehicle Manager - Ron Colgin

Responsible for the successful execution of all vehicle specific procedures prior to the vehicles being released to the lanes. Insures that all vehicles are safe and ready to go, at the appointed times, and at the appointed places. Must notify the Operations Manager that the vehicles are ready, before vehicles can be released to the lanes. Will track the progress of the scenarios in real time on the white board. Position will be at the white board.

2.5 North/South End Coordinators - Tommy Viner/Fred Mangerelli

Responsible for the successful execution of all vehicle specific procedures at the area of responsibility. Will maintain a hard copy of the procedures that are being executed in the staging area. Receives input from the Stager, Loader, Dispatcher, and Traffic Director. Notifies the Site Vehicle Manager as each step in the procedure is completed. Located in the respective staging area. Will have a radio for Communications. Details of all North end personnel and their responsibilities, as defined by the North End Coordinator, are contained in the following sections.

2.5.1 Vehicle Operations Personnel

2.5.1.1 Site Lead

- Oversees Staging Area operation. Responsible for all activities at the Staging Area.
- Can prohibit vehicles from entering the lanes or delay scenarios, as necessary.
- Directs Staging Area personnel if major change occurs to pre-planned activities.
- Serve as back-up to all other site operational positions as required.

2.5.1.2 Site Manager

- Ensures that the Staging Area facility is available, ready, and safe to begin executing scenarios.
- Interfaces with local law enforcement, Caltrans, medical, environmental, and construction organizations.
- Coordinates interaction with the Caltrans TMC, activation of facility, and storage. Specific responsibilities include:
  - Site Safety
  - Vehicle Storage
  - Coordinate Site Visitors
  - Site Logistics
  - Facility Open/Closure
  - Security
  - Coordinate with Caltrans TMC, Traffic Management Teams, etc.
- Serve as back-up to all other site operational positions as required.

2.5.1.3 Site Communications Coordinator

- Provides the Control and Site communications equipment.
- Assigns radios and conducts North Staging Area pre-operations communications checks.
- Resolve Operational Communications issues as required.
- Serves as the alternate Site Lead.
- Serve as back-up to all other site operational positions as required.

2.5.1.4 Stager

- Ensures that scenario vehicles are parked in appropriate staging area positions.
- Ensures that scenario vehicle crew movement to and from the staging area across the traffic areas is conducted safely.
- Ensures designated scenario vehicles are manned by drivers and narrators, started and in the correct sequence.
- Ensures designated scenario vehicles in the staging area are sent to the loading area in accordance with the scenario schedule and readied for departure.
- Check with Shuttle Coordinator B to determine status of Scenario Shuttle for staged scenario.
- Do not move scenario to the load point prior to the arrival of the staged scenario shuttle arrival.
- Notifies the loader before scenario vehicles are moved to the passenger loading point.

2.5.1.5 Shuttle Coordinator A (1 Person)

- Ensures Route A scenario shuttle vehicles flow within the Staging Area in a safe and efficient manner to ensure timely loading of departing passengers and positioning of shuttle vehicles for efficient traffic flow.
- Ensures Route A shuttle are aligned in the proper sequence and parked in the right lane of the shuttle exit lanes.
- Move shuttles forward in the right lane of the shuttle exit lane as the front shuttle leaves the queue.
- Coordinate with Host / Hostess A to ensure all passengers returning to Miramar College are on-board the appropriate scenario shuttle.

- Once all passengers are on-board departing scenario shuttle, dispatch the shuttle.
- Communicates with Passenger Manager at Miramar College on schedule issues with Route B Shuttles.
- Operate the Scenario Schedule Database.

2.5.1.6 Host / Hostess A (1 Person)

- Greets arriving vehicle scenario passengers at hospitality tent entrance point.
- Escorts passengers to designated scenario shuttle.
- Escorts return scenario passengers to the hospitality tent to wait for return scenario loading.
- Advises Host/Hostess B of waiting passengers for return scenario passengers.
- Advises staging area resident mentor of return trip passengers.
- As time permits checks the status of refreshments and departing passengers in the Hospitality Tent.

2.5.1.7 Shuttle Coordinator B (1 Person)

- Ensures Route B scenario shuttle vehicles flow within the Staging Area in a safe and efficient manner to ensure timely unloading of arriving passengers.
- Immediately dispatch Route B shuttles after passengers are unloaded in the left lane of the shuttle exit lanes.
- Move all Route B shuttles through the Coned Area unload area except the Route B Shuttle Bus.
- Coordinate with Host / Hostess B to ensure all arriving passengers are escorted to the appropriate scenario Technical Briefing / Display Tent.
- Communicates with Passenger Manager at Miramar College on schedule issues with Route B Shuttles.
- Operate the Scenario Schedule Database.

2.5.1.8 Host / Hostess B (1 Person)

- Greets arriving passengers at Shuttle unload point.
- Escorts passengers to designated scenario Technical Briefing / Display Tent.
- Coordinates with Host/Hostess A on scenario returning passengers.
- When Stager notifies Loader scenario vehicles are moving to Loading Point, begin collecting passengers for that scenario.
- Escorts passengers from briefing / display / hospitality tent to the loader at the right time, for a particular scenario.
    - Host / Hostess B Special Instructions:

      Red Scenario
        - Check passenger tickets to determine car passengers from bus passengers.
        - Remind car passengers that they will loaded first when the scenario is loaded.
        - When passengers are escorted to load point, advise loader which passengers are car passengers and bus passengers.

      Green Scenario
        - Check passenger tickets to determine which car number (1 -8) they are assigned.
        - Remind Passengers that they will be loaded in ascending order starting at Car #8 to Car #1.
        - When passengers are escorted to load point, arrange the passengers in ascending order.

- Utilize staging area Resident Mentor to respond to general Consortium/Demonstration questions from passengers or media.

2.5.1.9 Loader

- Ensures the proper vehicles are in the loading area, and are being loaded at the right time, for a particular scenario.
- Using the mega phone announce the arrival of the scenario at the loading point when ready for passenger loading.
- Ensures passengers have the correct boarding ticket for the loading scenario.
- Ensures passengers are expeditiously loaded in scenario vehicles. (In authorized bus seats)
- Ensures passenger seat belts are fastened as appropriate.
- Ensures scenario vehicles move to the dispatcher release line in time to be released by the Dispatcher.
- Notifies Dispatcher/Traffic Controller C when scenario is loaded with passengers and ready for movement to the ready line.
    - Loader Special Instructions:

      Red Scenario
        - Move car/mini-van passengers to the front of the loading queue.
        - Load car/mini-van passenger first.
        - Load Bus Passengers second.

      Green Scenario
        - Align Passengers in ascending order starting at Car #8 to Car #1.
        - Load cars from back to front (#8 to #1).

2.5.1.10 Dispatcher (1 Person)

- Alerts staging area operational crew when scenario vehicles are approaching staging area entrance. (Using local staging area Comm)
- Acknowledges arrival of Scenario vehicles and Obstacle Vehicles at the receiving Staging Area. (Control Comm)
- Releases designated scenario vehicles and Obstacle Vehicles from the Staging Area on command from the Demo Command and Control Center. (Control Comm)
- Ensures that vehicles departing the staging area are in the correct order for the scenario being run.
- Ensures that Obstacle Vehicles are interleaved in the correct places in the scenario sequence.
- Has the final release authority for all scenarios from the Staging Area.
- Advises Operations Control of any delays of scenario departure.

2.5.1.11 Unloader (2 Persons)

- Ensures that each scenario vehicle is expeditiously unloaded upon arrival at the unload point.
- Ensures that scenario vehicles move to their designated parking area.
- Escorts or directs departing passengers to the Hospitality Tent to await their shuttle to the Exposition Center. The Unloader then immediately returns to the Unload point.
- Directs Traffic Controller C to release scenario vehicles to the Staging Area parking.
- Notifies Stager scenario vehicles are enroute to parking area.
- Ensures passengers are safely moved from the unload point.

2.5.1.12 Traffic Controller A (1 Person)

- Ensures scenario vehicles flow into the Staging Area to the Unload Point in a safe and efficient manner to ensure timely unloading of passengers.
- Works with the Obstacle Vehicles to ensure the correct Obstacles are loaded on the correct vehicle and are parked in correct sequence.
- Coordinates with dispatcher to ensure correct Obstacle Vehicle is prepared to move out at the proper time.

2.5.1.13 Traffic Controller B (1 Person)

- Ensures scenario vehicles are stopped at the Unload Point to effect a safe efficient unloading of passengers.
- At the direction from the Unloader directs scenario vehicles to move to their staging area parking position.
- Directs spare vehicles or other vehicles from the vehicle traffic operational area through gate. This activity is coordinated with the Unloader to ensure safety of passenger pedestrians.

2.5.1.14 Traffic Controller C (1 Person)

- Perform the tasks of Traffic Controller A when that position is not staffed.
- Ensures scenario vehicles are stopped at the Dispatcher Ready Line.
- Directs scenario vehicles moving to their Staging Area parking positions.
- Release scenario vehicles on direction from the Dispatcher.

2.5.1.15 NSA Resident Mentor (2 Persons)

- Conduct discussions with waiting return trip passengers.
- Respond to general Consortium/Demonstration questions from media and passengers.

North Staging Area Vehicle Operations Personnel

Position	Principal	Organization
NSA Lead	Tommy Viner	Lockheed Martin - Program Office
Site Manager	Joy Pinne	Caltrans
Communications Coordinator	Aimee Cochran	Hughes
Stager	Karl Sauer	Bechtel
Shuttle Coordinator A	Marty Miller	Caltrans
Passenger Host (Hostess) A	Wanda Blount	Caltrans
Shuttle Coordinator B	John Hearn	Caltrans
Passenger Host (Hostess) B	Gloria Cesena	Caltrans
Passenger Host (Hostess) B (Alternate)	Linda Buys	Hughes-Program Office
Loader	Al Cox	Caltrans
Loader (Alternate)	Ron Hearne	Bechtel
Dispatcher	John Castro	Caltrans
Unloader	Brian Hughes	Bechtel
Traffic Controller A	John Schultz	Caltrans
Traffic Controller B	Mark Rominger	Caltrans
Traffic Controller C	Gerard Seubert	Caltrans

2.6 Passenger Coordinator - Ed Vanover

- Assists passenger manager in all duties described above.
- Additionally, responsible for developing daily shuttle schedules for passengers, narrators and drivers; provides "real time" schedule adjustments for passenger loading based on actual Demo progress.
- Interfaces with Operations Manager to status/confirm schedule updates.
- Interfaces with and assists with all other passenger staging functions as required.

Maintains OES radio contact with shuttle drivers, North and South End Hosts and shuttle dispatcher. Monitors Command Net Radio. Monitors "real time" scenario progress on computer database

2.6.1 Passenger Check-In - Gabrielle Stevens and Alice Leung

- Responsible for all ride assignments coordinated before and during the Demo
- Responsible for passenger check-in, issuing "boarding passes", and coordinating ride assignments for all "walk-ons"
- Coordinates waiting list and standby lists to fill open ride slots
- Generates daily passenger lists for coordination with Demo Team

Verbal communications with Passenger Manager and Coordinator.

2.6.2 Shuttle Coordination - Bob James

- Responsible for all shuttle and driver coordination, including
  - shuttle storage, cleaning, gas
  - driver assignments, training and daily briefings
- Loads shuttles, collects ride tickets and confirms passenger boarding
- Provide safety briefings to passengers in absence of narrator

Maintains verbal communications with shuttle drivers, dispatcher, Passenger Manager and Coordinator.

2.6.3 Shuttle Dispatcher - Lynn Barton (Butch Biendara/Ed Kennedy as backups)

- Communicates with North and South Hosts to confirm:
  - Shuttle departure times
  - Passenger counts
- Monitors Command Net Radio for schedule delays and potential operations impact
- Communicates with shuttle drivers to:
  - Confirm arrival/departure times
  - Be advised of delays, mechanical difficulties, or passenger emergencies
- Implements shuttle contingency plans (send spares, etc.)

Maintain OES radio contact with shuttle drivers, North and South End Hosts and Passenger Coordinator. Monitors Command Net Radio.

2.7 Process

The Caltrans Site Safety Officer (Tarbell Martin) will approve the lanes and staging areas at the beginning of the day and turn the facilities over the Control Center. Unless there is an unforeseen problem, the

Control Center should have no further contact with the Caltrans Site Safety Officer until the end of the day. The CT Site Manager, Vehicle Manager, Passenger Manager will then execute their respective procedures to prepare the vehicles, facilities, and passengers. Once all procedures have been completed and the CT Site Manager and Site Vehicle Manager have given their approval, the Operations Manager will give the go-ahead to begin the sequence. The Vehicle Manager will directly notify the appropriate dispatcher to release the scenario. The dispatcher will then release all vehicles in the scenario as needed. Figure 2 shows the individuals located in the Control Center, as well as the relationship between individuals. As the procedures are completed, the Operations Manager will update a hard copy of the procedures. The Scheduler will update an electronic copy of the procedure and relay shuttle buss information to the Operations Manager. The Vehicle Manager will track the progress of each scenario and obstacle vehicle on the white board.

A listing of procedures to be monitored by the Operations Manager is contained in this document.

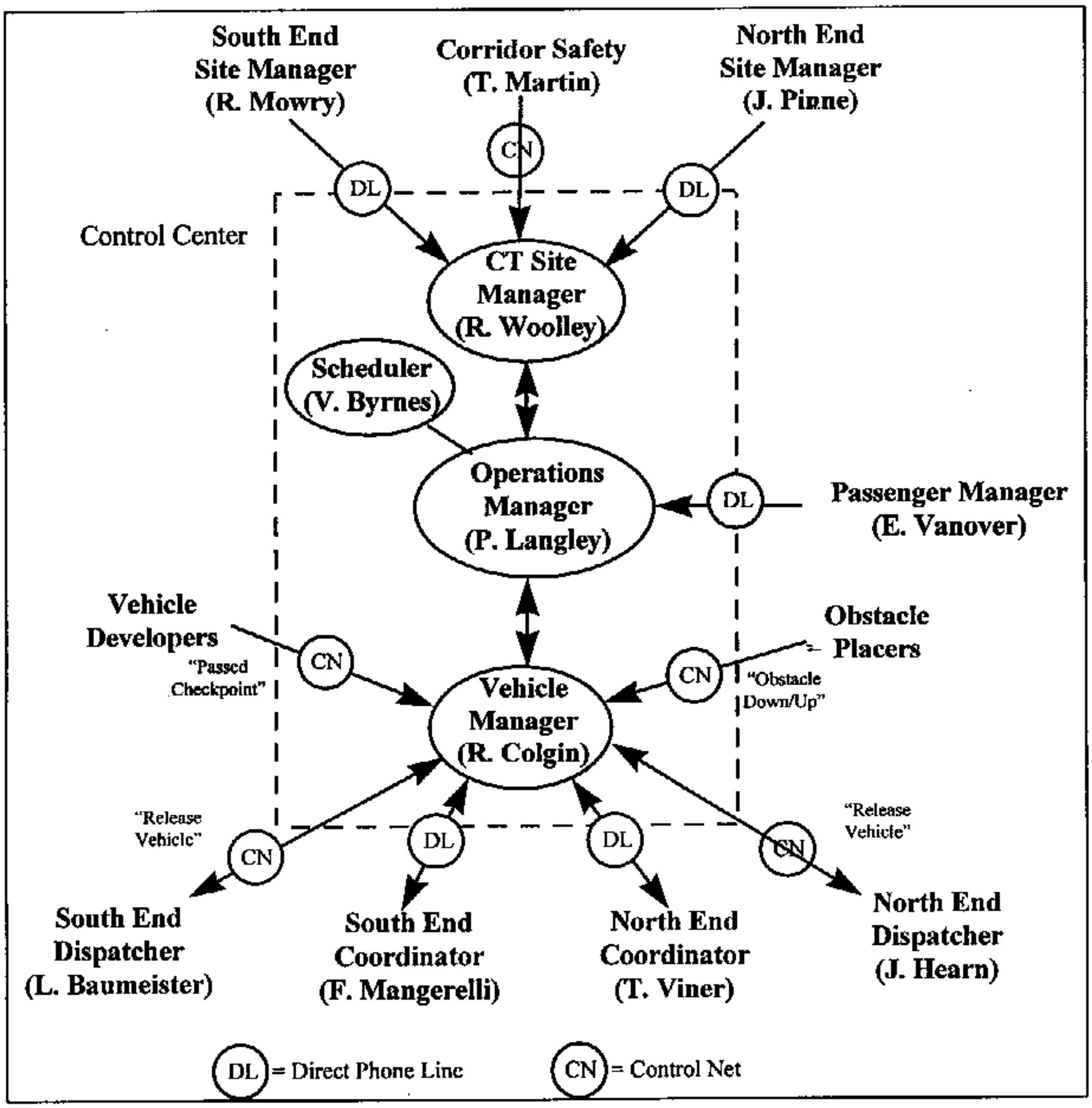

Figure 2 Control Center Roles

APPENDIX B Demonstration Baseline Operational Procedure

Ev - Gray, FA - Red, CT - Blue, Maint. - Orange, Platoon - Green, Truck - Purple, AT - Tan

TIME	Activity	Scenario	Activity	Comm Device	From	Bench Mark	TYPICAL RADIO TRAFFIC ON CONTROL NET
8:05	Start vehicle crew briefing						
8:30							
8:35	End Vehicle crew briefing						
8:40	vehicle crews report to vehicles	Evolutionary					
			Synchronize Watches				
			Radios On **Cell Phone On**				
							N Lead Ready **S Lead Ready**
8:45			Control Ops and all positions perform radio check.		operations		radio check
8:45	gray vehicles manned and started [4 vehicles]	Evolutionary					
8:50	red vehicles manned and started [5 vehicles]	Free Agent					
9:15	**LANES OPEN TO AHS**			Cntrl Net	operations site		15 minutes to start lanes open to AHS site.
					operations		10 minutes to start
				Cntrl Net	operations		clear to start scenario runs
			Infrastructure ready	Site Lead			site ready
					operations		5 minutes to start
			SCY Coordinator get vehicles in position.	OES Net	operations		position vehicles
		Evolutionary	prepare obs veh 1	Cntrl Net	control		prepare obs veh 1
9:15		**Obstacle Veh**	**obstacle veh 1 departs**	**Cntrl Net**	**control**	0	**release obs veh 1**
		Evolutionary			SCY disp		obs veh 1 released

	gray veh(s) move to release line	*Evolutionary*		*Cntrl Net*	*SCY disp*		*gray ready*	
		Obstacle Veh	*OV1 passed checkpoint*	*Cntrl Net*	*obs veh 1*	2.18	*ov1 passed c.p.*	
		Evolutionary	**first veh of scenario departs NORTH BOUND (trial run 1) from release line**	**Cntrl Net**	**control**	2.18	**release gray**	
		Evolutionary	Last vehicle of Gray Scenario departed	Cntrl Net	SCY disp		gray departed	
		Obstacle Veh	gray obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 1	4:25	#1 gray obs down	
		Evolutionary	gray scenario has begun their run	Cntrl Net	vehicle	5:04	gray started	
		Evolutionary	Red scenario at the release line	Cntrl Net	SCY disp		red ready	
		Evolutionary	last veh of gray scenario passes check point	Cntrl Net	vehicle	6.06	gray passed c.p.	
		Obstacle Veh	*OV3 passed checkpoint*	*Cntrl Net*	*obs veh 3*	7.52	*ov3 passed c.p.*	
		Free Agent	**first veh of red scenario departs NORTH BOUND (trial run 1) from release line**	**Cntrl Net**	**control**	7.52	**release red**	
		Free Agent	Last vehicle of Red Scenario departed	Cntrl Net	SCY disp		red departed	
		Obstacle Veh	gray obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 1	8.55	#2 gray obs down	
		Control Transition	Blue Scenario at the release line	Cntrl Net	SCY disp		blue ready	
				Cntrl Net	NSA Dispatch	10.18	ov1 clear	
		Obstacle Veh	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 3	10.53	#1 gray obs up	
		Obstacle Veh	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	11.48	#1 red obs down	
		Free Agent	*last veh of red scenario passes check point*			11.15	*red passed c.p.*	

		Obstacle Veh	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	14.28	#2 red obs down	
		Obstacle Veh	*blue obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 5*	14:40	*#1 blue obs down*	
		Obstacle Veh	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 2	14.53	#2 gray obs up	
	goes to parking area	Evolutionary	last veh of gray scenario crosses finish line	Cntrl Net	NSA disp	15:40	gray clear	
		Control Transition	**first veh of blue scenario departs NORTH BOUND (trial run 1) from release line**	**Cntrl Net**	**control**	15:10	**release blue**	
	orange veh(s) move to release line	Control Transition Maintenance Obstacle Veh	Last vehicle of Blue Scenario departed red obstacle has been placed and vehicle is rolling	Cntrl Net Cntrl Net	SCY disp obs veh 2	 16.02	blue departed #3 red obs down	
				Cntrl Net	NSA Dispatch	17.48	ov2&3 clear	
		Maintenance Obstacle Veh	Orange Scenario at the release line red obstacle has been picked up and vehicle is rolling	Cntrl Net Cntrl Net	SCY disp obs veh 5	 16.28	orange ready #1 red obs up	
		Control Transition	blue scenario has begun their run	Cntrl Net	vehicle	17.41	blue started	
		Obstacle Veh	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	17.31	#2 red obs up	
		Obstacle Veh	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	19.15	#3 red obs up	
		Control Transition	*last veh of blue scenario passes check point*	*Cntrl Net*	*vehicle*	19.24	*blue passed c.p.*	
		Obstacle Veh	*orange obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 6*	21.07	*#1 orange obs down*	
		Maintenance	**first veh of orange scenario departs NORTH BOUND (trial run 1) from release line**	**Cntrl Net**	**control**	21.18	**release orange**	

		Maintenance	Last vehicle of Orange Scenario departed	Cntrl Net	SCY disp		orange departed	
	goes to parking area	Free Agent	last veh of red scenario crosses finish line	Cntrl Net	NSA dispatch	19.54	red clear	
				Cntrl Net	NSA Dispatch	20.01	ov4&5 clear	
	green veh(s) move to release line	Platoon						
		Platoon	Green Scenario at the release line	Cntrl Net	SCY disp		green ready	
		Obstacle Veh	blue obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 6	22.35	#1 blue obs up	
		Maintenance	*orange obstacle has been picked up and vehicle is rolling*	*Cntrl Net*	*ORV*	25.05	*orange obs up*	
		Platoon	**first veh of scenario departs NORTH BOUND (trial run 1) from release line**	**Cntrl Net**	**control**	25.24	**release green**	
		Maintenance	last veh of orange scenario passes check point	Cntrl Net	vehicle	26.09	orange passed c.p.	
	goes to parking area	Control Transition	last veh of blue scenario crosses finish line	Cntrl Net	NSA dispatch	26.09	blue clear	
		Platoon	Last vehicle of Green Scenario departed	Cntrl Net	SCY disp		green departed	
	purple veh(s) move to release line	Truck	Purple Scenario at the release line	Cntrl Net	SCY disp		purple ready	
		Platoon	green scenario has begun their run	Cntrl Net	vehicle	28:30:00	green started	
		Platoon	*last veh of green scenario passes check point*		*vehicle*	30.18	*green passed c.p.*	
		Truck	**first veh of purple scenario departs NORTH BOUND (trial run 1) from release line**	**Cntrl Net**	**control**	30.18	**release purple**	
		Truck	Last vehicle of Purple Scenario departed	Cntrl Net	SCY disp		purple departed	
		Alternative	Tan Scenario at the release line	Cntrl Net	SCY disp		tan ready	

	goes to parking area	Technology Maintenance	last veh of orange scenario crosses finish line	Cntrl Net	NSA dispatch	32.07	orange clear	
		Alternative Technology	**first veh of tan scenario departs NORTH BOUND (trial run 1) from release line**	**Cntrl Net**	**control**	33.16	**release tan**	
		Alternative Technology	Last vehicle of Tan Scenario departed	Cntrl Net	SCY disp		tan departed	
		Truck	*last veh of purple scenario passes check point*	*Cntrl Net*	*vehicle*	34.01	*purple passed c.p.*	
		Alternative Technology	tan scenario has begun their run	Cntrl Net	vehicle	37.34	tan started	
	goes to parking area	Platoon	last veh of green scenario crosses finish line	Cntrl Net	NSA dispatch	37.34	green clear	
		Alternative Technology	last veh of tan scenario passes check point	Cntrl Net	vehicle	39.31	tan passed c.p.	
	goes to parking area	Truck	last veh of purple scenario crosses finish line	Cntrl Net	NSA dispatch	41.05	purple clear	
		Evolutionary	prepare obs veh 1	Cntrl Net	control		prepare obs veh 1	
	goes to parking area	***Alternative Technology***	***last veh of tan scenario crosses finish line***	***Cntrl Net***	***NSA dispatch***	47.27	***tan clear***	
	gray veh(s) move to release line	Evolutionary		Cntrl Net	NSA disp		gray ready	
10:05		**Evolutionary**	**obstacle veh 1 departed**	**Cntrl Net**	**NSA Dispatch**	0	**obs veh 1 released**	
		Obstacle Veh	*OV1 passed checkpoint*	*Cntrl Net*	*obs veh 1*	2.18	*ov1 passed c.p.*	
		Evolutionary	**first vehicle departs SOUTH BOUND (trial run 2) from release line**	**Cntrl Net**	**control**	2.18	**release gray**	
		Evolutionary	Last vehicle of Gray Scenario departed	Cntrl Net	NSA dispatch		gray departed	
		Free Agent	Red Scenario at the release line	Cntrl Net	NSA dispatch		red ready	

	shuttles manned, operational, and standing by at Miramar	Shuttles1		Direct Line	Passenger Mgr		shuttles ready
		Evolutionary	gray scenario has begun their run	Cntrl Net	vehicle	4:02	gray started
		Obstacle Veh	*gray obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 1*	5:04	*#1 gray obs down*
		Evolutionary	last veh of gray scenario passes check point	Cntrl Net	vehicle	6.06	gray passed c.p.
		Obstacle Veh	*OV3 passed checkpoint*	*Cntrl Net*	*obs veh 3*	7.52	*ov3 passed c.p.*
		Free Agent	**first vehicle departs SOUTH BOUND (trial run 2) from release line**	**Cntrl Net**	**control**	7.52	**release red**
		Free Agent	Last vehicle of Red Scenario departed	Cntrl Net	NSA dispatch		red departed
		Obstacle Veh	gray obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 1	8.55	#2 gray obs down
		Control Transition	Blue Scenario at the release line	Cntrl Net	NSA dispatch		blue ready
				Cntrl Net	NSA Dispatch	10.18	ov1 clear
		Free Agent	*last veh of red scenario passes check point*	*Cntrl Net*	*vehicle*	11:30	*red passed c.p.*
		Obstacle Veh	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	11.48	#1 red obs down
		Obstacle Veh	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 3	11.53	#1 gray obs up
		Shuttles1	begin loading gray shuttles at Miramar	Direct Line	control		load gray passengers
		Obstacle Veh	*blue obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 5*	14:40	*#1 blue obs down*
		Control Transition	**first vehicle departs SOUTH BOUND (trial run 2) from release line**	**Cntrl Net**	**control**	15:10	**release blue**
		Control Transition	Last vehicle of Blue Scenario departed	Cntrl Net	NSA dispatch		blue departed

		Obstacle Veh	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 2	14.53	#2 gray obs up	
		Obstacle Veh	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 2	16.02	#3 red obs down	
	go to parking area	Evolutionary	last gray veh crosses finish line	Cntrl Net	SCY disp	15.4	gray clear	
		Obstacle Veh	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	14.28	#2 red obs down	
		Maintenance Obstacle Veh	Orange Scenario at the release line red obstacle has been picked up and vehicle is rolling	Cntrl Net Cntrl Net	NSA dispatch obs veh 5	 16.28	orange ready #1 red obs up	
		Control Transition	blue scenario has begun their run	Cntrl Net	vehicle	17.41	blue started	
		Obstacle Veh	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	17.31	#2 red obs up	
				Cntrl Net	NSA Dispatch	17.48	ov2&3 clear	
		Obstacle Veh	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	19.15	#3 red obs up	
		Control Transition	*last veh of blue scenario passes check point*	*Cntrl Net*	*vehicle*	19.24	*blue passed c.p.*	
		Obstacle Veh	*orange obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 6*	21.07	*orange obs down*	
		Maintenance	**first vehicle departs SOUTH BOUND (trial run 2) from release line**	**Cntrl Net**	**control**	21.18	**release orange**	
	 go to parking area	Maintenance Free Agent	Last vehicle of Orange Scenario departed last red veh crosses finish line	Cntrl Net Cntrl Net	NSA dispatch SCY dispatch	 19.54	orange departed red clear	
				Cntrl Net	NSA Dispatch	20	ov4&5 clear	
	gray shuttles released from Miramar	Shuttles1 Platoon	 Green Scenario at the release line	Direct Line Cntrl Net	passenger mgr NSA dispatch		gray shuttles released green ready	

		Obstacle Veh	blue obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 6	22.35	#1 blue obs up	
		Maintenance	*orange obstacle has been picked up and vehicle is rolling*	*Cntrl Net*	*ORV*	25.05	*orange obs up*	
		Platoon	**first vehicle departs SOUTH BOUND (trial run 2) from release line**	**Cntrl Net**	**control**	25.24	**release green**	
		Platoon	Last vehicle of Green Scenario departed	Cntrl Net	NSA dispatch		green departed	
		Truck	Purple Scenario at the release line	Cntrl Net	NSA dispatch		purple ready	
		Maintenance	last veh of orange scenario passes check point	Cntrl Net	vehicle	26.09	orange passed c.p.	
	go to parking area	Control Transition	last blue veh crosses finish line	Cntrl Net	SCY dispatch	26.09	blue clear	
		Platoon	green scenario has begun their run	Cntrl Net	vehicle	28:30:00	green started	
		Platoon	*last veh of green scenario passes check point*	*Cntrl Net*	*vehicle*	30.18	*green passed c.p.*	
		Truck	**first vehicle departs SOUTH BOUND (trial run 2) from release line**	**Cntrl Net**	**control**	30.18	**release purple**	
		Truck	Last vehicle of Purple Scenario departed	Cntrl Net	NSA dispatch		purple departed	
		Alternative Technology	Tan Scenario at the release line	Cntrl Net	NSA dispatch		tan ready	
	go to parking area	Maintenance	last orange veh crosses finish line	Cntrl Net	SCY dispatch	32.07	orange clear	
				Cntrl Net			Sequence Status to Passenger Manager	
		Alternative Technology	**first vehicle departs SOUTH BOUND (trial run 2) from release line**	**Cntrl Net**	**control**	33.16	**release tan**	
		Alternative	Last vehicle of Tan Scenario	Cntrl Net	NSA dispatch		tan departed	

		Technology	departed				
		Truck	*last veh of purple scenario passes check point*	*Cntrl Net*	*vehicle*	34.01	*purple passed c.p.*
		Alternative Technology	tan scenario has begun their run	Cntrl Net	vehicle	37.34	tan started
	go to parking area	Platoon	last green veh crosses finish line	Cntrl Net	SCY dispatch	37.34	green clear
		Alternative Technology	last veh of tan scenario passes check point	Cntrl Net	vehicle	39.31	tan scenario passed c.p.
	go to parking area	Truck	last purple veh crosses finish line	Cntrl Net		41.05	purple scenario clear
		Evolutionary1	prepare obs veh 1	Cntrl Net	control		prepare obs veh 1 - Load Gray
	go to parking area	***Alternative Technology***	***last tan veh crosses finish line***	***Cntrl Net***		47.27	***tan scenario clear***
10:55		**Obstacle Veh**	**obstacle veh 1 departs**	**Cntrl Net**	**control**	0	**release obs veh 1**
		Evolutionary1	obstacle veh 1 departs	Cntrl Net	SCY dispatch		obs veh 1 released
		Evolutionary1	gray veh loading complete, veh(s) move to release line	Cntrl Net	SCY disp		gray ready
		Obstacle Veh	*OV1 passed checkpoint*	*Cntrl Net*	*obs veh 1*	2.18	*ov1 passed c.p.*
		Evolutionary 1	**first gray vehicle departs NORTH BOUND (run #1) from release line**	**Cntrl Net**	**control**	2.18	**release gray**
			Last vehicle of gray scenario departed		SCY dispatch		gray released
		Free Agent1	red veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		red ready
		Evolutionary1	gray scenario has begun their run	Cntrl Net	vehicle	4.02	gray started
		Evolutionary1	*gray obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 1*	5:04	*#1 gray obs down*
		Evolutionary1	last veh of gray scenario passes check point	Cntrl Net	vehicle	6.06	gray passed c.p.
		Obstacle Veh	*OV3 passed checkpoint*	*Cntrl Net*	*obs veh 3*	7.52	*ov3 passed c.p.*

		Free Agent1	**first red vehicle departs NORTH BOUND run #1) from release line**	**Cntrl Net**	**control**	7.52	**release red**	
		Free Agent1	last veh of red scenario departed	Cntrl Net	SCY dispatch		red released	
		Evolutionary1	gray obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 1	8.55	#2 gray obs down	
		Control Transition1	blue veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		blue ready	
				Cntrl Net	NSA Dispatch	10.18	ov1 clear	
		Evolutionary1	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 3	10.53	#1 gray obs up	
		Evolutionary1	*red obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 3*	11.48	*#1 red obs down*	
		Free Agent1	*last veh of red scenario passes check point*	*Cntrl Net*	*vehicle*	11:30	*red passed c.p.*	
	begin loading gray shuttles at Miramar	Shuttles2		Direct Line	control		load gray passengers	
		Evolutionary	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	14.28	#2 red obs down	
		Free Agent1	*blue obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 5*	14:40	*#1 blue obs down*	
		Evolutionary1	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 2	14.53	#2 gray obs up	
	veh(s) go to unload area	Evolutionary1	last gray veh crosses finish line	Cntrl Net	NSA disp	15:40	gray clear	
		Control Transition1	**first vehicle departs NORTH BOUND (run #1) from release line**	**Cntrl Net**	**control**	15:10	**release blue**	
		Control Transition1	last veh of blue scenario departed	Cntrl Net	SCY dispatch		blue released	
		Maintenance1	orange veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		orange ready	

		Evolutionary	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 2	16.02	#3 red obs down	
		Evolutionary1	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 5	16.28	#1 red obs up	
		Control Transition1	blue scenario has begun their run	Cntrl Net	vehicle	17.41	blue started	
		Evolutionary	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	17.31	#2 red obs up	
				Cntrl Net	NSA Dispatch	17.48	ov2&3 clear	
		Evolutionary	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	19.15	#3 red obs up	
		Control Transition1	*last veh of blue scenario passes check point*	*Cntrl Net*	*vehicle*	19.24	*blue passed c.p.*	
		Control Transition1	*orange obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 6*	21.07	*orange obstacle down*	
		Maintenance 1	**first vehicle departs NORTH BOUND (run #1) from release line**	**Cntrl Net**	**control**	21.18	**release orange**	
		Maintenance1	last veh of orange scenario departed	Cntrl Net	SCY dispatch		orange released	
	veh(s) go to unload area	Free Agent1	last red veh crosses finish line	Cntrl Net	NSA Dispatch	19.54	red clear	
				Cntrl Net	NSA Dispatch	20	ov4&5 clear	
	gray shuttles released from Miramar	Shuttles2		Direct Line	passenger mgr		gray shuttles released	
		Platoon1	green veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		green ready	
		Control Transition1	blue obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 6	22.35	#1 blue obs up	
		Maintenance1	*orange obstacle has been picked up and vehicle is rolling*	*Cntrl Net*	*ORV*	25.05	*orange obs up*	

		Platoon1	**first green vehicle departs NORTH BOUND (run #1) from release line**	**Cntrl Net**	**control**	25.24	**release green**	
		Platoon1	last veh of green scenario departed	Cntrl Net	SCY dispatch		green released	
		Truck1	purple veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		purple ready	
	veh(s) go to unload area	Control Transition1	last blue veh crosses finish line	Cntrl Net	NSA Dispatch	26.09	blue clear	
		Maintenance1	last veh of orange scenario passes check point	Cntrl Net	vehicle	26.09	orange passed c.p.	
		Platoon1	*green scenario has begun their run*	*Cntrl Net*	*vehicle*	28:30:00	*green started*	
		Platoon1	*last veh of green scenario passes check point*	*Cntrl Net*	*vehicle*	30.18	*green passed c.p.*	
		Truck1	**first vehicle departs NORTH BOUND (run #1) from release line**	**Cntrl Net**	**control**	30.18	**release purple**	
		Truck1	last veh of purple scenario departed	Cntrl Net	SCY dispatch		purple released	
		Alternative Technology1	tan veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		tan vehicles ready	
				Cntrl Net			Sequence Status to Passenger Manager	
	veh(s) go to unload area	Maintenance1	last orange veh crosses finish line	Cntrl Net	NSA dispatch	32.07	orange clear	
		Alternative Technology1	**first vehicle departs NORTH BOUND (run #1) from release line**	**Cntrl Net**	**control**	33.16	**release tan**	
		Alternative Technology1	last veh of tan scenario departed	Cntrl Net	SCY dispatch		tan released	
		Truck1	*last veh of purple scenario passes check point*	*Cntrl Net*	*vehicle*	34.01	*purple passed c.p.*	
		Alternative Technology1	tan scenario has begun their run	Cntrl Net	vehicle	37.34	tan started	
	veh(s) go to unload area	Platoon1	last green veh crosses finish line	Cntrl Net	NSA dispatch	37.34	green clear	

		Alternative Technology1	last veh of tan scenario passes check point	Cntrl Net	vehicle	39.31	last tan veh passed c.p.
	veh(s) go to unload area	Truck1	last purple veh crosses finish line	Cntrl Net	NSA dispatch	41.05	purple clear
		Evolutionary2	prepare obs veh 1	Cntrl Net	control		prepare obs veh 1 - Load Gray
	veh(s) go to unload area	***Alternative Technology1***	***last tan veh crosses finish line***	***Cntrl Net***	***NSA dispatch***	47.27	***tan clear***
11:45		**Obstacle Veh**	**obstacle veh 1 departs**	**Cntrl Net**	**control**	0	**release obs veh 1**
		Evolutionary2	obstacle veh 1 departs	Cntrl Net	NSA dispatch		obs veh 1 released
		Evolutionary2	gray veh loading complete, veh(s) move to release line	Cntrl Net	NSA disp		gray ready
		Obstacle Veh	*OV1 passed checkpoint*	*Cntrl Net*	*obs veh 1*	2.18	*ov1 passed c.p.*
		Evolutionary 2	**first vehicle departs SOUTH BOUND (run #2) from release line**	**Cntrl Net**	**control**	2.18	**release gray**
		Evolutionary2	last veh of gray scenario departed	Cntrl Net	NSA dispatch		gray released
		Free Agent2	red veh loading complete, veh(s) move to release line	Cntrl Net	NSA disp		red ready
		Evolutionary2	*gray scenario has begun their run*	*Cntrl Net*	*vehicle*	4.02	*gray started*
		Evolutionary2	gray obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 1	5:04	#1 gray obs down
		Evolutionary2	last veh of gray scenario passes check point	Cntrl Net	vehicle	6.06	gray passed c.p.
		Obstacle Veh	*OV3 passed checkpoint*	*Cntrl Net*	*obs veh 3*	7.52	*ov3 passed c.p.*
		Free Agent2	**first red vehicle departs SOUTH BOUND (run #2) from release line**	**Cntrl Net**	**control**	7.52	**release red**
		Free Agent2	last veh of red scenario departed	Cntrl Net	NSA dispatch		red released
		Evolutionary2	gray obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 1	8.55	#2 gray obs down
		Control Transition2	blue veh loading complete, veh(s) move to release line	Cntrl Net	NSA dispatch		blue ready

				Cntrl Net	NSA Dispatch	10.18	ov1 clear	
		Evolutionary2	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	11.48	#1 red obstacle down	
		Evolutionary2	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 3	10.53	#1 gray obs up	
		Free Agent2	*last veh of red scenario passes check point*	*Cntrl Net*	*vehicle*	11:30	*red passed c.p.*	
		Evolutionary2	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 2	14.53	#2 gray obs up	
		Evolutionary	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 2	16.02	#3 red obs down	
		Evolutionary	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	14.28	#2 red obs down	
		Free Agent2	*blue obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 5*	14:40	*#1 blue obs down*	
		Control Transition2	**first blue vehicle departs SOUTH BOUND (run #2) from release line**	**Cntrl Net**	**control**	15:10	**release blue**	
		Control Transition2	last veh of blue scenario departed	Cntrl Net	NSA dispatch		blue released	
		Maintenance2	orange veh loading complete, veh(s) move to release line, grn obstacle veh departs	Cntrl Net	NSA dispatch		orange ready	
	veh(s) go to unload area	Evolutionary2	last gray veh crosses finish line	Cntrl Net	SCY disp	15:40	gray clear	
		Evolutionary2	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 5	16.28	#1 red obs up	
		Control Transition2	blue scenario has begun their run	Cntrl Net	vehicle	17.41	blue started	
		Evolutionary	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	17.31	#2 red obs up	
				Cntrl Net	NSA Dispatch	17.48	ov2&3 clear	

		Evolutionary	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	19.15	#3 red obs up	
		Control Transition2	*last veh of blue scenario passes check point*	*Cntrl Net*	*vehicle*	*19.24*	*blue passed c.p.*	
		Control Transition2	*orange obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 6*	*21.07*	*#1 orange obs down*	
		Maintenance 2	**first orange vehicle departs SOUTH BOUND (run #2) from release line**	**Cntrl Net**	**control**	**21.18**	**release orange**	
		Maintenance2	last veh of orange scenario departed	Cntrl Net	NSA dispatch		orange released	
	veh(s) go to unload area	Free Agent2	last red veh crosses finish line	Cntrl Net	SCY dispatch	19.54	red clear	
				Cntrl Net	NSA Dispatch	20	ov4&5 clear	
	gray shuttles depart from Miramar	Shuttles3		Cntrl Net	control		release gray shuttles from Miramar	
	green veh loading complete, veh(s) move to release line	Platoon2		Cntrl Net	NSA dispatch		green ready	
		Control Transition2	blue obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 6	22.35	#1 blue obs up	
		Maintenance2	*orange obstacle has been picked up and vehicle is rolling*	*Cntrl Net*	*ORV*	*25.05*	*orange obs up*	
		Platoon2	**first vehicle departs SOUTH BOUMD (run #2) from release line**	**Cntrl Net**	**control**	**25.24**	**release green**	
		Platoon2	last veh of green scenario departed	Cntrl Net	NSA dispatch		green released	
		Truck2	purple veh loading complete, veh(s) move to release line	Cntrl Net	NSA dispatch		purple ready	
	veh(s) go to unload area	Control Transition2	last blue veh crosses finish line	Cntrl Net	SCY dispatch	26.09	blue clear	
		Maintenance2	last veh of orange scenario passes check point		vehicle	26.09	orange passed c.p.	

		Platoon2	green scenario has begun their run	Cntrl Net	vehicle	28:30:00	green started	
		Platoon2	*last veh of green scenario passes check point*	*Cntrl Net*	*vehicle*	30.18	*green passed c.p.*	
		Truck2	**first vehicle departs SOUTH BOUND (run #2) from release line**	**Cntrl Net**	**control**	30.18	**release purple**	
		Truck2	last veh of purple scenario departed	Cntrl Net	NSA dispatch		purple released	
		Alternative Technology2	tan veh loading complete, veh(s) move to release line	Cntrl Net	NSA dispatch		tan vehicles ready	
				Cntrl Net			Sequence Status to Passenger Manager	
	veh(s) go to unload area	Maintenance2	last orange veh crosses finish line	Cntrl Net	SCY dispatch	32.07	orange clear	
		Alternative Technology2	**first vehicle departs SOUTH BOUND (run #2) from release line**	**Cntrl Net**	**control**	33.16	**release tan vehicle**	
		Alternative Technology2	last veh of tan scenario departed	Cntrl Net	NSA dispatch		tan released	
		Truck2	*last veh of purple scenario passes check point*	*Cntrl Net*	*vehicle*	34.01	*purple passed c.p.*	
		Alternative Technology2	*tan scenario has begun their run*	*Cntrl Net*	*vehicle*	37.34	*tan started*	
	veh(s) go to unload area	Platoon2	last green veh crosses finish line	Cntrl Net	SCY dispatch	37.34	green clear	
		Alternative Technology2	last veh of tan scenario passes check point	Cntrl Net	vehicle	39.31	last tan vehicle passed c.p.	
	veh(s) go to unload area	Truck2	last purple veh crosses finish line	Cntrl Net	SCY dispatch	41.05	purple clear	
		Evolutionary3	prepare obs veh 1	Cntrl Net	control		prepare obs veh 1 - Load Gray	
	veh(s) go to unload	***Alternative***	***last tan veh crosses finish line***	***Cntrl Net***	***SCY***	47.27	***tan clear***	

	area	Technology2			dispatch		
12:35		**Obstacle Veh**	**obstacle veh 1 departs**	**Cntrl Net**	**control**	0	**release obs veh 1**
		Evolutionary3	gray obstacle veh departs	Cntrl Net	SCY dispatch		obs veh 1 released
		Evolutionary3	gray veh loading complete, veh(s) move to release line	Cntrl Net	SCY disp		gray ready
		Obstacle Veh	*OV1 passed checkpoint*	*Cntrl Net*	*obs veh 1*	2.18	*ov1 passed c.p.*
		Evolutionary 3	**first vehicle departs NORTH BOUND (run #3) from release line**	**Cntrl Net**	**control**	2.18	**release gray**
		Evolutionary3	last veh of gray scenario departed	Cntrl Net	SCY dispatch		gray released
		Free Agent3	red veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		red ready
		Evolutionary3	*gray scenario has begun their run*	*Cntrl Net*	*vehicle*	4.05	*gray started*
		Evolutionary3	*gray obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 1*	4:50	*#1 gray obs down*
		Evolutionary3	last veh of gray scenario passes check point	Cntrl Net	vehicle	6.06	gray passed c.p.
		Obstacle Veh	*OV3 passed checkpoint*	*Cntrl Net*	*obs veh 3*	7.52	*ov3 passed c.p.*
		Free Agent3	**first vehicle departs NORTH BOUND (run #3) from release line**	**Cntrl Net**	**control**	7.52	**release red**
		Evolutionary3	last veh of red scenario departed	Cntrl Net	SCY dispatch		red released
		Evolutionary3	gray obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 1	8.55	#2 gray obs down
		Control Transition33	blue veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		blue ready
				Cntrl Net	NSA Dispatch	10.18	ov1 clear
		Evolutionary3	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 3	10.53	#1 gray obs up

		Evolutionary3	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	11.48	#1 red obs down	
		Free Agent3	*last veh of red scenario passes check point*	*Cntrl Net*	*vehicle*	11:30	*red passed c.p.*	
		Evolutionary3	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 2	14.53	#2 gray obs up	
		Evolutionary	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	14.28	#2 red obs down	
		Free Agent3	*blue obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 5*	14:40	*#1 blue obs down*	
		Control Transition3	**first vehicle departs NORTH BOUND (run #3) from release line**	**Cntrl Net**	**control**	15:10	**release blue**	
		Control Transition3	last veh of blue scenario departed	Cntrl Net	SCY dispatch		blue released	
		Maintenance3	orange veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		orange ready	
	veh(s) go to unload area	Evolutionary3	last gray veh crosses finish line	Cntrl Net	NSA disp	15:40	gray clear	
		Evolutionary	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 2	16.02	#3 red obs down	
		Evolutionary3	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 5	16.28	#1 red obs up	
		Control Transition3	blue scenario has begun their run	Cntrl Net	vehicle	17.41	blue started	
		Evolutionary	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	17.31	#2 red obs up	
				Cntrl Net	NSA Dispatch	17.48	ov2&3 clear	
		Evolutionary	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	19.15	#3 red obs up	
		Control Transition3	*last blue veh of scenario passes check point*	*Cntrl Net*	*vehicle*	19.24	*blue passed c.p.*	
		Control Transition3	*orange obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 6*	21.07	*orange obs down*	

		Maintenance 3	**first vehicle departs NORTH BOUND (run #3) from release line**	**Cntrl Net**	**control**	21.18	**release orange**	
		Maintenance3	last veh of orange scenario departed	Cntrl Net	SCY dispatch		orange released	
	veh(s) go to unload area	Free Agent3	last red veh crosses finish line	Cntrl Net	NSA dispatch	19.54	red clear	
				Cntrl Net	NSA Dispatch	20	ov4&5 clear	
	gray shuttles released from Miramar	Shuttles4		Direct Line	passenger mgr		gray shuttles released	
		Platoon3	green veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		green ready	
		Control Transition3	blue obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 6	22.35	#1 blue obs up	
		Maintenance3	*orange obstacle has been picked up and vehicle is rolling*	*Cntrl Net*	*ORV*	25.05	*orange obs up*	
		Platoon3	**first vehicle departs NORTH BOUND (run #3) from release line**	**Cntrl Net**	**control**	25.24	**release green**	
		Platoon3	last veh of green scenario departed	Cntrl Net	SCY dispatch		green released	
		Truck3	purple veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		purple ready	
	veh(s) go to unload area	Control Transition3	last blue veh crosses finish line	Cntrl Net	NSA dispatch	26.09	blue clear	
		Maintenance3	last veh of orange scenario passes check point	Cntrl Net	vehicle	26.09	orange passed c.p.	
		Platoon3	green scenario has begun their run	Cntrl Net	vehicle	28:30:00	green started	
		Platoon3	*last veh of green scenario passes check point*	*Cntrl Net*	*vehicle*	30.18	*green passed c.p.*	
		Truck3	**first vehicle departs NORTH BOUND (run #3) from release line**	**Cntrl Net**	**control**	30.18	**release purple**	
		Truck3	last veh of purple scenario departed	Cntrl Net	SCY dispatch		purple released	

		Alternative Technology3	tan veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch control		tan ready Sequence Status to Passenger Manager
	veh(s) go to unload area	Maintenance3	last orange veh crosses finish line	Cntrl Net	NSA dispatch	32.07	orange clear
		Alternative Technology3	**first vehicle departs NORTH BOUND (run #3) from release line**	**Cntrl Net**	**control**	33.16	**release tan**
		Alternative Technology3	last veh of tan scenario departed	Cntrl Net	SCY dispatch		tan released
		Truck3	*last veh of purple scenario passes check point*	*Cntrl Net*	*vehicle*	34.01	*purple passed c.p.*
		Alternative Technology3	tan scenario has begun their run	Cntrl Net	vehicle	37.34	tan started
		Platoon3	last green veh crosses finish line	Cntrl Net	NSA dispatch	37.34	green clear
		Alternative Technology3	last veh of tan scenario passes check point	Cntrl Net	vehicle	39.31	last tan vehicle passed c.p.
		Truck3	last purple veh crosses finish line	Cntrl Net	NSA dispatch	41.05	purple clear
		Evolutionary4	prepare obs veh 1	Cntrl Net	control		prepare obs veh 1 - Load Gray
		Alternative Technology3	***last tan veh crosses finish line***	***Cntrl Net***	***NSA dispatch***	47.27	***tan clear***
13:25		**Obstacle Veh**	**obstacle veh 1 departs**	**Cntrl Net**	**control**	0	**release obs veh 1**
		Evolutionary4 Evolutionary4	gray obstacle veh departs gray veh loading complete, veh(s) move to release line	Cntrl Net Cntrl Net	NSA dispatch NSA disp		obs veh 1 released gray ready

		Obstacle Veh	*OV1 passed checkpoint*	*Cntrl Net*	*obs veh 1*	2.18	*ov1 passed c.p.*	
		Evolutionary 4	**first vehicle departs SOUTH BOUND (run #4) from release line**	**Cntrl Net**	**control**	2.18	**release gray**	
		Evolutionary4	last veh of gray scenario departed	Cntrl Net	NSA dispatch		gray released	
	red veh loading complete, veh(s) move to release line	Free Agent4		Cntrl Net	NSA dispatch		red ready	
		Evolutionary4	gray scenario has begun their run	Cntrl Net	vehicle	4.02	gray started	
		Evolutionary4	gray obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 1	5:04	#1 gray obs down	
		Evolutionary4	last veh of gray scenario passes check point	Cntrl Net	vehicle	6.06	gray passed c.p.	
		Obstacle Veh	*OV3 passed checkpoint*	*Cntrl Net*	*obs veh 3*	7.52	*ov3 passed c.p.*	
		Free Agent4	**first vehicle departs SOUTH BOUND (run #4) from release line**	**Cntrl Net**	**control**	7.52	**release red**	
		Free Agent4	last veh of red scenario departed	Cntrl Net	NSA dispatch		red released	
		Evolutionary4	gray obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 1	8.55	#2 gray obs down	
		Control Transition4	blue veh loading complete, veh(s) move to release line	Cntrl Net	NSA dispatch		blue ready	
				Cntrl Net	NSA Dispatch	10.18	ov1 clear	
		Evolutionary4	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	11.48	#1 red obs down	
		Evolutionary4	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 3	10.53	#1 gray obs up	
		Free Agent4	*last veh of red scenario passes check point*	*Cntrl Net*	*vehicle*	11:30	*red passed c.p.*	
		Evolutionary4	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 2	14.53	#2 gray obs up	
		Evolutionary	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 2	16.02	#3 red obs down	

		Evolutionary	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	14.28	#2 red obs down	
		Free Agent4	*blue obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 5*	14:40	*#1 blue obs down*	
		Control Transition4	**first vehicle departs SOUTH BOUND (run #4) from release line**	**Cntrl Net**	**control**	15:10	**release blue**	
		Control Transition4	last veh of blue scenario departed	Cntrl Net	NSA dispatch		blue released	
	orange veh loading complete, veh(s) move to release line	Maintenance4		Cntrl Net	NSA dispatch		orange ready	
		Evolutionary4	last gray veh crosses finish line	Cntrl Net	SCY disp	15:40	gray clear	
		Evolutionary4	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 5	16.28	#1 red obs up	
		Control Transition4	blue scenario has begun their run	Cntrl Net	vehicle	17.41	blue started	
		Evolutionary	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	17.31	#2 red obs up	
				Cntrl Net	NSA Dispatch	17.48	ov2&3 clear	
		Evolutionary	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	19.15	#3 red obs up	
		Control Transition4	*last blue veh of scenario passes check point*	*Cntrl Net*	*vehicle*	19.24	*blue passed c.p.*	
		Control Transition4	*orange obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 6*	21.07	*orange obs down*	
		Maintenance 4	**first vehicle departs SOUTH BOUND (run #4) from release line**	**Cntrl Net**	**control**	21.18	**release orange**	
		Maintenance4	last veh of orange scenario departed	Cntrl Net	NSA dispatch		orange released	
		Free Agent4	last red veh crosses finish line	Cntrl Net	SCY	19.54	red clear	

					dispatch			
				Cntrl Net	NSA Dispatch	20	ov4&5 clear	
		Platoon4	green veh loading complete, veh(s) move to release line	Cntrl Net	NSA dispatch		green ready	
		Control Transition4	blue obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 6	22.35	#1 blue obs up	
		Maintenance4	*orange obstacle has been picked up and vehicle is rolling*	*Cntrl Net*	*ORV*	25.05	*orange obs up*	
		Platoon4	**first vehicle departs SOUTH BOUND (run #4) from release line**	**Cntrl Net**	**control**	25.24	**release green**	
		Platoon4	green released	Cntrl Net	NSA dispatch		green released	
		Truck4	purple veh loading complete, veh(s) move to release line	Cntrl Net	NSA dispatch		purple ready	
		Control Transition4	last blue veh crosses finish line	Cntrl Net	SCY dispatch	26.09	blue clear	
		Maintenance4	last veh of orange scenario passes check point	Cntrl Net	vehicle	26.09	orange passed c.p.	
		Platoon4	*green scenario has begun their run*	*Cntrl Net*	*vehicle*	28:30:00	*green started*	
		Platoon4	*last veh of green scenario passes check point*	*Cntrl Net*	*vehicle*	30.18	*green passed c.p.*	
		Truck4	**first vehicle departs SOUTH BOUND (run #4) from release line**	**Cntrl Net**	**control**	30.18	**release purple**	
		Truck4	last veh of purple scenario departed	Cntrl Net	NSA dispatch		purple released	
		Truck4	tan veh loading complete, veh(s) move to release line	Cntrl Net	NSA dispatch		tan ready	
		Maintenance4	last orange veh crosses finish line	Cntrl Net	SCY dispatch	32.07	orange clear	
		Alternative Technology4	**first vehicle departs SOUTH BOUND (run #4) from release line**	**Cntrl Net**	**control**	33.16	**release tan**	

		Alternative Technology4	last veh of tan scenario departed	Cntrl Net	NSA dispatch		tan released
		Truck4	*last veh of purple scenario passes check point*	*Cntrl Net*	*vehicle*	34.01	*purple passed c.p.*
		Alternative Technology4	*tan scenario has begun their run*	*Cntrl Net*	*vehicle*	37.34	*tan started*
	all blue veh(s) are parked	Control Transition4					
	all orange passengers are unloaded	Maintenance4					
		Platoon4	last green veh crosses finish line	Cntrl Net	SCY dispatch	37.34	green clear
		Alternative Technology4	last veh of tan scenario passes check point	Cntrl Net	vehicle	39.31	last tan vehicle passed c.p.
		Truck4	last purple veh crosses finish line	Cntrl Net	SCY dispatch	41.05	purple clear
		Alternative Technology4	***last tan veh crosses finish line***	***Cntrl Net***	***SCY dispatch***	47.27	***tan clear***
	red shuttles arrive at Expo	Shuttles4		Direct Line	passenger manager		red shuttles arrive at Expo
14:15	**LANES CLOSED TO AHS (ON THURSDAY and FRIDAY)**			Cntrl Net	**control**		**Radios Off**
	Break For Lunch						
	gray shuttles depart from Miramar	Shuttles5		Cntrl Net	control		release gray shuttles from Miramar
			Radios On **Cell Phone On**				**N Lead Ready** **S Lead Ready**

			Control Ops and all positions perform radio check.		operations		radio check
15:15				Cntrl Net	control		CHP Sweep
		Evolutionary5	prepare obs veh 1	Cntrl Net	control		prepare obs veh 1 - Load Gray
15:30		**Evolutionary 5**	**gray obstacle veh departs**	**Cntrl Net**	**control**	**0**	**release obs veh 1**
		Evolutionary5	gray obstacle veh departs	Cntrl Net	NSA dispatch		obs veh 1 released
		Evolutionary5	gray veh loading complete, veh(s) move to release line	Cntrl Net	SCY disp		gray ready
		Obstacle Veh	*OV1 passed checkpoint*	*Cntrl Net*	*obs veh 1*	2.18	*ov1 passed c.p.*
		Evolutionary 5	**first vehicle departs NORTH BOUND (run #5) from release line**	**Cntrl Net**	**control**	2.18	**release gray**
		Evolutionary5	last veh of gray scenario departed	Cntrl Net	SCY dispatch		gray released
		Free Agent5	red veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		red ready
		Evolutionary5	gray obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 1	4:50	#1 gray obs down
		Evolutionary5	gray scenario has begun their run	Cntrl Net	vehicle	4.05	gray started
		Evolutionary5	last veh of gray scenario passes check point	Cntrl Net	vehicle	6.06	gray passed c.p.
		Obstacle Veh	*OV3 passed checkpoint*	*Cntrl Net*	*obs veh 3*	7.52	*ov3 passed c.p.*
		Free Agent5	**first vehicle departs NORTH BOUND (run #5) from release line**	**Cntrl Net**	**control**	7.52	**release red**
		Free Agent5	last veh of red scenario departed	Cntrl Net	SCY dispatch		red released
		Evolutionary5	gray obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 1	8.55	#2 gray obs down
		Control Transition5	blue veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		blue ready

				Cntrl Net	NSA Dispatch	10.18	ov1 clear	
	gray obstacle has been picked up and vehicle is rolling	Evolutionary5		Cntrl Net	obs veh 3	10.53	#1 gray obs up	
		Evolutionary5	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	11.48	#1 red obs down	
		Free Agent5	*last veh of red scenario passes check point*		*vehicle*	11:30	*red passed c.p.*	
	begin loading gray shuttles at Miramar	Shuttles6		Direct Line	control		load gray passengers	
		Evolutionary5	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 2	14.53	#2 gray obs up	
		Evolutionary	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	14.28	#2 red obs down	
		Free Agent5	*blue obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 5*	14.4	*#1 blue obs down*	
		Control Transition5	**first vehicle departs NORTH BOUND (run #5) from release line**	**Cntrl Net**	**control**	15:10	**release blue**	
		Control Transition5	last veh of blue scenario departed	Cntrl Net	SCY dispatch		blue released	
		Evolutionary5	last gray veh crosses finish line	Cntrl Net	NSA disp	15:40	gray clear	
		Evolutionary	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 2	16.02	#3 red obs down	
		Maintenance5	orange veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		orange ready	
		Evolutionary5	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 5	16.28	#1 red obs up	
		Control Transition5	blue scenario has begun their run	Cntrl Net	vehicle	17.41	blue started	
		Evolutionary	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	17.31	#2 red obs up	
				Cntrl Net	NSA	17.48	ov2&3 clear	

					Dispatch			
		Evolutionary	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	19.15	#3 red obs up	
		Control Transition5	*last blue veh of scenario passes check point*	*Cntrl Net*	*vehicle*	19.24	*blue passed c.p.*	
		Control Transition5	*orange obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 6*	21.07	*orange obs down*	
		Maintenance 5	**first vehicle departs NORTH BOUND (run #5) from release line**	**Cntrl Net**	**control**	21.18	**release orange**	
		Maintenance5	last veh of orange scenario departed	Cntrl Net	SCY dispatch		orange released	
		Free Agent5	last red veh crosses finish line	Cntrl Net	NSA dispatch	19.54	red clear	
				Cntrl Net	NSA Dispatch	20	ov4&5 clear	
	gray shuttles released from Miramar	Shuttles6		Direct Line	passenger mgr		gray shuttles released	
		Platoon5	green veh loading complete, veh(s) move to release line	Cntrl Net	SCY dispatch		green ready	
		Control Transition5	blue obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 6	22.35	#1 blue obs up	
		Maintenance5	*orange obstacle has been picked up and vehicle is rolling*	*Cntrl Net*	*ORV*	25.05	*orange obs up*	
		Platoon5	**first vehicle departs NORTH BOUND (run #5) from release line**	**Cntrl Net**	**control**	25.24	**release green**	
		Platoon5	last veh of green scenario departed	Cntrl Net	SCY dispatch		green released	
		Truck5	purple veh loading complete, veh(s) move to release line		SCY dispatch		purple ready	
		Control Transition5	last blue veh crosses finish line	Cntrl Net	NSA dispatch	26.09	blue clear	
		Maintenance5	last veh of orange scenario passes check point	Cntrl Net	vehicle	26.09	orange passed c.p.	

		Platoon5	green scenario has begun their run	Cntrl Net	vehicle	28:30:00	green started	
		Platoon5	*last veh of green scenario passes check point*	*Cntrl Net*	*vehicle*	30.18	*green passed c.p.*	
		Truck5	**first vehicle departs NORTH BOUND (run #5) from release line**	**Cntrl Net**	**control**	30.18	**release purple**	
		Truck5	last veh of purple scenario departed	Cntrl Net	SCY dispatch		purple released	
		Alternative Technology5	tan veh loading complete, veh(s) move to release line		SCY dispatch		tan ready	
		Maintenance5	last orange veh crosses finish line	Cntrl Net	NSA dispatch	32.07	orange clear	
				Cntrl Net	control		Sequence Status to Passenger Manager	
		Alternative Technology5	**first vehicle departs NORTH BOUND (run #5) from release line**	**Cntrl Net**	**control**	33.16	**release tan**	
		Alternative Technology5	last veh of tan scenario departed	Cntrl Net	SCY dispatch		tan released	
		Truck5	*last veh of purple scenario passes check point*	*Cntrl Net*	*vehicle*	34.01	*purple passed c.p.*	
		Alternative Technology5	*tan scenario has begun their run*	*Cntrl Net*	*vehicle*	37.34	*tan started*	
		Platoon5	last green veh crosses finish line	Cntrl Net	NSA dispatch	37.34	green clear	
		Alternative Technology5	last veh of tan scenario passes checkpoint	Cntrl Net	vehicle	39.31	tan passed c.p.	
		Truck5	last purple veh crosses finish line	Cntrl Net	NSA dispatch	41.05	purple clear	
		Evolutionary6	prepare obs veh 1	Cntrl Net	control		prepare obs veh 1 - Load Gray	
		Alternative Technology5	***last tan veh crosses finish line***	***Cntrl Net***	***NSA dispatch***	47.27	***tan clear***	
16:20		**Evolutionary**	**obstacle veh 1 departs**	**Cntrl Net**	**control**	0	**release obs veh 1**	

		6						
		Evolutionary6	gray obstacle veh departs	Cntrl Net	NSA dispatch		gray obs veh 1 released	
		Evolutionary6	gray veh loading complete, veh(s) move to release line	Cntrl Net	NSA disp		gray ready	
		Obstacle Veh	*OV1 passed checkpoint*	*Cntrl Net*	*obs veh 1*	2:18	*ov1 passed c.p.*	
		Evolutionary 6	**first vehicle departs SOUTH BOUND (run #6) from release line**	**Cntrl Net**	**control**	2:18	**release gray**	
		Evolutionary6	last veh of gray scenario departed	Cntrl Net	NSA dispatch		gray released	
		Free Agent6	red veh loading complete, veh(s) move to release line	Cntrl Net	NSA dispatch		red ready	
		Evolutionary6	gray scenario has begun their run	Cntrl Net	vehicle	4:02	gray started	
		Evolutionary6	gray obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 1	5:04	#1 gray obs down	
		Evolutionary6	last veh of gray scenario passes check point	Cntrl Net	vehicle	6:06	gray passed c.p.	
		Obstacle Veh	*OV3 passed checkpoint*	*Cntrl Net*	*obs veh 3*	7:52	*ov3 passed c.p.*	
16:30		**Free Agent6**	**first vehicle departs SOUTH BOUND (run #6) from release line**	**Cntrl Net**	**control**	7:52	**release red**	
		Free Agent6	last veh of red scenario departed	Cntrl Net	NSA dispatch		red released	
		Evolutionary6	gray obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 1	8:55	#2 gray obs down	
		Control Transition6	blue veh loading complete, veh(s) move to release line	Cntrl Net	NSA dispatch		blue ready	
				Cntrl Net	NSA Dispatch	10.18	ov1 clear	
		Evolutionary6	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	11:48	#1 red obs down	
		Evolutionary6	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 3	10:53	#1 gray obs up	
		Free Agent6	*last veh of red scenario passes check point*	*Cntrl Net*	*vehicle*	11:30	*red passed c.p.*	

		Evolutionary6	gray obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 2	14.53	#2 gray obs up	
		Evolutionary	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 2	16.02	#3 red obs down	
		Evolutionary	red obstacle has been placed and vehicle is rolling	Cntrl Net	obs veh 3	14.28	#2 red obs down	
		Free Agent6	*blue obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 5*	14:40	*#1 blue obs down*	
16:35		**Control Transition6**	**first vehicle departs SOUTH BOUND (run #6) from release line**	**Cntrl Net**	**control**	15:10	**release blue**	
		Control Transition6	last veh of blue scenario departed	Cntrl Net	NSA dispatch		blue released	
		Maintenance6	orange veh loading complete, veh(s) move to release line	Cntrl Net	NSA dispatch		orange ready	
		Evolutionary6	last gray veh crosses finish line	Cntrl Net	SCY disp	15:40	gray clear	
		Evolutionary6	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 5	16.28	#1 red obs up	
		Control Transition6	blue scenario has begun their run	Cntrl Net	vehicle	17.41	blue started	
		Evolutionary	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	17.31	#2 red obs up	
				Cntrl Net	NSA Dispatch	17.48	ov2&3 clear	
		Evolutionary	red obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 4	19.15	#3 red obs up	
		Control Transition6	*last blue veh of scenario passes check point*	*Cntrl Net*	*vehicle*	19.24	*blue passed c.p.*	
		Control Transition6	*orange obstacle has been placed and vehicle is rolling*	*Cntrl Net*	*obs veh 6*	21.07	*orange obs down*	
16:40		**Maintenance 6**	**first vehicle departs SOUTH BOUND (run #6) from release line**	**Cntrl Net**	**control**	21.18	**release orange**	
		Maintenance6	last veh of orange scenario departed	Cntrl Net	NSA dispatch		orange released	

		Free Agent6	last red veh crosses finish line	Cntrl Net	SCY dispatch	19.54	red clear	
				Cntrl Net	NSA Dispatch	20	ov4&5 clear	
		Platoon6	green veh loading complete, veh(s) move to release line	Cntrl Net	NSA dispatch		green ready	
		Control Transition6	blue obstacle has been picked up and vehicle is rolling	Cntrl Net	obs veh 6	22.35	#1 blue obs up	
		Maintenance6	*orange obstacle has been picked up and vehicle is rolling*	*Cntrl Net*	*ORV*	25.05	*orange obs up*	
16:45		**Platoon6**	**first vehicle departs SOUTH BOUND (run #6) from release line**	**Cntrl Net**	**control**	25.24	**release green**	
		Platoon6	last veh of green scenario departed	Cntrl Net	NSA dispatch		green released	
		Truck6	purple veh loading complete, veh(s) move to release line	Cntrl Net	NSA dispatch		purple ready	
		Control Transition6	last blue veh crosses finish line	Cntrl Net	SCY dispatch	26.09	blue clear	
		Maintenance6	last veh of orange scenario passes check point	Cntrl Net	vehicle	26.09	orange passed c.p.	
		Platoon6	green scenario has begun their run	Cntrl Net	vehicle	28:30:00	green started	
		Platoon6	*last veh of green scenario passes check point*	*Cntrl Net*	*vehicle*	30.18	*green passed c.p.*	
16:50		**Truck6**	**first vehicle departs SOUTH BOUND (run #6) from release line**	**Cntrl Net**	**control**	30.18	**release purple**	
		Truck6	last veh of purple scenario departed	Cntrl Net	NSA dispatch		purple released	
		Alternative Technology6	tan veh loading complete, veh(s) move to release line	Cntrl Net	NSA dispatch		tan ready	
		Maintenance6	last orange veh crosses finish line	Cntrl Net	SCY dispatch	32.07	orange clear	

16:55		**Alternative Technology6**	**first vehicle departs SOUTH BOUND (run #6) from release line**	**Cntrl Net**	**control**	33.16	**release tan**	
		Alternative Technology6	last veh of tan scenario departed	Cntrl Net	NSA dispatch		tan released	
		Truck6	last veh of purple scenario passes check point	Cntrl Net	vehicle	34.01	purple passed c.p.	
		Alternative Technology6	*tan scenario has begun their run*	*Cntrl Net*	*vehicle*	37.34	*tan started*	
		Platoon6	last green veh crosses finish line	Cntrl Net	SCY dispatch	37.34	green clear	
		Alternative Technology6	last veh of tan scenario passes check point	Cntrl Net	vehicle	39.31	tan passed c.p.	
		Truck6	last purple veh crosses finish line	Cntrl Net	SCY dispatch	41.05	purple clear	
		Alternative Technology6	last tan veh crosses finish line	Cntrl Net	SCY dispatch	47.27	tan clear	
	LANES CLOSED TO AHS (ON SATURDAY and SUNDAY)							

APPENDIX C Voice Communications Contingency Plan

July 11, 1997

Automated Highway System

1997 Demonstration

TECHNICAL OWNER:
Aimee Cochran

Communications Coordinator

APPROVED:

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Theresa Quinlan
AHS '97 Demonstration Task Leader

PURPOSE:
The Voice Communications Contingency Plan documents the procedures which will be followed in the event of a failure in the voice communications network supporting the Automated Highway Systems (AHS) 1997 Demonstration of Technical Feasibility.

SCOPE:
This document covers use of the National Automated Highway Systems Consortium (NAHSC) Command Net and the Caltrans SOLEDAD Net. The NAHSC Command Net operates using the NAHSC repeater and the Caltrans SOLEDAD Net operates using the SOLEDAD repeater. The operating frequencies and channel assignments for the networks are described in Appendix A.

The contingency plan does not apply to the UHF and VHF radios loaned by the California Office of Emergency Services (OES) radios. The OES radios are assigned to sub nets for use at the North Staging Area, South Control Yard, Expo and Mini Demos. The OES sub nets are used for administrative purposes and are not safety critical communications nets.

NAHSC Repeater Failure
The NAHSC repeater channel shall be the primary frequency for command and control of live vehicle operation during the 1997 demonstration. The SOLEDAD repeater channel shall be the secondary frequency.

Command Center Communications
In the event that the NAHSC repeater becomes inoperable during the demonstration, the command center radio shall be switched to the SOLEDAD frequency for the duration of the scenarios on the lanes. No additional vehicles shall be released until a roll call has been completed on the secondary repeater channel.

The Vehicle Lead shall contact the Corridor Safety Officer via the Caltrans SOLEDAD net to verify the loss of the NAHSC repeater and the switch to the SOLEDAD net. The Corridor Safety Officer shall have the authority to approve continuation of the demonstration runs using the SOLEDAD repeater.

The Vehicle Lead shall contact the North Staging Area (NSA) coordinator and the South Control Yard (SCY) coordinator to verify the switch to the SOLEDAD repeater. The Vehicle Lead shall relay the message to the NSA and SCY coordinators via cell phone or pager, or use the Vehicle Production or Vehicle Operations Leads as couriers.

The NSA and SCY coordinators shall be responsible for contacting each of the vehicle radio operators to verify the switch to the SOLEDAD repeater. Each coordinator shall perform a roll call of each vehicle in the respective staging area. The coordinators shall report back to the command center Vehicle Lead at the conclusion of the SOLEDAD channel roll call.

The Vehicle Lead may resume release of scenarios following verification of vehicle roll calls. The use of the SOLEDAD channel for continuation of scenario sequences shall be contingent on approval for use of the SOLEDAD channel by the Corridor Safety Officer.

Vehicle Communications
In the event that the NAHSC repeater becomes inoperable during the demonstration, the command center radio shall be switched to the SOLEDAD frequency for the duration of the scenarios on the lanes. The vehicle radio operators shall be contacted by an agent of the Vehicle Lead via pager to notify of the switch to the SOLEDAD channel. A message code shall be established that will indicate to the vehicle radio operators that the SOLEDAD channel should be selected. Radio communication shall be returned to the Command channel when instructions are received from the Vehicle Lead via the Corridor Safety Officer.

Command Center Radio Failure
An alternate radio will be available in the event that the command center radio fails. The SCY communications lead will connect the backup radio and verify communications to the Corridor Safety Officer, the Kearny Mesa TMC, and the NSA and SCY coordinators. The SCY and NSA coordinators will monitor the progress of vehicles on the lanes during the interim period until command center radio communications are re-established. No additional vehicles shall be released until the Vehicle Lead notifies the NSA and SCY coordinators that the command center radio is operational.

Vehicle Radio Failure
If interference or jamming is experienced which prevents communications on the Command Net, vehicle radio operators shall switch to the Caltrans SOLEDAD channel. The vehicle radio operator shall notify the other vehicles in the scenario via the scenario administrative voice communications of the switch to the SOLEDAD channel by one of the vehicles. The lead vehicle in the scenario shall report to the Vehicle Lead at the command center which vehicle in the scenario is operating on the SOLEDAD channel. If the Command channel failure occurs in the lead vehicle in the scenario, then the last vehicle in the scenario shall make the report to the Vehicle Lead. The Vehicle Lead shall report to the Corridor Safety Officer that a vehicle on the lanes has switched to the SOLEDAD channel. The problem shall be reported to the NSA or SCY coordinator at the conclusion of the scenario.

The NSA or SCY Communications Lead shall diagnose the radio failure. A spare radio will be available, and may be substituted if necessary. The NSA or SCY coordinator shall notify the Vehicle Lead when the voice communications are restored to the Command channel for that vehicle.

If radio communication is not possible on either the Command or SOLEDAD channel, use an alternate means of communication to advise the Vehicle Lead of the loss of voice communications. The back-up communications device shall be the team administrative radio. In the event that an emergency occurs and voice communications can not be established with the Vehicle Lead at the control center using the communications available in the vehicle, roadside emergency call boxes may be used to contact emergency services.

Attachment:
A - Voice Radio Specifications

Attachment A - Voice Radio Specifications

The voice radio specifications are as follows:

Frequency
Receive: 851-869 MHz (repeater operation)
Transmit: 806-824 MHz (repeater operation)
851-869 MHz (direct talk around operation)

Squelch
Switchable between carrier operated and decoder operated squelch. Shall be able to use any of the standard EIA CTCSS tones on both transmit and receive.

Power Output:
15 watts nominal RF power output; 5 watts to 35 watts power output acceptable.

User Interface:
- Frequency switchable between operating frequencies.
- Switchable between direct and repeater modes of operation.

NAHSC Command Net Operating Frequencies
For primary control, safety, and operational communications (NAHSC Repeater)
Receive: 868.0375 MHz
Transmit: 823.0375 MHz (NAHSC Repeater)
868.0375 MHz direct (talk-around) operation
Decoder operated squelch: 192.8 Hz - Both Transmit and Receive

Caltrans SOLEDAD Net Operating Frequencies
For Backup Emergency Communications from Vehicles (SOLEDAD Repeater)
Receive: 857.1000 MHz
Transmit: 812.1000 MHz (SOLEDAD Repeater)
Decoder operated squelch: 110.9 Hz - Both Transmit and Receive

APPENDIX D Passenger Management Plan

Automated Highway System

1997 Demonstration

A. PASSENGER SELECTION/RIDE ASSIGNMENTS

The process for assigning and tracking live-vehicle demo rides, and accommodating ride preferences considers the following:

- Invitations to ride sent out to entire VIP list (~ 2000 people)
- Invitations include reply card to indicate day/time of ride preference
- Due to limited number of rides, rides cannot be guaranteed - reply card ensures "best opportunity for a ride"
- Failure to reply - rides subject to availability as walk-ons
- Pre-assigned rides are made based on information received
- Rides tracked in database developed to compile ride preferences and assignments
- Ride assignments consider:
  - Ride day/time reply card requests received
  - Requests for a specific scenario or vehicle
  - Company, organization or stakeholder category
  - Special group requests
- ~ 20% of ride slots are reserved to accommodate schedule changes, scenario changes, no-shows, and walk-ons, etc.
- Notification of preliminary ride assignments faxed to all VIPs requesting a ride (see Exhibit 1)
- Top priority given to VVIP's targeting Thurs./Fri. ride assignments
- Two-way rides made available upon request
- In addition to invitations, VVIPs may be contacted by phone to encourage participation, and obtain additional information on ride preferences
- On-going coordination of ride assignments continues up to and throughout the Demonstration
- Number of available rides:

  (Subject to change: assumes all scenarios run at full capacity; 4 runs on Thurs./Fri., 6 runs on Sat./Sun.; does not include spare passenger seats)

- THURSDAY 8/7	268
- FRIDAY 8/8	268
- SATURDAY 8/9	402
- SUNDAY 8/10	402
TOTAL	**1340**

NAHSC

National AHS Consortium

Technical Feasibility Demonstration

August 7-10, 1997

San Diego, CA

NAHSC DEMO '97
National AHS Consortium
Technical Feasibility Demonstration

To:
Fax Number:
Work Phone:
International Phone:
email:

From: Gabrielle Stevens
Phone Number: 301-417-4472
email: gstevens@bechtel.com

You are tentatively scheduled to take a live-vehicle demo ride as follows:

Date:
Passenger Check-In Time:
Scenario:

On the day of your scheduled ride, please report to the Distinguished Guest Booth in the Exposition Registration Area at Miramar College. You will then be directed to the Passenger Staging Area (C-500 Building) at your scheduled passenger check-in time.

We are excited about your interest in Demo '97 which will showcase applications of technologies, systems, and subsystems that will lead to a full AHS. All rides will be conducted in demonstration vehicles, which are not production vehicles. Although the demonstration vehicles have been subjected to numerous safety checks, technical "glitches" are possible.

For more information, see our website at http://nahsc.volpe.dot.gov

Directions from I-15: Take the Mira Mesa exit and go west on Mira Mesa. Take a left onto Black Mountain Road. At the second traffic light, take a left into Miramar College. Park in the visitor parking lot and proceed to the Expo Registration area for your voucher.

Because the number of available rides is limited, please contact Gabrielle Stevens if you are unable to attend.

Exhibit 1

B. PASSENGER MANAGEMENT PLAN - DEMO LOGISTICS

All passengers participating in the "Live-Vehicle Demo Rides" on I-15 will begin and end the ride in the Passenger Staging Area (PSA) at Miramar College (see Miramar College - General Location Map, Exhibit 2). Shuttles will transport passengers to and from the South Control Yard and North Staging Areas (see Area Map, Exhibit 3). The Passenger Management Team operating at the PSA, including roles and responsibilities, is summarized in Appendix A of this Procedure.

The process for addressing passenger management functions during Demo '97 considers the following:

- All VIP's to register at the Expo "Distinguished Guest" booths where registration material and name badges will be provided
- VIP database to be used as source for identifying the "Distinguished Guests"
- VIPs will be directed to Passenger Staging Area as follows:
  - "Pre-assigned-VIP" will be advised to check-in at PSA 20-30 minutes before shuttle loading time
  - If VIP has no ride assignment, will be directed to PSA where ride request will try to be accommodated through stand-by, walk-on, etc.
- At the passenger check-in area:
  - Pre-assigned VIPs sign-in, and obtain "boarding pass"
  - VIP walk-ons can:
    - Sign-up for next open ride slot
    - Get on standby list for next available ride
    - Get on waiting list for ride on later Demo days
- The PSA will function as a VIP waiting area (see PSA Layout, Exhibit 5) and includes:
    - Video display - general AHS briefing
    - Refreshments
    - AHS displays distributed throughout room
    - Mentors (~6) to meet/greet and answer questions
- Passenger manager will announce when scenarios are loading
  - Passengers escorted to shuttle loading area
- Shuttles identified by scenario color and linked to color coded boarding pass
- Shuttles will transport passengers to staging areas
  - Narrator will provide briefings
    - General safety briefing
    - Scenario briefing
- Passengers dropped off at north or south staging areas
- Passengers loaded into Demo vehicles and take "Live Vehicle Demo Ride" on I-15
- Passengers picked up at other end and shuttled back to Expo
- Total time to ride (from check-in at Expo to unload at Expo) is approximately 1 1/2 hours

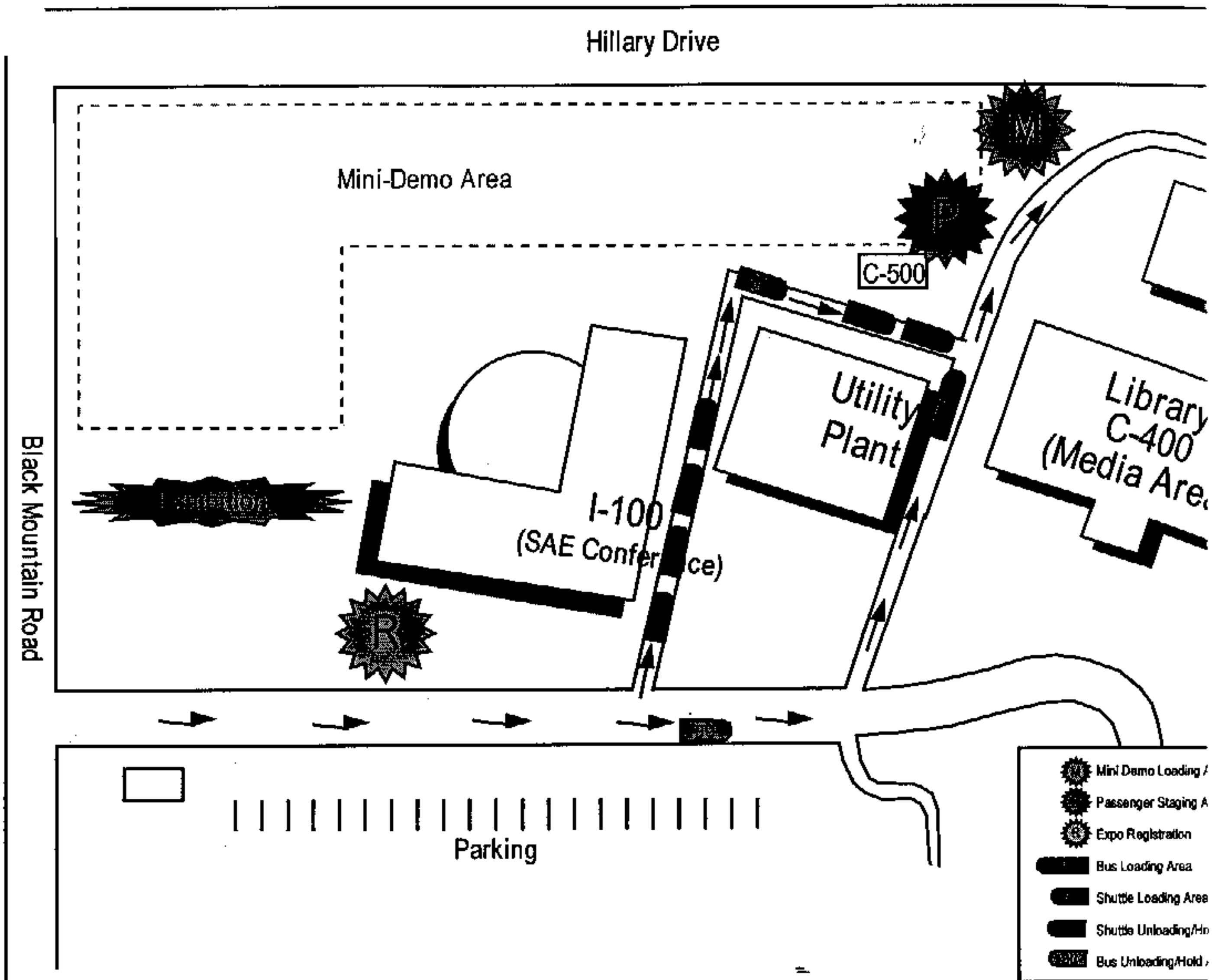

Exhibit 2
Miramar College – General Location Map

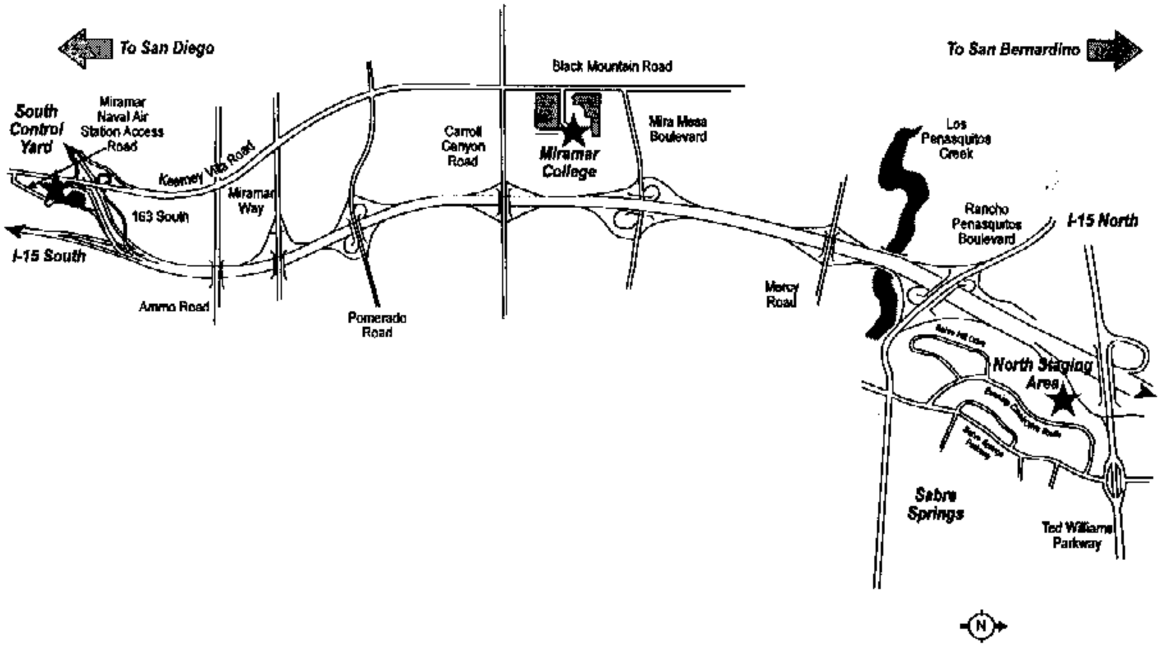

Exhibit 3
Area Map

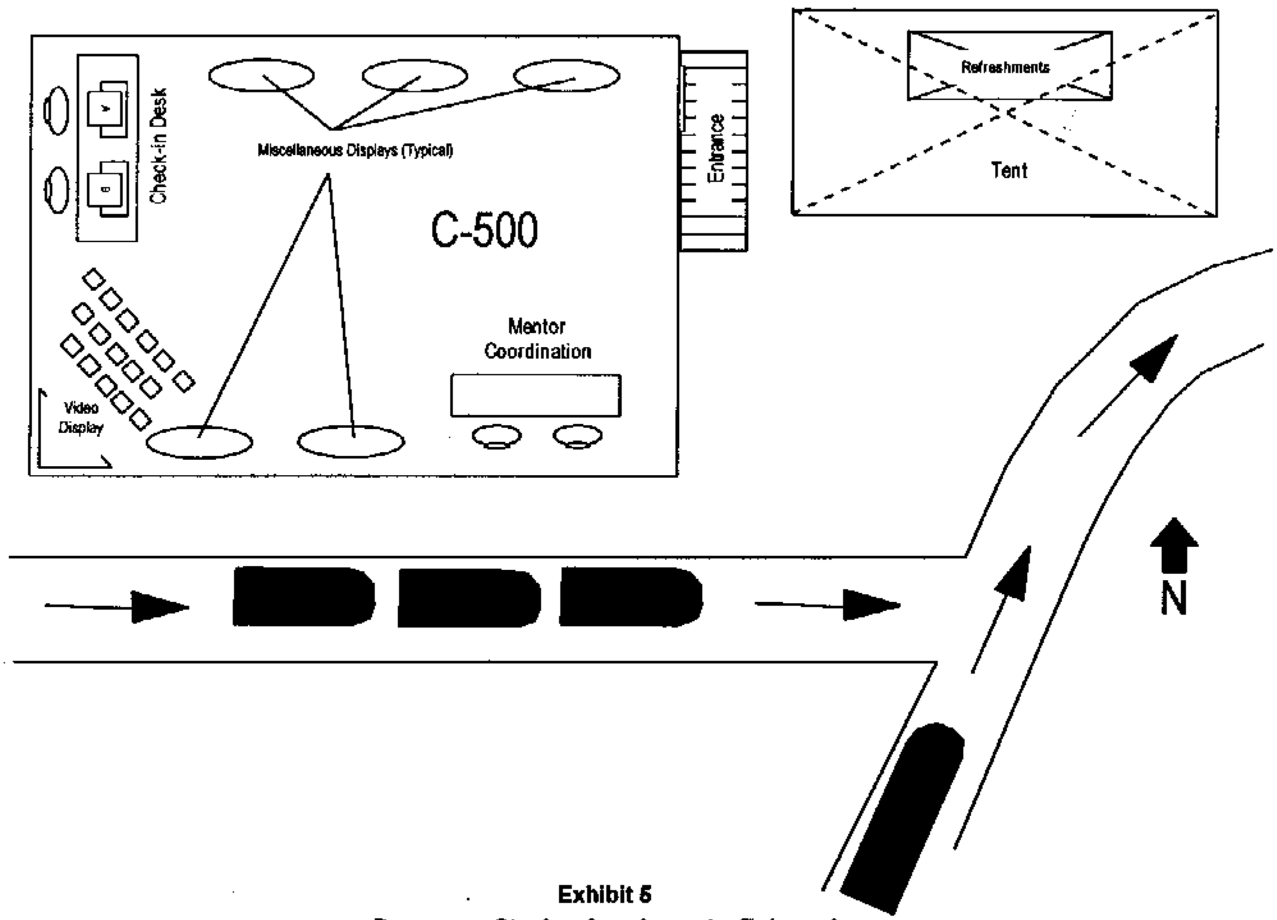

Exhibit 5
Passenger Staging Area Layout – Enlarged

C. SHUTTLE MANAGEMENT PLAN

The AHS Demonstration consists of seven vehicle scenarios. Each scenario is comprised of a set of vehicles working together to demonstrate the various technologies currently available. Each scenario services a different number of passengers. To aid in coordinating the many Demo planning functions, each scenario has a designated color. Scenario information is summarized in Exhibit 6.

EXHIBIT 6
Scenario Summary

Scenario	Color Code	Max. Number Passengers
Evolutionary	**Gray**	4
Free Agent, Multi-Platform	**Red**	34
Control Transition	**Blue**	4
Maintenance	**Orange**	2
Platoon	**Green**	16
Heavy Truck	**Purple**	3
Alternative Technology	**Tan**	4

During the Demonstration on August 7-10, the live vehicle scenarios will be deployed in the order shown, and repeated several times throughout the day. Each group of seven scenarios is considered one complete "run". During the Demonstration, the planned total number of runs with passengers is summarized in Exhibit 7.

Shuttle requirements are summarized in Exhibit 8, based on 5 minute departure times, and utilizing separate shuttles for each scenario. Two separate "Teams" of shuttles are required, as indicated.

Shuttle management responsibilities include the following:

- Developing shuttle schedules for each Demo Day (see Exhibit 9 for Sample)
- Driver training and coordination (see Exhibit 10 for Driver checklist)
- Shuttle storage, cleaning, and gassing
- Shuttle contingency plans to address shuttle breakdowns, passengers missing shuttles, etc.
- Developing shuttle main and alternate routes
- Shuttle communications during Demonstration

EXHIBIT 7
Live Vehicle Demo Schedule
(Planned Runs with Passengers)

Date	Run	Maximum Passengers
August 7, 1997	1	67
	2	67
	3	67
	4	67
August 8, 1997	1	67
	2	67
	3	67
	4	67
August 9, 1997	1	67
	2	67
	3	67
	4	67
	5	67
	6	67
August 10, 1997	1	67
	2	67
	3	67
	4	67
	5	67
	6	67
TOTALS	20	1340

EXHIBIT 8
Shuttle Requirements

Scenario	Shuttle ID	Shuttle Type	Maximum Shuttle Passenger Capacity
TEAM A			
Evolutionary	Gray A	Chevy Venture Mini-Van	4
Free Agent, Multi-Platform	Red A	Bus	40
Control Transition	Blue A	Chevy Venture Mini-Van	4
Maintenance	Orange A	Chevy Venture Mini-Van	4
Platoon	Green 1A	Chevy Express Van	10
Platoon	Green 2A	Chevy Express Van	10
Heavy Truck	Purple A	Chevy Venture Mini-Van	4
Alternative Technology	Tan A	Chevy Venture Mini-Van	4
TEAM B			
Evolutionary	Gray B	Chevy Venture Mini-Van	4
Free Agent, Multi-Platform	Red B	Bus	40
Control Transition	Blue B	Chevy Venture Mini-Van	4
Maintenance	Orange B	Chevy Venture Mini-Van	4
Platoon	Green 1B	Chevy Express Van	10
Platoon	Green 2B	Chevy Express Van	10
Heavy Truck	Purple B	Chevy Venture Mini-Van	4
Alternative Technology	Tan B	Chevy Venture Mini-Van	4

NOTES:

1. Team A serves passengers on Run Numbers 1, 3 and 5. Vehicles travel from Miramar College to South Control Yard to North Staging Area to Miramar College.
2. Team B serves passengers on Run Numbers 2, 4 and 6. Vehicles travel from Miramar College to North Staging Area to South Control Yard to Miramar College.

EXHIBIT 9
Shuttle Schedule

SHUTTLE SCHEDULE
RUN NUMBER 1 (AUGUST 7-10,1997)
TEAM "A"

SHUTTLE	EXPO	SCY	SCY	NCY	NCY	EXPO
ID	LEAVE	ARRIVE	LEAVE	ARRIVE	LEAVE	ARRIVE
GRAY	10:25 AM	10:40 AM	10:45 AM	11:00 AM	11:25 AM	11:40 AM
RED	10:30 AM	10:45 AM	10:50 AM	11:05 AM	11:30 AM	11:45 AM
BLUE	10:35 AM	10:50 AM	10:55 AM	11:10 AM	11:35 AM	11:50 AM
ORANGE	10:40 AM	10:55 AM	11:00 AM	11:15 AM	11:40 AM	11:55 AM
GREEN	10:45 AM	11:00 AM	11:05 AM	11:20 AM	11:45 AM	12:00 PM
PURPLE	10:50 AM	11:05 AM	11:10 AM	11:25 AM	11:50 AM	12:05 PM
TAN	10:55 AM	11:10 AM	11:15 AM	11:30 AM	11:55 AM	12:10 PM

SHUTTLE SCHEDULE
RUN NUMBER 3 (AUGUST 7-10,1997)
TEAM "A"

SHUTTLE	EXPO	SCY	SCY	NCY	NCY	EXPO
ID	LEAVE	ARRIVE	LEAVE	ARRIVE	LEAVE	ARRIVE
GRAY	12:05 PM	12:20 PM	12:25 PM	12:40 PM	1:05 PM	1:20 PM
RED	12:10 PM	12:25 PM	12:30 PM	12:45 PM	1:10 PM	1:25 PM
BLUE	12:15 PM	12:30 PM	12:35 PM	12:50 PM	1:15 PM	1:30 PM
ORANGE	12:20 PM	12:35 PM	12:40 PM	12:55 PM	1:20 PM	1:35 PM
GREEN	12:25 PM	12:40 PM	12:45 PM	1:00 PM	1:25 PM	1:40 PM
PURPLE	12:30 PM	12:45 PM	12:50 PM	1:05 PM	1:30 PM	1:45 PM
TAN	12:35 PM	12:50 PM	12:55 PM	1:10 PM	1:35 PM	1:50 PM

SHUTTLE SCHEDULE
RUN NUMBER 5 (AUGUST 9-10, 1997)
TEAM "A"

SHUTTLE	EXPO	SCY	SCY	NCY	NCY	EXPO
ID	LEAVE	ARRIVE	LEAVE	ARRIVE	LEAVE	ARRIVE
GRAY	3:00 PM	3:15 PM	3:20 PM	3:35 PM	4:00 PM	4:15 PM
RED	3:05 PM	3:20 PM	3:25 PM	3:40 PM	4:05 PM	4:20 PM
BLUE	3:10 PM	3:25 PM	3:30 PM	3:45 PM	4:10 PM	4:25 PM
ORANGE	3:15 PM	3:30 PM	3:35 PM	3:50 PM	4:15 PM	4:30 PM
GREEN	3:20 PM	3:35 PM	3:40 PM	3:55 PM	4:20 PM	4:35 PM
PURPLE	3:25 PM	3:40 PM	3:45 PM	4:00 PM	4:25 PM	4:40 PM
TAN	3:30 PM	3:45 PM	3:50 PM	4:05 PM	4:30 PM	4:45 PM

EXHIBIT 9
Shuttle Schedule (Continued)

SHUTTLE SCHEDULE
RUN NUMBER 2 (AUGUST 7-10,1997)
TEAM "B"

SHUTTLE	EXPO	NCY	NCY	SCY	SCY	EXPO
ID	LEAVE	ARRIVE	LEAVE	ARRIVE	LEAVE	ARRIVE
GRAY	11:15 AM	11:30 AM	11:35 AM	11:50 AM	12:15 PM	12:30 PM
RED	11:20 AM	11:35 AM	11:40 AM	11:55 AM	12:20 PM	12:35 PM
BLUE	11:25 AM	11:40 AM	11:45 AM	12:00 PM	12:25 PM	12:40 PM
ORANGE	11:30 AM	11:45 AM	11:50 AM	12:05 PM	12:30 PM	12:45 PM
GREEN	11:35 AM	11:50 AM	11:55 AM	12:10 PM	12:35 PM	12:50 PM
PURPLE	11:40 AM	11:55 AM	12:00 PM	12:15 PM	12:40 PM	12:55 PM
TAN	11:45 AM	12:00 PM	12:05 PM	12:20 PM	12:45 PM	1:00 PM

SHUTTLE SCHEDULE
RUN NUMBER 4 (AUGUST 7-10,1997)
TEAM "B"

SHUTTLE	EXPO	NCY	NCY	SCY	SCY	EXPO
ID	LEAVE	ARRIVE	LEAVE	ARRIVE	LEAVE	ARRIVE
GRAY	12:55 PM	1:10 PM	1:15 PM	1:30 PM	1:55 PM	2:10 PM
RED	1:00 PM	1:15 PM	1:20 PM	1:35 PM	2:00 PM	2:15 PM
BLUE	1:05 PM	1:20 PM	1:25 PM	1:40 PM	2:05 PM	2:20 PM
ORANGE	1:10 PM	1:25 PM	1:30 PM	1:45 PM	2:10 PM	2:25 PM
GREEN	1:15 PM	1:30 PM	1:35 PM	1:50 PM	2:15 PM	2:30 PM
PURPLE	1:20 PM	1:35 PM	1:40 PM	1:55 PM	2:20 PM	2:35 PM
TAN	1:25 PM	1:40 PM	1:45 PM	2:00 PM	2:25 PM	2:40 PM

SHUTTLE SCHEDULE
RUN NUMBER 6 (AUGUST 9-10, 1997)
TEAM "B"

SHUTTLE	EXPO	NCY	NCY	SCY	SCY	EXPO
ID	LEAVE	ARRIVE	LEAVE	ARRIVE	LEAVE	ARRIVE
GRAY	3:50 PM	4:05 PM	4:10 PM	4:25 PM	4:50 PM	5:05 PM
RED	3:55 PM	4:10 PM	4:15 PM	4:30 PM	4:55 PM	5:10 PM
BLUE	4:00 PM	4:15 PM	4:20 PM	4:35 PM	5:00 PM	5:15 PM
ORANGE	4:05 PM	4:20 PM	4:25 PM	4:40 PM	5:05 PM	5:20 PM
GREEN	4:10 PM	4:25 PM	4:30 PM	4:45 PM	5:10 PM	5:25 PM
PURPLE	4:15 PM	4:30 PM	4:35 PM	4:50 PM	5:15 PM	5:30 PM
TAN	4:20 PM	4:35 PM	4:40 PM	4:55 PM	5:20 PM	5:35 PM

EXHIBIT 10
Driver Checklist

JOB FUNCTION: SAFELY SHUTTLE PASSENGERS TO AND FROM MIRAMAR COLLEGE AND THE LIVE VEHICLE DEMONSTRATION STAGING AREAS

1. Departure times from Miramar College are based on average speeds and traffic conditions, with passengers arriving at the staging areas approximately ten minutes prior to Demo loading time. No speeding or reckless driving shall be considered at any time. Passenger safety shall always be considered top priority.
2. Schedules assume no stops (i.e. for food, gas, etc.) between start and end points. Breaks shall taken during down time between runs.
3. Please do not eat, drink, or smoke in the vans.
4. DO NOT SPEED; YARD AND EXPO SPEED IS 5 MPH.
5. Always follow instructions of traffic coordinators.
6. Visually inspect your vehicle at the beginning and end of each day.
7. Stay in or near shuttle at all times.
8. OES radios in the vehicles are for emergency use only and for monitoring the status of the Demonstration. Keep the radios on at all times. (To activate, push on/power. Push mode button until you reach NAHS. Adjust volume as required). Use radios to advise of traffic delays, mechanical breakdowns, and passenger emergencies.
9. Vans must be in PARK before cargo door will open automatically.
10. Keep passengers in A/C van, until directed to load/unload.
11. Complete vehicle mileage logs daily.
12. Learn main and alternate routes to and from all sites.
13. Wash and gas vehicles as instructed.

At the end of each day secure the van (close windows, leave keys on the dash, remove trash, clean windows).

APPENDIX C Associate Participant Guidelines

NATIONAL AUTOMATED HIGHWAY SYSTEM CONSORTIUM

Agreement For Participation in the National Automated Highway System Consortium Technical Feasibility Demonstration

NAHSC

Date Page 202 of 6

This Agreement between the National Automated Highway System Consortium (the "Consortium") and ------------------("Vehicle Developer"), sets forth the roles, duties, obligations, rights and responsibilities of the Consortium and Vehicle Developer regarding participation in the "live vehicle" portion of National Automated Highway System Consortium Technical Feasibility Demonstration ("Demonstration '97") to be held on I-15 High Occupancy Vehicle (HOV) Express lanes in San Diego, California. The provisions of this Agreement and the Vehicle Developer's Demonstration Work Plan constitutes the total agreement between the Consortium and the Vehicle Developer regarding Demonstration '97. The effective period of this agreement covers the period starting on the date of signature of the agreement to the conclusion of the demonstration task.

Applicable Documents
The following documents of the exact issue shown form a part of this document to the extent referenced herein.

National Automated Highway System Consortium Technical Feasibility Demonstration Specification, dated April 7, 1997.

National Automated Highway System Consortium Technical Feasibility Demonstration Test/Certification Plan, dated April 7, 1997.

National Automated Highway System Consortium Technical Feasibility Demonstration Performance and Safety Certification Procedure, dated May 16, 1997, Revision A

National Automated Highway System Consortium Technical Feasibility Demonstration Safety Plan, dated April 7, 1997.

1. **Demonstration Scenarios** - Each Vehicle Developer shall submit a Demonstration Scenario which specifies a "High" and "Low" goal for their demonstration.

   a) ***Scenario Baseline*** - The content of the scenarios shall be "frozen" effective 1 November 1996. Subsequent changes to scenario content shall require review and approval by the Demonstration Team. After 1 November 1996 dissemination of scenario content will be permitted to all Demonstration '97 participants and made available for Public Relations and Media activities.

   b) ***Scenario Driver and Narrator*** - All scenario automated vehicles require a person dedicated as the driver and another person dedicated as the narrator. The scenario vehicle driver is responsible for operating the scenario vehicle for the execution of the scenario. The scenario vehicle narrator is responsible for keeping the passengers apprised of what is happening and what is about to happen with the vehicle, as well as the scenario and perform as the Voice Radio Operator in the vehicle.

c) ***Scenario Scheduling*** - Demonstration scenarios shall be executed in accordance with published scenario sequences and schedules. In the event a participant is not able to execute their scenario in its allocated time slot, Core participants shall have "first right of refusal" for the vacated time slot. However, a vacated time slot will not be filled unless the vacated time slot is known at least 2 hours prior to the scheduled initiation of the vacated scenario.

d) ***Demonstration Passenger Scheduling*** -. Scheduling of passenger rides in live demonstration vehicles shall be performed by the Demonstration Public Education and Live Vehicle Production Teams.

2. **Demonstration Requirements** - Demonstration performance, safety and scenario requirements shall be demonstrated to the Consortium prior to Demonstration '97. The requirements for demonstration vehicles are documented in the National Automated Highway System Consortium Technical Feasibility Demonstration Specification.

3. **Voice Communications** - The Vehicle Developer shall provide in-vehicle voice communications compatible with the Demonstration '97 voice communications system for all vehicles participating in the "live" demonstration.

4. **Vehicle Development Status Reporting** - The Vehicle Developer shall submit a monthly status report to the NAHSC Program Office, Attention: Ron Colgin, indicating progress and any problems relative to the Demonstration Vehicle Development Schedule and Vehicle Development Plan submitted as part of the Vehicle Developer's Demonstration Work Plan. The status report should be received at the Program Office by the 5th working day of each month through July 1997.

5. **Vehicle Certification** - All vehicles shall be subject to the provisions of the National Automated Highway System Consortium Technical Feasibility Demonstration Specification and Performance and Safety Certification Procedure.

   a) Each Live Vehicle Demonstration participant shall submit an "On-Lane" Test Schedule for proposed testing on the I-15 lanes not later than 1 December 1996.
   b) On-lane Test Plans shall be submitted not later than two weeks prior to a Vehicle Developer's scheduled on-lane testing.
   c) As part of the vehicle certification process, a performance and safety evaluation team shall visit each vehicle developer site to conduct an on-site evaluation of all vehicles prior to delivery of the vehicles to the San Diego I-15 lanes.
   d) All vehicle "On-Lane" certification shall be accomplished prior to the first scheduled Dress Rehearsal in July 1997.
   e) Completion of vehicle "On-Lane" certification is a pre-requisite for participation in the first Dress Rehearsal.
   f) Vehicles which do not participate in all scheduled Dress Rehearsals shall be excluded from the live vehicle demonstration.

   [Dates contained in this section may be adjusted by the Consortium based on the vehicle development schedule and vehicle availability at local development sites for pre-certification and at the I-15 area for on-lane certification.]

6. **"On - Lane" Dry Runs** - Dry Runs shall be conducted by each demonstration vehicle and system developer at the I-15 High Occupancy Vehicle (HOV) Express Lanes in San Diego California. Dry Runs include, continued development, experiments, test and scenario validation conducted by vehicle and system developers of functional, performance and safety requirements as specified in the National Automated Highway System Consortium Technical Feasibility Demonstration Specification.

7. **Dress Rehearsals** - The Vehicle Developer shall participate in all Consortium sponsored "Dress Rehearsals" during the month of July, 1997. Each dress rehearsal shall take place in a period of time not to exceed a week (7 days) in duration.

8. **Demonstration Site Operations** - All Vehicle Developers are subject to the following:

   a) ***Site Work Rules*** - Vehicle Developers shall comply with all posted site work rules, hours of operation, safety and security requirements from the time of arrival at the demonstration site, through the time they leave the demonstration site.

   b) ***Fueling*** - Vehicle Developers shall coordinate with the Caltrans Site Manager or designee prior to the start of any fueling operations.

   c) ***Food, Water, Toilet Facilities*** - The Consortium will provide access to food, water, toilet facilities, trash collection and disposal and other support services for Vehicle Developer teams of the "Live Vehicle" portion of Demonstration '97, from the initial occupancy of South Control Yard facilities (estimated 1 May 1997) through the conclusion of Demonstration '97.

   d) ***Spare Parts and Repairs*** - Vehicle Developers shall provide a published plan for emergency repair to accommodate unforeseen component failures during Demonstration week, including labor, spare parts and spare vehicle as required.

   e) ***Major Maintenance*** - Vehicle Developers' major mechanical maintenance shall be performed at a location other than the South Control Yard or the North Staging Area. Vehicle Developers must provide their own major maintenance facilities at off-site locations, if required.

   f) ***South Control Yard Facilities*** - NAHSC will make facilities, hoists, tools, etc. available at the South Control Yard and other locations in support of live vehicle demonstration participants strictly on an as-available basis. Core participants shall have priority in the use of these facilities.

9. **Public Relations and Media Activities** - The Vehicle Developer shall provide prior notification of specific content regarding public relations/media activities related to the National Automated Highway System Consortium Technical Feasibility Demonstration to Celeste Speier of the Consortium Public Education Team. All such public relations/media activities must first be approved by the Consortium Public Education Team. Public Relations and Media materials relating to the Live Vehicle Demonstration and Exposition Center Exhibits, distributed by Demonstration participants before, during and after the Demonstration event, shall be coordinated through Demonstration Public Education team.

10. **Exposition Center Requirements** - Requirements for Exhibit booth space, static and other demonstrations in the Exposition area shall be procured and coordinated through the Demonstration Exposition Production Team.

11. **Live Demonstration Hospitality and Media Operations:**

   a) There shall be a NAHSC Hospitality tent in the North Staging Area where all Core and Associate Participants in the Live Vehicle. Demonstration logos and a list of all other Consortium Associates will be displayed.

   b) There will not be a Media Tent/Structure at either the North Staging Area or the South Control Yard. Interviews and public relations materials provided to the media by Live Vehicle Demonstration participants and passengers will be provided at the Exposition Center. Spare Demonstration vehicles and/or scenario specific presentation material may be displayed at the North Staging Area for passenger review.

c) Core or Associate organizational specific tents are not permitted at the North Staging Area or the South Control Yard, except for work area shade tents(or shelter) at the South Control Yard.

12. **Demonstration Vehicle Logos** - All vehicles participating in the live demonstration shall display a logo as provided below:

    a. ***On I-15 HOV Express Lanes*** - During the live vehicle demonstration event, on the I-15 HOV express lanes, the standard Consortium logo or the standard Consortium logo with the word "Associate" as a header or footer will be required on the demonstration vehicles and will be the only logo allowed on the vehicles. Such logos will be provided by the NAHSC

    b. ***Off I-15 HOV Express Lanes*** - When demonstration vehicles are used for static media displays, presentation backdrops, pre-recorded video, mini-demos, etc., the vehicles may use additional company or team logos.

13. **Live Video** - All requests for permission to provide live video from live demo vehicles, whether from vehicle installed video cameras or hand held video cameras shall be coordinated through the Demonstration Public Education Team.

14. **Financial Support** - Other than as specified herein, or separately agreed to by both parties in writing, the Consortium shall not provide any financial support to the Vehicle Developer.

15. **Cost Share** - The Vehicle Developer shall provide written estimates of the value of its Demonstration participation, excluding vehicle development cost, as cost share to the National Automated Highway System Consortium Technical Feasibility Demonstration.

16. **Demonstration Vehicle Exclusion** - The Consortium has the right to exclude from the Demonstration any vehicle that fails to meet the "Requirements" as specified by the National Automated Highway System Consortium Technical Feasibility Demonstration Specification, Safety and Certification requirements, or any other requirements listed in this agreement in connection with the National Automated Highway System Consortium Technical Feasibility Demonstration.

17. **Information Markings Guidelines** - Due to the public nature of the Consortium and the entire AHS Program, the Consortium cannot guarantee that information or data provided by a party in connection with the 1997 Demonstration will be protected from public release. Nevertheless, if there is data supplied to the Consortium that the Vehicle Developer wishes not to be shared with another Vehicle Developer, such data should be marked NAHSC/ASSOCIATE SENSITIVE. The Consortium will use reasonable commercial efforts to protect disclosure of any information or data that is clearly marked NAHSC/ASSOCIATE SENSITIVE from any third party other than the NAHSC Core Participants and the Vehicle Developer who supplied the data, but neither the Consortium nor any of its Participants shall have any liability whatsoever if such information is disclosed. The Consortium will not under any circumstances accept any information marked PROPRIETARY or CONFIDENTIAL.

18. **Insurance** - Vehicle Developer shall maintain not less than the following insurance during performance of Services under this Agreement:

    a) Commercial General Liability Insurance for not less than a $5,000,000 combined single limit each occurrence for Bodily Injury and Property Damage Liability.
    b) Commercial Automobile Liability Insurance for not less than a $5,000,000 combined single limit each occurrence for Bodily Injury and Property Damage Liability.
    c) Workers Compensation Insurance as required by law and Employers Liability Insurance for not less than a $1,000,000 limit.

19. **Liability Disclaimer** - The Vehicle Developer shall participate in Demonstration '97 at its own risk, and neither the Consortium, any Core Participant or any shareholder, officer, director, employee, agent, attorney or consultant to the Consortium or any Core Participant (collectively, "Affiliated Parties") shall have any liability to the Vehicle Developer, its shareholders, officers, directors, agents, or employees, or any third party resulting from such participation and Vehicle Developer indemnifies and holds the Consortium, each Core Participant and their respective Affiliated Parties harmless against any such liability.

    All passengers of live demonstration vehicles Will be required to sign an Informed Consent form as provided by the Consortium.

By the evidence of the signatures below, both parties understand and agree to their respective roles and responsibilities in regard to satisfying the requirements of the National Automated Highway System Consortium Technical Feasibility Demonstration.

______________________ ________ Date   ____________________ NAHSC ______ Date

APPENDIX D Communications Plan

PURPOSE:
To establish voice communications operating guidelines for the National Automated Highway System Consortium (NAHSC) 1997 Technical Feasibility Demonstration.

SCOPE:
Applies to all participants in the Automated Highway System 1997 Technical Feasibility Demonstration. Includes the "Live Vehicle" demonstration on the I-15 express lanes, staging areas at the North and South ends of the demonstration lanes, the South Control Yard Facility, Mini-Demonstrations, the '97 Demonstration Exposition Center and transport operations between the Exposition Center and the Live Vehicle demonstration lanes.

RESPONSIBILITIES:
Each Participant is responsible for ensuring that the guidelines established herein are followed. Anyone found not in compliance with the guidelines set forth in this document will be asked to leave the Demonstration facility and report to the Demonstration Task Lead for further instructions.

REMARKS:
This document is intended to provide a set of guidelines to ensure safe and efficient operation of voice communications during testing, dry runs, and execution of live vehicle demonstrations on the Demonstration Facility.

DEFINITIONS:

Caltrans Radio Net
A designated voice radio net for safety operations and emergency reporting. This channel will provide the back-up access for Emergency Broadcast and Safety information and operational communications for the Live Vehicle Demonstration. This channel will provide connectivity to the Kearny Mesa Caltrans TMC, and the South Control Yard. The capability to transmit and receive on the SOLEDAD Repeater channel is required to operate vehicles on the lanes under Caltrans safety policy. The voice radios which will be installed in each of the vehicles participating in live demonstrations on the I-15 express lanes in San Diego will be capable of monitoring the Caltrans dedicated channel for safety and emergency communications. The Caltrans Radio Net includes the following participants:

- Demonstration Control Center at the South Control Yard
- Demonstration Vehicles
- Caltrans District 11 Kearny Mesa Transportation Management Center

Control Center
The facility at the South Control Yard where all Live Vehicle Demonstration control and communications control will be accomplished. This facility will provide a central point for all key live vehicle demonstration control personnel functions. This function will be in the Electronics Laboratory area of the Temporary Service Building of the South Control Yard.

Demonstration Administrative Voice Communications
Provided by each demonstration participant for their individual team communications. Provides for internal voice communications among members of a particular core or associate group. This is an optional voice radio/communications net. It is acceptable to operate commercially available voice radio or cellular telephone communications equipment within the demonstration venue.

Demonstration Facility

All sites and facilities associated with the AHS '97 Technical Feasibility Demonstration. Includes I-15 express demonstration lanes, North and South Staging Areas, South Control Yard, Mini-Demonstration area and Exposition Center.

Demonstration Lanes

The 7.6 mile segment of reversible express lanes along Interstate 15 north of San Diego, California. The segment consists of two twelve-foot wide concrete paved lanes with two ten-foot wide asphalt paved shoulders. The segment is comprised of lanes constructed in the median of I-15 which are open for southbound traffic during the morning commuting hours and northbound traffic during the afternoon commuting hours. Jersey barriers are installed on both sides of the lanes for the total length, providing isolation and protection from vehicles traveling in the mainline traffic lanes. The lanes are instrumented for radio communications and remote gate control through the local Caltrans Transportation Management Center.

Demonstration Radio Net

The voice radios which will be installed in each of the vehicles participating in live demonstrations on the I-15 HOV express lanes in San Diego will be used to monitor the NAHSC dedicated channel for on-going lane activity coordination. The channel is intended to ensure that all participants are aware at all times of activity on the lanes, including when vehicles are in motion and their position when on the lanes. This channel will also provide the primary access for Emergency Broadcast and Safety information. This channel will provide connectivity to all Demonstration Command and Control facilities via the NAHSC Repeater as well as direct talk-around operations. The capability to transmit and receive on the NAHSC Repeater channel and the existing SOLEDAD Repeater channel is required to operate vehicles on the lanes under Caltrans safety policy. Depending on the time of day, one or both of two available channels will be utilized for emergency communications. The Demonstration Radio Net includes the following participants:

- Caltrans District 11 Kearny Mesa Transportation Management Center
- NAHSC Demo Presentation Center (DPC) at the Exposition Center
- North Staging Area
- South Staging Area
- Demonstration Control Center at the South Control Yard
- All Demonstration Vehicles
- All Demonstration Operations Portable Radios

Live Vehicle Demonstration

The event encompassing instrumented vehicles executing scenarios on the I-15 express demonstration lanes.

Live Vehicle Demonstration Facility

The Live Vehicle Demonstration Facility includes the Demonstration Lanes, North and South Staging Areas and South Control Yard.

North Staging Area

A parcel of land owned by Pardee Construction Company adjacent to the I-15 off-ramp to Ted Williams Parkway (Route 56) is being designed for use as a staging area. This site has become known as the "North Staging Area" and is being leased by Caltrans for use during the Live Vehicle Demonstration. Improvements are being made to allow for loading and unloading of passengers during the Live Vehicle Demonstration. A media and light refreshment "hospitality" area including restrooms is being provided for the Live Vehicle Demonstration passengers. Transportation to and from this site and the Demonstration Exposition Center will be provided.

South Control Yard

A section of land adjacent to the Route 163 entrance ramp to the northbound I-15 HOV express lanes, set aside to be utilized as a maintenance and storage area. This site has come to be known as the South Control Yard and will serve as the primary maintenance and storage site during the testing and rehearsal stage prior to and during the 1997 Demonstration. The site is configured such that access is possible via Kearny Villa Road, an arterial road which crosses Route 163. The general configuration of the South Control Yard will include two functional buildings, a portable restroom trailer, several service trailers and covered parking for twenty demonstration vehicles. The access road, which will be constructed across the Miramar egress, provides a path of travel into the staging area. The direct path of this road continues through the parking structure and onto the entrance ramp dedicated to the demonstration roadway. This new entrance ramp to the express lanes will have a jersey barrier-type wall on the Route 163 live traffic side. This wall will ensure that vehicles traveling on Route 163 will not have access to the demonstration roadway, plus provide safety for the demonstration vehicles. Site security will be ensured by providing a 6 foot chain-link fence around the entire site. Gates will be provided at the roadways, which will be locked when the site is not in use. Twenty-four hour security personnel will be on-site beginning when the first demonstration vehicle arrives on site.

South Staging Area

The temporary storage structure designated for vehicle storage and parking in the South Control Yard near the Route 163 entrance ramp will be utilized as a staging area. This site will be known as the "South Staging Area" and will serve as the demonstration lanes south end staging area for the Live Vehicle Demonstration. The South Staging Area will provide a location for loading demonstration passenger and initiation and termination of demonstration scenarios. Restrooms provided will either be temporary portable toilets located near the facility or the restrooms provided for the South Control Yard. Transportation to and from this site and the Demonstration Exposition Center will be provided.

GUIDELINES:

Vehicle Radio Requirements

Every vehicle entering the Demonstration Facility must have a vehicular mounted or portable radio dedicated to voice radio communications turned on at all times for communication and instructional purposes. The voice radios must be capable of operating on both the Demonstration Radio Net and the Caltrans Radio Net. If a portable radio is used in a vehicle, it must remain within the vehicle at all times the vehicle is in operation on the facility (just as a vehicle mounted radio would). It is recommended that the portable radio be provided with vehicle power rather than rely on battery power. (See Attachment A for Voice Radio Specifications)

Demonstration Radio Net Communications

During on-lane test and certification, the Demonstration Radio Net will be used extensively for vehicle-to-vehicle coordination and communications directly related to testing, certification, and coordination. Beginning with the Dress Rehearsals, and during the actual demonstration, the Demonstration Radio Net will be used for operational control purposes, and vehicle-to-vehicle coordination will be minimized. The need for extensive vehicle-to-vehicle communications/coordination during the demonstration will be resolved procedurally prior to the Dress Rehearsal and Demonstration time. (See Attachment B for Demo Operational Control Voice Communications Equipment List)

Demonstration Administrative Voice Communications

The Demonstration Administrative Voice Communications is an optional voice communications system. However, administrative communications is prohibited over the **Demonstration Radio Net** or **Caltrans Radio Net.**

Participants using Demonstration Administrative Voice Communications are reminded that communications within that system is not part of the Demonstration Radio Net or Caltrans Radio Net. **All operations, control and emergency communications must be transmitted and received over either the Demonstration Radio Net or Caltrans Radio Net.**

It is acceptable to operate any commercially available voice communications equipment, including cellular telephone or voice radio within the demonstration venue. Caltrans does NOT have additional licenses available to support separate channels for radio communications within individual groups. Each group interested in voice communications dedicated to internal operations will be responsible for providing that capability separately from the Caltrans or NAHSC dedicated channels. In the case of voice radio, each participant will be responsible for obtaining licenses, if necessary, to operate the private voice radio communications channel of their choice. In the case of cellular telephone, each participant will be responsible for obtaining the required services within the demonstration venue.

Any participant choosing to operate a private voice radio channel should notify the demonstration communications lead of your plans so that interference can be minimized. Contact information is as follows:

Aimee Cochran
Voice: (619) 683-8794
FAX: (619) 683-8799
E-Mail: acochran@msmail3.hac.com

The following information should be provided for the private voice communications channel expected to be used:

- frequency of operation
- licensing status
- number of vehicles/radios anticipated

_ maximum transmit power.

(See Attachment C for Demo Administrative Voice Communications Equipment List)

Voice Radio Call Signs

All Live Vehicle Demonstration participants and support staff have assigned designated Call Signs (See Attachment D). Participants will use the Call Signs when communicating on the Demonstration Radio Net or Caltrans Radio Net.

Live Vehicle Demo Control positions listed in Attachment D will be assigned to either base mounted or portable radios capable of operating in both the Demonstration Radio Net and Caltrans Radio Net. The Call Signs designated for each position will be used during voice radio communications.

When using the Demonstration Administrative Voice Communications system, Live Vehicle Demo Control positions listed in Attachment D are expected to use designated Call Signs.

Live Vehicle Narrators will operate either vehicle mounted or portable radios while in the vehicles during on-lane demonstrations. The Call Signs designated for each vehicle will be used during voice radio communications.

Net Control Procedures

Caltrans Radio Net
The Caltrans Radio Net will be controlled at the Caltrans District 11 Kearny Mesa TMC. Existing Caltrans procedures will govern the operation of the Caltrans Radio Net. Operators of radios using the SOLEDAD channel shall identify themselves using their call sign and shall state their location.

Demonstration Radio Net
The Demonstration Communications Lead at the South Control Yard Command and Control Center will exercise Net Control procedures for the Demonstration Radio Net.

The primary Demonstration Radio Net channel is identified as NAHSC. The NAHSC channel shall be used for all safety and activity coordination communications by demonstration participants. The NAHSC channel shall not be used for conducting administrative communications.

The Safety Officer shall have constant communication access to the Caltrans District 11 TMC and to all vehicles operating on the I15 express demonstration lanes. The Safety Officer shall have the authority to suspend activity on the Demonstration venue if non-emergency communications on the NAHSC channel are disrupted.

The NAHSC channel shall be used as the primary channel for reporting emergencies on the demonstration facility. The SOLEDAD channel shall be used as the backup channel in the event that acknowledgment is not received to emergency communications conducted using the NAHSC channel. Emergency call boxes are located on both sides of the I15 express demonstration lanes at half-mile intervals. The call boxes shall be used to contact emergency personnel in the event that communications on both the SOLEDAD and NAHSC channels are not acknowledged. Dial 911 using the call box telephone in the event of an emergency that is not acknowledged using the SOLEDAD or NAHSC channels.

Operators of radios using the NAHSC channel shall identify themselves using their call sign and shall state their location. Messages shall be kept brief when using the Demonstration Radio Net or Caltrans Radio Net. Refer to Attachment E for voice radio call signs.

Non-emergency radio communications shall be conducted by the scenario narrator in each vehicle while the vehicle is in motion. The vehicle driver shall not conduct non-emergency radio communications while operating the vehicle.

Refer to Attachment E for Demonstration Radio Net entry and operating procedures.

Telephone/Facsimile/Computer Terminals/Data Links Operations

General

Caltrans New Technology department personnel will coordinate Core and Associate Participants telephone service requirements.

A separate account for each Associate Participant will be established for their Telephone/Facsimile/Computer Terminals/Data Link services. Associate Participants will be billed separately and directly by Pacific Bell for Telephone/Facsimile/Computer Terminals/Data Link services.

A group account for all Core participants will be established. Core Participants will be billed under one NAHSC account established with Pacific Bell for all Core Participants' Telephone/Facsimile/Computer Terminals/Data Link services. A Live Vehicle Production communication budget will be established and assigned to a Core Participant for administration.

South Control Yard and Staging Area

Caltrans New Technology department personnel will arrange to install Telephone/Facsimile/Computer Terminals/Data Link service in the '97 Demonstration facilities at the South Control Yard with Pacific Bell.

North Staging Area

Caltrans New Technology department personnel will arrange for installation of wiring to support Telephone/Facsimile/Computer Terminals/Data Link service at the North Staging Area. Caltrans New Technology department personnel will coordinate Core and Associate Participants telephone service requirements at the North Staging Area.

Exposition Center

Coordination of telephone service at the Exposition Center will be accomplished through the Exposition Production Team Lead. There are provisions in the Consortium agreement with Miramar College for two (2) telephone voice lines and one (1) Fax line at the small site office. The Exposition Site Office may be reached through the Miramar College switchboard. Direct access to the Exposition Site Office telephone numbers is also possible when dialed directly. An answering machine will be used on the Exposition Site Office telephones until Miramar College activates a voice mail system. No other permanent telephone service is planned at this time.

Temporary telephone services will be made available for rent by each Exhibitor. Coordination for telephone service will be accomplished by the Exposition Production Team.

A temporary trailer mounted pay telephone service will be provided for the Exposition/Conference/Demonstration attendees in the Exposition Center area for general public use.

Allocation of Telephone/Facsimile/Computer Terminals/Data Link services will be provided as shown in Attachment F. A '97 Demonstration Telephone Directory will be published as a separate document.

Non-Radio Communications Using Vehicle Lights

Non-Radio Communications Using Vehicle Lights is described in Attachment G.

EMI/EMC Considerations

The NAHSC organization is not capable of enforcing control over intentional or unintentional radiators. The FCC and the military have this responsibility and power. Therefore, the NAHSC will defer to licensing regulations of the FCC and interests of security of the military at Miramar. The NAHSC will not be capable of preventing interference and therefore does not intend to monitor the presence of intentional or unintentional radiators. (See Attachment H)

REFERENCES:

1. Memorandum, "Voice Communications and Operating Procedure", Hughes, Aimee Cochran, 6 September 1996
2. Memorandum, "NAHSC Voice Communications on I-15 HOV Express Lanes", Caltrans, Bob Battersby, 11 October 1996

ATTACHMENTS:

A - Voice Radio Specifications
B - Demo Operational Control Voice Communications Equipment Requirements Matrix
C - Demo Administrative Voice Communications Equipment Requirements Matrix
D - Demonstration Operational Control Voice Radio Communications Call Signs
E - Radio Communications Procedures
F - Telephone/Facsimile/ Computer Terminals/Data Link Service
G - Non-Radio Communications Using Vehicle Lights
H - EMI/EMC Considerations
I - Voice Radio Communications Contingency

TECHNICAL OWNER: **Aimee Cochran**
Communications Coordinator
AHS '97 Demonstration
AHS Program

APPROVED: ______________________

Theresa Quinlan
AHS '97 Demonstration Task Leader
AHS Program

Attachment A - Voice Radio Specifications

The voice radio specifications are as follows:

Frequency
Receive: 851-869 MHz (repeater operation)
Transmit: 806-824 MHz (repeater operation)
851-869 MHz (direct talk around operation)

Squelch
Switchable between carrier operated and decoder operated squelch. Shall be able to use any of the standard EIA CTCSS tones on both transmit and receive.

Power Output:
15 watts nominal RF power output (preferred). 5 watts to 35 watts should provide acceptable operation.

User Interface:
- Helmet mounted headset with selectable voice activated transmit (VOX) may be desirable for vehicle radios.
- Frequency switchable between operating frequencies.
- Switchable between direct and repeater modes of operation.

NAHSC Demonstration Radio Net Operating Frequencies
For primary control, safety, and operational communications (NAHSC Repeater)
Receive: 868.0375 MHz
Transmit: 823.0375 MHz (NAHSC Repeater)
868.0375 MHz direct (talk-around) operation
Decoder operated squelch: 192.8 Hz - Both Transmit and Receive

Caltrans Radio Net Operating Frequencies
For Backup Emergency Communications from Vehicles (SOLEDAD Repeater)
Receive: 857.1000 MHz
Transmit: 812.1000 MHz (SOLEDAD Repeater)
Decoder operated squelch: 110.9 Hz - Both Transmit and Receive

Attachment B - Demo Operational Control Voice Communications Equipment Requirements Matrix

	Radio			Cellular			
User	**Base**	**Vehicle**	**Portable**	**Analog**	**Digital**	**Source**	**Remarks**
'97 Demo Operations							
Demo C^3	1					Caltrans	@ SCY
Caltrans TMC	1					Caltrans	@ TMC
'97 Demo Lead			1			Caltrans	
'97 Demo Lead, Assistant			1			Caltrans	
Demonstration Safety							
Demonstration Safety Lead			1			Caltrans	
Demonstration Safety Lead, Assistant			1				
Live Vehicle Production Safety Officer			1			Caltrans	
Live Vehicle Production Safety Officer, Assistant			1				
Exposition Safety Officer			1				
Exposition Safety Officer, Assistant			1				
Mini Demo Safety Officer			1				
Mini Demo Safety Officer, Assistant			1				
Caltrans Safety Officer (San Diego TMC Safety Officer)			1			Caltrans	
Caltrans Safety Officer (San Diego TMC Safety Officer), Assistant			1			Caltrans	
Live Vehicle Production							
Vehicle Production Lead			1			Caltrans	
Vehicle Production Lead, Assistant			1				
Caltrans Site Manager			1			Caltrans	
Caltrans Site Manager Assistant			1				
Communications Lead			1			Caltrans	
Communications Lead Assistant			1				
Site Vehicle Manager			1			Caltrans	
Site Vehicle Manager Assistant			1				
Passenger Assignment Coordinator			1				
Passenger Assignment Coordinator Assistant							
Shuttle Bus Coordinator			1				

Attachment B - Demo Operational Control Voice Communications Equipment Requirements Matrix (Continued)

	Radio			Cellular			
User	Base	Vehicle	Portable	Analog	Digital	Source	Remarks
Live Vehicle Production(Continued)							
Shuttle Bus Coordinator Assistant							
Shuttle Bus Operator (1-6)			6				
North Staging Area Coordinator			1				
South Staging Area Coordinator			1				
Mini-Demo Lead (Expo Vehicle Manager)			1				
Mini-Demo Lead (Expo Vehicle Manager) Assistant			1				
Multi-Platform Free Agent Scenario							
CMU/ Houston Metro Vehicle #1		TBD				TBD	
CMU/ Houston Metro Vehicle #2		1				Hughes	
CMU/ Houston Metro Vehicle #3		TBD				TBD	
CMU/ Houston Metro Vehicle #4		1				Hughes	
CMU/ Houston Metro Vehicle #5		1				Hughes	
Platoon Scenario							
Platoon Vehicle #1 - PATH		1				Hughes	
Platoon Vehicle #2 - PATH		1				Hughes	
Platoon Vehicle #3 - PATH		1				Hughes	
Platoon Vehicle #4 - PATH		1				Hughes	
Platoon Vehicle #5 - PATH		1				Hughes	
Platoon Vehicle #6 - PATH		1				Hughes	
Platoon Vehicle #7 - PATH		1				Hughes	
Platoon Vehicle #8 - PATH		1				Hughes	
Platoon Vehicle #9 - PATH - Spare		1				Hughes	
Platoon Vehicle #10 - PATH -Spare		1				Hughes	

Attachment B - Demo Operational Control Voice Communications Equipment Requirements Matrix (Continued)

	Radio			Cellular			
User	**Base**	**Vehicle**	**Portable**	**Analog**	**Digital**	**Source**	**Remarks**
Live Vehicle Production(Continued)							
IDV/ORV Scenario							
Caltrans Infrastructure Diagnostic Vehicle		1				Hughes	
Caltrans Debris Removal Vehicle		1				Hughes	
Caltrans Infrastructure Diagnostic Vehicle (Spare)		1				Hughes	
Honda Scenario							
Honda Vehicle #1		1				Honda	
Honda Vehicle #2		1				Honda	
Honda Vehicle #3 - Spare		1				Honda	
Toyota Scenario							
Toyota Vehicle #1 - Non Automated		1				Toyota	
Toyota Vehicle #2 - Non Automated		1				Toyota	
Toyota Vehicle #3 - Automated		1				Toyota	
Toyota Vehicle #4 - Automated		1				Toyota	
OSU Scenario							
OSU Vehicle #1 - Non Automated		1				OSU	
OSU Vehicle #2 - Automated		1				OSU	
OSU Vehicle #3 - Automated		1				OSU	
Live Vehicle Production(Continued)							
Eaton Scenario							
Eaton VORAD Truck		1				Eaton	
Eaton VORAD Car 1		1				Eaton	
Eaton VORAD Car 2		1				Eaton	
Houston Scenario							
Houston Metro Bus #1		1				Houston	
Houston Metro Bus #2		1				Houston	
Houston Metro Police Car		1				Houston	

Attachment B - Demo Operational Control Voice Communications Equipment Requirements Matrix (Continued)

	Radio			Cellular			
User	**Base**	**Vehicle**	**Portable**	**Analog**	**Digital**	**Source**	**Remarks**
Obstacle Placer							
Obstacle 1			1			Caltrans	
Obstacle 2			1			Caltrans	
Obstacle 3			1			Caltrans	
Obstacle 4			1			Caltrans	
Obstacle 5			1			Caltrans	
Vehicle Haulers			1				
Emergency Services Operators							
Ambulance 1			1				
Fire Truck 1			1				
Wrecker 1			1				
Exposition Production							
Exposition Production Lead			1	1			
Exposition Production Lead, Assistant			1	1			
Demonstration Presentation Center (DPC) Lead			1	1			
Demonstration Presentation Center (DPC) Lead, Assistant							
Camera Operator			1	1			
Technical Conference Lead				1			
Technical Conference Lead, Assistant				1			
Expo Marketing Lead				1			
Expo Marketing Lead, Assistant				1			
NAHSC Exhibit Coordinator				1			
NAHSC Exhibit Coordinator, Assistant				1			
Hospitality Coordinator				1			
Hospitality Coordinator, Assistant				1			
Service Contract Coordinator			1				
CPS Coordinator				1			
NTP Coordinator				1			
ASTS Coordinator							

Attachment B - Demo Operational Control Voice Communications Equipment Requirements Matrix (Continued)

	Radio			Cellular			
User	**Base**	**Vehicle**	**Portable**	**Analog**	**Digital**	**Source**	**Remarks**
Public Education							
Public Education Lead			1	1			
Public Education Lead, Assistant				1			
Media Lead				1			
Media Lead, Assistant				1			
Materials Lead				1			
Materials Lead, Assistant				1			
Community Relations Lead				1			
Community Relations Lead, Assistant				1			
Thematic Images Lead				1			
Thematic Images Lead, Assistant				1			
Attendee Services Coordinator				1			
Attendee Services Coordinator, Assistant				1			
Grandstand Announcer			1	1			

Attachment B - Demo Operational Control Voice Communications Equipment Requirements Matrix (Continued)

Recapitulations

Core Consortium Operational Control Voice Communications Equipment Requirement Recap:

	Radio			Cellular		
User/Purpose	**Base**	**Vehicle**	**Portable**	**Analog**	**Digital**	**Remarks**
Demo Team						
'97 Demo Operations	2		12			
Live Vehicle Production		16	30			
Exposition Production			5	12		
Public Information			2	13		
Totals	***2***	***16***	***49***	***25***		

Core Consortium Operational Control Voice Radio Equipment Source Recap:

Radio Type	Caltrans	Hughes	Total Available	Total Required	Delta
Base Stations	2	0	2	2	0
Vehicle	0	18	18	16	2 (Note 1)
Portable	8	0	8	49	-41
Portable Radio Battery Charger					
Spare Batteries					
Total	***10***	***18***	***28***	***67***	***-39***

Note 1: Two (2) vehicle-mount radios reserved as operational spares.

Core Consortium Operational Control Voice Cellular Equipment Recap:

Cellular Phone Type	Caltrans	Hughes	Total Available	Total Required	Delta
Analog				25	-25
Digital					
Cellular Battery Charger					
Total				***25***	***-25***

Associates Operational Control Voice Communications Equipment Recap:

	Radio			Cellular		
User/Purpose	**Base**	**Vehicle**	**Portable**	**Analog**	**Digital**	**Source**
Eaton VORAD/Vehicles		3				Eaton
Houston Metro/Vehicles		3				Houston
Honda/Vehicles		3				Honda
OSU/Vehicles		3				OSU
Toyota/Vehicles		4		4		Toyota
Totals		***16***		***4***		

Attachment C - Demonstration Administrative Voice Communications Equipment Requirements Matrix

Core Participants Administrative Voice Communications Equipment Requirements

	Radio			Cellular		Remarks
User	Base	Vehicle	Portable	Analog	Digital	
Bechtel						
Caltrans						
CMU				5		
Delco						
GM						
Hughes						
LMC			4	3		Note 1
Parsons Brinckerhoff						
PATH				5		
USDOT						
Totals			***4***	***13***		

Note 1: IDV/ORV team requests use of 4 portable units loaned by California Office of Emergency Services

Associate Participants Administrative Voice Communications Equipment Requirements

	Radio			Cellular		
User	Base	Vehicle	Portable	Analog	Digital	Remarks
Eaton VORAD						
Houston Metro				15		
Honda			10			Note 1
OSU						
Toyota			6	2	7	Note 2
Totals			***16***	***17***	7	

Note 1: Honda 10 Portable Radios - Nextel PCS using public service.
Note 2: Toyota 6 Radios - UHF on team frequency.

Attachment D - Demo Operational Control Voice Radio Communications - Call Signs

Call Sign	Demo Position	Responsibilities
TBD	*'97 Demo Operations*	
TBD	'97 Demo Lead	Responsible for the success of the execution of the overall Demo. Reports to Program Manager Council and NAHSC Program Manager.
TBD	'97 Demo Lead, Alternate	Perform as the '97 Demo Lead in her absence. Assist Demo Lead in communication with key lead personnel.
	Demonstration Safety	
Safety 1	Demonstration Safety Lead	Overall responsibility for the safe operation of all aspects of the '97 Demonstration, including the Exposition Center, the Live Vehicle demonstrations on I-15 HOV Express lanes, and the Mini-Demos. Final authority for initiation of all demonstration activities each day, and authority to stop any aspect of the demonstration in the event of an unsafe condition. Coordinates with the '97 Demonstration Lead on all safety matters but does not report directly to any demonstration or Consortium management personnel.
Safety 2	Demonstration Safety Lead, Assistant	Perform as the Demonstration Safety Lead in his absence. Assist Demonstration Safety Lead in the execution of his duties.
Vehicle Safety 1	Live Vehicle Production Safety Officer	Safe operation of all aspects of the live vehicle demonstration, including I-15 HOV express on-lane activities, both north and south staging areas, and shuttle service to and from the staging areas. Final authority for initiation of the live vehicle elements of demonstration activities each day, and authority to stop any aspect of the live vehicle demonstration in the event of an unsafe condition. Coordinates with the '97 Demonstration Lead and Demonstration Safety Lead on all safety matters but does not report directly to any demonstration or Consortium management personnel.
Vehicle Safety 2	Live Vehicle Production Safety Officer, Assistant	Perform as the Live Vehicle Production Safety Officer in his absence. Assist Live Vehicle Production Safety Officer in the execution of his duties.
Expo Safety 1	Exposition Safety Officer	Safe operation of all aspects of the demonstration at the Exposition Center. This includes safety within the Exposition Center, the Conference Center, Expo parking facilities, shuttle services between the Expo Center and hotels and during the conduct of evening events. Final authority for initiation of the Expo Center elements of demonstration activities each day, and authority to stop any aspect of the Expo Center demonstration activities in the event of an unsafe condition. Coordinates with the '97 Demonstration Lead and Exposition Production Lead on all safety matters. Reports directly to Demonstration Safety Lead on all safety matters but does not report directly to any other demonstration or Consortium management personnel.

Attachment D - Demo Operational Control Voice Radio Communications - Call Signs (Continued)

Call Sign	Demo Position	Responsibilities
	Demonstration Safety(Continued)	
Expo Safety 2	Exposition Safety Officer, Assistant	Perform as the Exposition Safety Officer in his absence. Assist Exposition Safety Officer in the execution of his duties.
Mini Demo Safety 1	Mini Demo Safety Officer	Safe execution of all aspects of the Mini-Demo activities including, vehicle safety, driver and passenger safety and spectator safety. Final authority for initiation of Mini-Demo activities each day, and authority to stop any aspect of the Mini-Demo activities in the event of an unsafe condition. Coordinates with the '97 Demonstration Lead and Vehicle Production Lead on all safety matters. Reports directly to Demonstration Safety Lead on all safety matters but does not report directly to any other demonstration or consortium management personnel.
Mini Demo Safety 2	Mini Demo Safety Officer, Assistant	Perform as the Mini Demo Safety Officer in his absence. Assist Mini Demo Safety Officer in the execution of his duties.
Caltrans Safety 1	Caltrans Safety Officer (San Diego TMC Safety Officer)	Certifies that the I-15 HOV Express lanes are safe prior to turning the lanes over to the Consortium for live vehicle demonstration activities. Full authority to stop the live vehicle portion of the demonstration if a need arises for public use of the express lanes during non-scheduled times.
Caltrans Safety 2	Caltrans Safety Officer (San Diego TMC Safety Officer), Assistant	Perform as the Caltrans Safety Officer in his absence. Assist Caltrans Safety Officer in the execution of his duties.
	Live Vehicle Production	
Production 1	Vehicle Production Lead	Responsible for all live vehicle activities at the South Control Yard, the North Staging Area, and on the I-15 HOV Express lanes including coordination of all live vehicle activities, oversight of the execution of the scenario minute by minute schedule, coordination with the Exposition center, all staging activities, and public information activities related to the live vehicle demonstration. Reports to '97 Demonstration Lead.
TBD	Vehicle Production Lead, Assistant	Perform as the Vehicle Production Lead in his absence. Assist Vehicle Production Lead in the execution of his duties.

Attachment D - Demo Operational Control Voice Radio Communications - Call Signs (Continued)

Call Sign	Demo Position	Responsibilities
Site 1	Caltrans Site Manager	Insures the demonstration facility is available, ready, and safe to begin executing the live vehicle demonstration scenarios. Interfaces with local law enforcement, Caltrans and other agencies as required. Coordinates with Caltrans TMC for opening and closing of the I-15 HOV express lanes for testing or demonstration. Responsible for all activities at the South Control Yard, North Staging Area, and I-15 HOV express lanes that are not vehicle specific. Examples, communications facilities, TMC coordination, opening/closing lanes, site services and logistics, site visitors, site security and vehicle storage. Reports to Vehicle Production Lead for all activities except safety. Reports to Vehicle Production Safety Officer for safety.
TBD	Caltrans Site Manager Assistant	Perform as the Caltrans Site Manager in his absence. Assist Caltrans Site Manager in the execution of his duties.
Communications 2	Communications Lead	Ensure the operability of voice and video communications links for live vehicle demonstrations. Work with the Caltrans Site Manager to resolve EMI/EMC and radio frequency interference issues with Miramar Naval Air Station. Reports to Vehicle Production Lead. Located at South Control Yard during execution of demonstration.
Communications 1	Communications Lead Assistant	Ensure the operability of all data communications links for live vehicle demonstrations. Perform as the Communications Lead in his absence. Reports to Communications Lead. Located at North Staging Area during execution of demonstration.
Vehicle 1	Site Vehicle Manager	Develops, maintains, publishes and enforces the on-lane vehicle test schedule prior to the live demonstration. Coordinates all vehicle testing, dry runs, and dress rehearsal vehicle activities. Participates in the pre-demo vehicle certification process. Verifies daily certification of vehicle safety and operational readiness at the demo site. Has authority to remove from testing or live demonstration any vehicle which does not meet established operational or safety requirements. Decisions related to vehicle safety will be coordinated with the Vehicle Production Safety Officer. Responsible for all decisions related to vehicle readiness, reliability, or suitability for demonstration. Reports to Vehicle Production Lead.
TBD	Site Vehicle Manager Assistant	Perform as the Site Vehicle Manager in his absence. Assist Site Vehicle Manager in the execution of his duties.
TBD	Passenger Assignment Coordinator	Determines which VIPs will ride in which vehicles. Reports to Site Vehicle Manager.
TBD	Passenger Assignment Coordinator Assistant	Perform as the Passenger Assignment Coordinator in his absence. Assist Passenger Assignment Coordinator in the execution of his duties.

Attachment D - Demo Operational Control Voice Radio Communications - Call Signs (Continued)

Call Sign	Demo Position	Responsibilities
	Live Vehicle Production (Continued)	
TBD	Shuttle Bus Coordinator	Ensures that shuttle service is available between Miramar College, the North Staging Area and South Staging Area. Ensures that all shuttle vehicles are on-time for passenger pick-up and drop-off. Reports to Passenger Assignment Coordinator
TBD	Shuttle Bus Coordinator Assistant	Perform as the Shuttle Bus Coordinator in his absence. Assist Shuttle Bus Coordinator in the execution of his duties.
TBD 1 - 6	Shuttle Bus Operator (1-6)	Drive the passenger bus between Miramar College, the North Staging Area and South Staging Area. Reports to Shuttle Bus Coordinator.
North Lead	North Staging Area Coordinator	Coordinates all activities related to the live vehicle demonstration at the North Staging Area. Has the authority to prohibit vehicles from entering the lanes or delay scenarios, as necessary. Reports to the Site Vehicle Manager.
South Lead	South Staging Area Coordinator	Coordinates all activities related to the live vehicle demonstration at the South Staging Area. Has the authority to prohibit vehicles from entering the lanes or delay scenarios, as necessary. Reports to the Site Vehicle Manager.
TBD	Mini-Demo Lead (Expo Vehicle Manager)	Coordinates all on-site vehicle logistics, testing and dry-runs at the Exposition Center. Implements final vehicle testing, certification and demonstrations. Reports to Vehicle Production Lead.
TBD	Mini-Demo Lead (Expo Vehicle Manager) Assistant	Perform as the Mini-Demo Lead in his absence. Assist Mini-Demo Lead in the execution of his duties.
	Scenarios	**Scenario Lead** - Ensures all vehicles and personnel associated with their scenario are operational. Has the authority to delay participation if some aspect of their scenario is not ready. **Driver** - Operates the Scenario Vehicle. Responsible for the successful execution of the scenario as well as the safety of the passengers. **Vehicle Narrator** - Individual in each vehicle to narrate for the passengers responsible for keeping the passengers apprised of what is happening and what is about to happen with the vehicle, as well as the scenario. Perform as the Voice Radio Operator in the Vehicle.
TBD	Multi Platform Free Agent Scenario	Reports to Site Vehicle Manager.
Red 1	Multi Platform Free Agent Vehicle #1	

Attachment D - Demo Operational Control Voice Radio Communications - Call Signs (Continued)

Call Sign	Demo Position	Responsibilities
	Live Vehicle Production (Continued)	
Red 2	Multi Platform Free Agent Vehicle #2	
Red 3	Multi Platform Free Agent Vehicle #3	
Red 4	Multi Platform Free Agent Vehicle #4	
Red 5	Multi Platform Free Agent Vehicle #5	
TBD	Platoon Scenario	Reports to Site Vehicle Manager.
Green 1	Platoon Vehicle #1 - PATH	
Green 2	Platoon Vehicle #2 - PATH	
Green 3	Platoon Vehicle #3 - PATH	
Green 4	Platoon Vehicle #4 - PATH	
Green 5	Platoon Vehicle #5 - PATH	
Green 6	Platoon Vehicle #6 - PATH	
Green 7	Platoon Vehicle #7 - PATH	
Green 8	Platoon Vehicle #8 - PATH	
Green 9	Platoon Vehicle #9 - PATH - Spare	
Green 10	Platoon Vehicle #10 - PATH -Spare	
TBD	IDV/ORV Scenario	Reports to Site Vehicle Manager.
Orange 1	Caltrans/LMC Infrastructure Diagnostic Vehicle	
Orange 2	Caltrans/LMC Obstacle Removal Vehicle	
Orange 3	Caltrans Infrastructure Diagnostic Vehicle (Spare)	
TBD	Honda Scenario	Reports to Site Vehicle Manager.
Blue 1	Honda Vehicle #1	
Blue 2	Honda Vehicle #2	

Attachment D - Demo Operational Control Voice Radio Communications - Call Signs (Continued)

Call Sign	Demo Position	Responsibilities
	Live Vehicle Production (Cont'd)	
Blue 3	Honda Vehicle #3 - Spare	
TBD	Toyota Scenario	Reports to Site Vehicle Manager.
Gray 1	Toyota Vehicle #1 - Automated	
Gray 2	Toyota Vehicle #2 - Automated	
Gray 3	Toyota Vehicle #3 - Non Automated	
Gray 4	Toyota Vehicle #4 - Non Automated	
TBD	OSU Scenario	Reports to Site Vehicle Manager.
Tan 1	OSU Vehicle #1 - Non Automated	
Tan 2	OSU Vehicle #2 - Automated	
Tan 3	OSU Vehicle #3 - Automated	
TBD	Eaton Scenario	Reports to Site Vehicle Manager.
Purple 2	Eaton VORAD Truck	
Purple 1	Eaton VORAD Corvette	
	Obstacle Placer	Set/remove obstacles (x5 locations). Ensure that all obstacles are in place for the given scenarios and the obstacles are cleared for other scenarios.
TBD	Obstacle 1	Reports to Caltrans Site Manager.
TBD	Obstacle 2	Reports to Caltrans Site Manager.
TBD	Obstacle 3	Reports to Caltrans Site Manager.
TBD	Obstacle 4	Reports to Caltrans Site Manager.
TBD	Obstacle 5	Reports to Caltrans Site Manager.
TBD	Vehicle Haulers	Moves demo non-street legal vehicles routinely or demo vehicle breakdowns during vehicle on-lane operations.
Security 1	Emergency Services Operators	Operates Ambulance, Fire Trucks, Wrecker vehicles during on-lane operations. (A number suffix will be added to the type of Emergency Service vehicle call sign, i.e., if there are 2 Ambulances the call signs would be Ambulance 1 and Ambulance 2, etc.)
TBD	Ambulance 1	
TBD	Fire Truck 1	
TBD	Wrecker 1	

Attachment D - Demo Operational Control Voice Radio Communications - Call Signs (Continued)

Call Sign	Demo Position	Responsibilities
	Exposition Production	
TBD	Exposition Production Lead	Coordinate the activities and events in and adjacent to the exhibition center. Overall responsibility for exhibitors logistics support, Demonstration Presentation Center, Technical Conference, Exposition Marketing, Trade Show (including registration), Exposition Center security, Exposition Center Craft Services, and airport and hotel shuttles to and from the Exposition Center. Reports to '97 Demonstration Lead.
TBD	Exposition Production Lead, Assistant	Perform as the Exposition Production Lead in his absence. Assist Exposition Production Lead in the execution of his duties.
DPC 1	Demonstration Presentation Center (DPC) Lead	Responsible for the successful execution of the DPC/TMC scenarios as scripted to support various aspects of the Live Vehicle Demonstrations on I-15 HOV Express lanes and information center for the Exposition center. Responsibilities include: slide presentations, pre-recorded videos, scenario lead-ins, and live vehicle coordinated live video presentations. Supervises DPC narrators and serves as principal ombudsman, answering questions and distributing printed material for the'97 Demonstration information center. Showcase the AHS Traffic Management capabilities. Coordinates with Caltrans TMC. Reports to Exposition Production Lead.
TBD	Demonstration Presentation Center (DPC) Lead, Assistant	Perform as the DPC Lead in his absence. Assist DPC Lead in the execution of his duties.
Camera 1	Camera Operator	Individual at TMC in the Exposition Center to operate video cameras. Responsible for operating all video cameras during the Demo. May need to interface with CPS to obtain the optimum video footage.
TBD	Technical Conference Lead	Coordinates the activities and events associated with the technical conference. Supervises on-site registration, security, maintenance, catering, schedules and all tasks pertaining to the successful conduct of the technical conference. Reports to Exposition Production Lead.
Tech Conference 2	Technical Conference Lead, Assistant	Perform as the Technical Conference Lead in his absence. Assist Technical Conference Lead in the execution of his duties.
Market 1	Expo Marketing Lead	Coordinates the event sponsorship activities, registration and hospitality. Reports to Exposition Production Lead.
Market 2	Expo Marketing Lead, Assistant	Perform as the Expo Marketing Lead in his absence. Assist Expo Marketing Lead in the execution of his duties.
Exhibit 1	NAHSC Exhibit Coordinator	Coordinates the logistics support and registration for NAHSC exhibitors at the Exposition Center. Reports to Exposition Production Lead.

Attachment D - Demo Operational Control Voice Radio Communications - Call Signs (Continued)

Call Sign	Demo Position	Responsibilities
	Exposition Production (Continued)	
Exhibit 2	NAHSC Exhibit Coordinator, Assistant	Perform as the NAHSC Exhibit Coordinator in his absence. Assist NAHSC Exhibit Coordinator in the execution of his duties.
Hospitality 1	Hospitality Coordinator	Coordinates all hospitality activities for the '97 Demonstration including in and adjacent to the Exposition Center and at the North Staging Area. Reports Expo Marketing Lead.
Hospitality 2	Hospitality Coordinator, Assistant	Perform as the Hospitality Coordinator in his absence. Assist Hospitality Coordinator in the execution of his duties.
Service 1	Service Contract Coordinator	Individual to oversee service contract functions - Responsible for ensuring that all facilities, equipment, consumables are available, clean, and in good working condition.
CPS	Creative Promotional Solutions (CPS) Coordinator	Individual from CPS to coordinate CPS activities.
NTP	National Trade Productions (NTP) Coordinator	Individual from NTP to coordinate NTP activities.
ASTS	Automotive Safety Transportation Systems (ASTS) Coordinator	Individual from ASTS to coordinate ASTS activities.
	Public Education	
Public Education 1	Public Education Lead	
Public Education 2	Public Education Lead, Assistant	Perform as the Public Education Lead in his absence. Assist Public Education Lead in the execution of his duties.
Media 1	Media Lead	
Media 2	Media Lead, Assistant	Perform as the Media Lead in his absence. Assist Media Lead in the execution of his duties.
Material 1	Materials Lead	
Material 2	Materials Lead, Assistant	Perform as the Materials Lead in his absence. Assist Materials Lead in the execution of his duties.
Community Relations 1	Community Relations Lead	
Community Relations 2	Community Relations Lead, Assistant	Perform as the Community Relations Lead in his absence. Assist Community Relations Lead in the execution of his duties.
Thematic Images 1	Thematic Images Lead	
Thematic Images 2	Thematic Images Lead, Assistant	Perform as the Thematic Images Lead in his absence. Assist Thematic Images Lead in the execution of his duties.

Attachment D - Demo Operational Control Voice Radio Communications - Call Signs (Continued)

Call Sign	Demo Position	Responsibilities
	Public Education (Cont'd)	
Attendee Services 1	Attendee Services Coordinator	Coordinates '97 Demo attendee, hotel arrangements, attendance at opening ceremony and other meetings, tours. Coordinates housing arrangements for '97 Demo team workers. Reports to Public Education Lead.
Attendee Services 2	Attendee Services Coordinator, Assistant	Perform as the Attendee Services Coordinator in his absence. Assist Attendee Services Coordinator in the execution of his duties.
Grandstand	Grandstand Announcer	Individual to announce at grandstands - Responsible for keeping spectators at the grandstands appraised of the scenarios that are being viewed.

Attachment D Rev A - Voice Radio Communications Call Signs

Vehicle Operation Positions

Call Sign	Function	Assignment	Radio Net
Production	Lead	Bob Smilgis	NAHSC
Operations	Operations	Pat Langley	NAHSC
Vehicle Control	Lead	Ron Colgin	NAHSC
Vehicle Safety	Vehicle Safety Officer	Dan Grigsby	NAHSC
Corridor Safety	Corridor Safety Officer	Tarbell Martin	NAHSC
Site Lead	Lead	Randy Woolley	NAHSC OES SCY
Site EMS	EMS Coordinator	Stan Slavin	NAHSC OES SCY
Site South	SCY Site Manager	Rebecca Mowry	NAHSC OES SCY
South Lead	SCY Coordinator	Fred Mangarelli	NAHSC OES SCY
South Dispatch	SCY Dispatcher	Larry Baumeister	NAHSC OES SCY
Comm South	SCY Communications	Bob Battersby	NAHSC OES SCY
North Lead	NSA Coordinator	Tommy Viner	NAHSC OES NSA
Site North	NSA Site Manager	Joy Pinne	NAHSC OES NSA
North Dispatch	NSA Dispatcher	John Castro	NAHSC OES NSA
Comm North	NSA Communications	Aimee Cochran	NAHSC OES NSA
DPC Ops	DPC Lead	Tony Rubner	NAHSC
Video Ops	Video Camera Operator	Sean Campbell	NAHSC
Passenger	Passenger Coordinator	Ed Vanover	NAHSC OES Expo OES Mini

Attachment D Rev A - Voice Radio Communications Call Signs (Continued)

Vehicle Operation Positions (Continued)

Call Sign	Function	Assignment	Radio Net
Obstacle 1	Obstacle Placer	D11	NAHSC
Obstacle 2	Obstacle Placer	D11	NAHSC
Obstacle 3	Obstacle Placer	D11	NAHSC
Obstacle 4	Obstacle Placer	D11	NAHSC
Obstacle 5	Obstacle Placer	D11	NAHSC
Obstacle 6	Obstacle Placer	D11	NAHSC
CHP	California Highway Patrol		NAHSC
TOW 1	Tow Truck 1		NAHSC
TOW 2	Tow Truck 2		NAHSC
EMS	Ambulance		NAHSC

Vehicle Radios

Call Sign	Function	Assignment	Radio Net
Gray 1	Evolutionary Vehicle 1 Narrator		NAHSC
Gray 2	Evolutionary Vehicle 2 Narrator		NAHSC
Gray 3	Evolutionary Vehicle 3 Narrator		NAHSC
Gray 4	Evolutionary Vehicle 4 Narrator		NAHSC
Red 1	Multi-Platform Free Agent Bus 1 Narrator		NAHSC
Red 2	Multi-Platform Free Agent Vehicle 2 Narrator	John Kozar	NAHSC
Red 3	Multi-Platform Free Agent Bus 3 Narrator		NAHSC
Red 4	Multi-Platform Free Agent Vehicle 4 Narrator	Dave Duggins	NAHSC
Red 5	Multi-Platform Free Agent Vehicle 5 Narrator	Bala Kumar	NAHSC
Blue 1	Control Transition Vehicle 1 Narrator		NAHSC
Blue 2	Control Transition Vehicle 2 Narrator		NAHSC
Orange 1	IDV Narrator	Bill Kennedy	NAHSC
Orange 2	ORV Narrator	John Kaula	NAHSC
Green 1	Platoon Vehicle 1 Narrator	Sei-Bom Choi	NAHSC
Green 2	Platoon Vehicle 2 Narrator	Rajesh Rajamani	NAHSC
Green 3	Platoon Vehicle 3 Narrator	Benedicte Bougler	NAHSC
Green 4	Platoon Vehicle 4 Narrator	Jay Kniffen	NAHSC
Green 5	Platoon Vehicle 5 Narrator	Han-Shue Tan	NAHSC
Green 6	Platoon Vehicle 6 Narrator	Juergen Guldner	NAHSC

Call Sign	Function	Assignment	Radio Net
Green 7	Platoon Vehicle 7 Narrator	Chieh Chen	NAHSC
Green 8	Platoon Vehicle 8 Narrator		NAHSC
Green 9	Platoon Vehicle 9 Narrator		NAHSC
Purple 1	Target Vehicle Driver		NAHSC
Purple 2	Truck Narrator (lead)	James Gonzales	NAHSC
Tan 1	Alternative Technology Vehicle 1 Narrator		NAHSC
Tan 2	Alternative Technology Vehicle 2 Narrator		NAHSC
Tan 3	Alternative Technology Vehicle 3 Narrator		NAHSC
Tan 4	Alternative Technology Vehicle 4 Narrator		NAHSC

North Staging Area Vehicle Operations

Call Sign	Function	Assignment	Radio Net
North Lead	NSA Coordinator	Tommy Viner	OES NSA NAHSC
North Dispatch	NSA Dispatcher	John Castro	OES NSA NAHSC
Site North	NSA Site Manager	Joy Pinne	OES NSA NAHSC
Communications North	NSA Communications	Aimee Cochran	OES NSA NAHSC
North Traffic A	NSA Traffic Control	John Schultz	OES NSA
North Traffic B	NSA Traffic Control	Mark Rominger	OES NSA
North Traffic C	NSA Traffic Control	Gerard Seubert	OES NSA
Shuttle "A" Coordinator	Shuttle "A" Coordinator	Marty Miller	OES NSA
Shuttle "B" Coordinator	Shuttle "B" Coordinator	John Hearn	OES NSA
Hostess "A"	NSA Passenger Hostess	Gloria Cesena	OES NSA
Hostess "B"	NSA Passenger Hostess	Linda Buys	OES NSA
North Loader	NSA Loader	Al Cox / Ron Hearne	OES NSA
North Unloader	NSA Unloader	Brian Hughes	OES NSA
North Stager	NSA Stager	Karl Sauer	OES NSA
IDV North	IDV/ORV Support	Mark Rosenblum	OES NSA
Gray Lead	Evolutionary Lead	Mike Wolterman	N/A
Red Lead	Multi-Platform Free Agent Lead	Todd Jochem	N/A
Blue Lead	Control Transition Lead	Damon Delorenzis	N/A
Orange Lead	Maintenance Lead	Tom West	N/A
Green Lead	Platoon Lead	Wei-Bin Zhang	N/A
Purple Lead	Eaton Vorad Lead (narrator)	James Gonzales	N/A
Tan Lead	Alternative Technology Lead	Umit Ozguner	N/A

South Staging Area Vehicle Operations

Call Sign	Function	Assignment	Radio Net
South Lead	SCY Coordinator	Fred Mangarelli	OES SCY NAHSC
South Dispatch	SCY Dispatcher	Larry Baumeister	OES SCY NAHSC
Site Lead	Lead	Randy Woolley	OES SCY NAHSC
Site South	SCY Site Manager	Rebecca Mowry	OES SCY NAHSC
Site EMS	EMS Coordinator	Stan Slavin	OES SCY NAHSC
Communications South	SCY Communications	Bob Battersby	OES SCY NAHSC
IDV South	IDV/ORV Support	Kin Yen	OES SCY
South Traffic A	SCY Traffic Control	D11	OES SCY
South Traffic B	SCY Traffic Control	D11	OES SCY
South Traffic C	SCY Traffic Control	D11	OES SCY
South Traffic D	SCY Shuttle Dispatcher	D11	OES SCY
South Host	SCY Host- Loading	Greta Huang	OES SCY
South Loader	SCY Loader	Nick Jigalin	OES SCY
South Unloader	SCY Unloader	Eric Reichelt	OES SCY
South Stager	SCY Stager	Ernie Gomes	OES SCY
Gray Lead	Evolutionary Lead	Mike Wolterman	N/A
Red Lead	Multi-Platform Free Agent Lead	Todd Jochem	N/A
Blue Lead	Control Transition Lead	Damon Delorenzis	N/A
Orange Lead	Maintenance Lead	Tom West	N/A
Green Lead	Platoon Lead	Wei-Bin Zhang	N/A
Purple Lead	Eaton Vorad Lead (narrator)	James Gonzales	N/A
Tan Lead	Alternative Technology Lead	Umit Ozguner	N/A

Public Education

Call Sign	Function	Assignment	Radio Net
VIP 1	VIP Manager	Roger Boothe	OES Expo
Media	Media Manager	Celeste Speier	OES Expo
Strat@com	Strat@com Manager	John Undeland	OES Expo
VIP 2	Expo VIP/Media Asst	Kyle Nelson	OES Expo
Registration 1	Registration Coordination	B. Serchak	OES Expo

Exposition Center

Call Sign	Function	Assignment	Radio Net
Expo 1	Exposition Lead	Victoria Dewey	OES Expo
Expo 2	Exposition Asst/ Booth	Bill Gouse	OES Expo
Expo Safety	Expo Safety Officer		OES Expo
Pass. Lead	Passenger Coordinator	Ed Vanover	OES Expo NAHSC OES Mini
Shuttle Lead	Shuttle Dispatch	Lynn Barton	OES Expo
Booth Mentor	NAHSC Booth Mentor	Alan Lubliner	OES Expo
VIP 3	VIP Exhibitor Service		OES Expo
Registration 2	Expo Registration		OES Expo

Mini Demos

Call Sign	Function	Assignment	Radio Net
Mini Safety	Outdoor Technology Safety	Tom Clarkin	OES Mini
Pass. Lead	Passenger Coordinator	Ed Vanover	OES Mini NAHSC OES Expo
Mini Lead	Mini Demo Coordinator	Marty Turner	OES Mini
Mini Ops	Mini Demo Operations	Willie Levy	OES Mini
Student Demo	Mini Demo Student Comp.	Rob Meinert	OES Mini
Student Ops	Mini Demo Student Competition Operations		OES Mini

Attachment E - Radio Communications Procedures

In order to conduct efficient radio communications during the '97 Demonstration operations, we will use a modified version of Caltrans radio communications procedures. Caltrans uses the following "guidelines" and California Highway Patrol "Ten Codes" to support radio net procedures. A brief summary of the guidelines include:

1. **Guidelines**
   a. Use proper radio conversation.
      - Keep the messages brief.
      - No inappropriate language (swearing, Citizen Band (CB) jargon, sexual or other harassment).
      - Keep the messages on the related topic (no tangents or unrelated information).
      - Official business only (no personal business).

   b. Use Proper Radio identification with call signs. Identify the station you are calling first, followed by your identity and location.
      For example:
      - **Demo 1 this is Caltrans Site 1, at the South Control Yard**
        or
      - **Demo 1, Caltrans Site 1, South Control Yard**

2. **Authentication and Message Receipt Acknowledgment**
   a. Authentication will not be accomplished via any formal authentication process for the Demonstration Operation or Caltrans Radio Net.
   b. Message Receipt Acknowledgment of the last message or any important data should be acknowledged with the appropriate Ten Code (for example, 10-4) A partial list of the most frequently used California Highway Patrol ten codes is provided in Table E-1. A complete list is available from Caltrans if needed.

3. **Back-Up Channel Use**
   a. If interference or jamming is experienced which prevents communications on the Demonstration Operation Radio Net, radio operators shall switch to the Caltrans Radio Net channel, and report the problem to the Safety Officer and the Communications Lead. Radio communication shall be returned to the Demonstration Operation Radio channel when instructions are received from the Safety Officer.
   b. If radio communication is not possible on either channel, use an alternate means of communication, including emergency call box, land line telephone, cellular phone, administrative radio or personnel courier, to advise the Safety Officer and the Communications Lead or the Control Center at the South Control Yard.

4. **Demonstration Net Control Procedures**
   a. The North Staging Area (NSA) coordinator will control net participation for the NSA and southbound scenarios.
   b. The NAHSC repeater channel (Channel 1) will be used to communicate with participants in the NSA. The NSA coordinator will perform a roll call to initiate southbound scenarios. The net participants will respond to the roll call acknowledging operation on Channel 1. The NSA coordinator will verify that all participants are operating on the NAHSC repeater channel prior to releasing the vehicles to perform the scenario.
   c. The South Staging Area (SSA) coordinator will monitor the progress of southbound scenarios. The SSA coordinator will perform a roll call of each participant at the conclusion of southbound scenarios. Each participant will acknowledge communications on the NAHSC

repeater channel. The SSA coordinator then will communicate the status of the scenario to the NSA coordinator using the NAHSC repeater channel prior to initiating the next scenario.

d. The South Staging Area (SSA) coordinator will control net participation for the SSA and northbound scenarios.

e. The NAHSC repeater channel (Channel 1) will be used to communicate with participants in the SSA. The SSA coordinator will perform a roll call to initiate northbound scenarios. The net participants will respond to the roll call acknowledging operation on Channel 1. The SSA coordinator will verify that all participants are operating on the NAHSC repeater channel prior to releasing the vehicles to perform the scenario.

c. The North Staging Area (NSA) coordinator will monitor the progress of northbound scenarios. The NSA coordinator will perform a roll call of each participant at the conclusion of northbound scenarios. Each participant will acknowledge communications on the NAHSC repeater channel. The NSA coordinator then will communicate the status of the scenario to the SSA coordinator using the NAHSC repeater channel prior to initiating the next scenario.

Table E-1. California Highway Patrol "Ten Codes"

Code	Purpose	Code	Purpose
10-1	Poor Reception	10-21	Telephone
10-2	Reception Good	10-22	Disregard (last message or assignment)
10-4	Message Received	10-23	Stand By
10-5	Relay Message	10-28	Request for Registration
10-6	Busy, stand by	10-29	Check for wanted (person, vehicle, or object)
10-7	Out-of-Service	10-30	Improper Radio Traffic
10-8	In-Service	10-31	Attempted suicide
10-9	Repeat Transmission	10-35	Code 2 Backup
10-10	Off Duty	10-36A	Confidential Information, Subject Possibly Armed
10-11	Identify Mobile Frequency (example Free Agent 1, "Caltrans" Channel)	10-36	Confidential Information
10-13	Advise road or weather conditions	10-36F	Confidential Information, Possible Felony Wants
10-14	Provide Escort	10-36M	Confidential Information, Possible Misdemeanor Wants
10-15	Prisoner in Custody	10-37	What time is it?
10-17	Relay papers, supplies, etc.	10-39	Message or Item Delivered
10-19	Return or return to	10-97	Arrived at Scene
10-20	Location Requested	10-98	Assignment Completed

Attachment F - Telephone/Facsimile/ Computer Terminals/Data Link Service

Table F-1. Summary of South Control Yard Telephone/Facsimile/ Computer Terminals/Data Link Service

Participant	Telephone	Facsimile	Computer	Total
Demonstration Operations	5	1	1	7
U. C. - PATH, GM, CMU	1	1	0	2
Honda	1	1	1	3
Toyota	2	1	0	3
Houston	1	0	0	1
Eaton VORAD	1	0	0	1
OSU	1	0	0	1
Security Guard	1	0	0	1
Total	**13**	**4**	**2**	**19**

Note: The South Staging Area telephone service will be satisfied by existing service in the Sprung Structure in the South Control Yard. Any other voice communications for the South Staging Area will be satisfied by either Cellular Telephone or Portable Radio Communications.

Table F-2. Summary of North Staging Area Telephone/Facsimile/ Computer Terminals/Data Link Service

Participant	Telephone	Facsimile	Computer	Total
North Staging Operations	0	0	0	0
Hospitality Tent	4	0	0	4
Media Tent	5	1	0	6
U. C. - PATH	0	0	0	0
CMU	0	0	0	0
Honda	0	0	0	0
Toyota	0	0	0	0
Houston	0	0	0	0
Eaton VORAD	1	0	0	1
OSU	0	0	0	0
Security Guard	0	0	0	0
Total	**10**	**1**	**0**	**11**

Note: All participants communications services at the North Staging areas with the exception of the Hospitality and Media Tents will be satisfied by either Cellular Telephone or Portable Radio Communications.

Attachment F - Telephone/Facsimile/ Computer Terminals/Data Link Service (Continued)

Table F-3. Summary of Exposition Center Area Telephone/Facsimile/ Computer Terminals/Data Link Service

Participant	Telephone	Facsimile	Computer	Total	Remarks
Exhibit Operations	2	1	0	3	Note #1
Media Operations	6	1	0	7	Note #2
DPC/TMC	2	0	0	2	Note #3
U. C. - PATH	0	0	0	0	
CMU	0	0	0	0	
Honda	0	0	0	0	
Toyota	0	0	0	0	
Houston	0	0	0	0	
Eaton VORAD	0	0	0	0	
OSU	0	0	0	0	
Security Guard	0	0	0	0	
Total	**10**	**2**	**0**	**12**	Note #4

Notes:

1. Telephone service as provided by the agreement between NAHSC and Miramar College.
2. Telephone service proposed and requested for Media Center operations. Not currently planned for media center installation.
3. Telephone service proposed and requested for the DPC/TMC operations. Not currently planned for DPC/TMC installation. The land-line telephones listed in the matrix does not account for 10 special telephone lines required for the Live Video feeds and another set to handle all of the Vehicle-to-TMC transmissions.
4. All participants land line telephone communications services at the Exposition Center areas are arranged through the Exposition Center Lead.

Attachment G - Non-Radio Communications Using Vehicle Lights

Non-Radio Communications Using Vehicle Lights

In the event voice radio communications is not available the following non-voice radio communications signals will be used:

- Parking lights are for use only when the vehicle is parked at the side of an active roadway or Demo facility.
- Headlights are to be used only:
  - At night and dusk.
  - During inclement weather.
  - When specifically required by Demo or test procedure.
  - If it becomes necessary to stop another vehicle under Demo or test conditions, flash your headlights off and on.
- Do not use flashers while driving on the 7.6 mile Demo Lanes unless it is part of the demonstration scenario.
- Flashing warning lights should be interpreted as follows:
  - RED: Fire truck, ambulance, police.
  - BLUE: Fire truck, ambulance, police.
  - AMBER: Maintenance.

Safely yield right-of-way to emergency equipment displaying a flashing red or blue light and / or siren.

Attachment H - EMI/EMC Considerations

Voice Radio

The operation of both the NAHSC and SOLEDAD repeaters by Caltrans is done under license of the FCC. The use of the NAHSC frequency is reserved for the use of the consortium for the demo. SMR radios must be intentionally programmed to operate on specific channels to provide direct interference. Certainly private parties could purchase radios capable of transmitting on the same channel. This would assume that the party would have knowledge of the operating channel. It is obviously important not to publish the TX, RX, and PL tone information for the NAHSC channel.

The primary mitigation technique during operation of the demo will involve using the Soledad repeater as a backup in emergencies. The majority of voice traffic on the voice net will not be safety critical. The communications operating plan address the procedures necessary for acknowledging voice messages and the procedure for using the backup channel in the event that a critical message is not acknowledged. Cellular telephones can also be considered as backup communications links to the voice radios for some purposes. (See Attachment E Radio Communications Procedures).

A formal complaint may need to be filed with the FCC in the event that persistent jamming of the voice radio is experienced.

Vehicle-Vehicle Radio

The vehicle-vehicle radios operate in the unlicensed spread spectrum ISM band. This means that the system must be operated under the assumption that other interferers may be present. The nature of spread spectrum provides a certain level of interference immunity. The configuration of the platoon will also work as an advantage.

The radios used in the demo are direct sequence spread spectrum. An illicit operator would have to operate synchronously with the radios in the platoon, and have the same spreading code in place. Spread spectrum devices made by other manufacturers will raise the noise floor of the environment, but will not directly jam transmission. Deliberate jamming would involve the purchase of the same model radio and use of the same frequencies at the same TDMA rate, and be synchronized to effectively jam the vehicle-vehicle transmissions.

The level of the noise floor is an issue for low power spread spectrum over ranges exceeding 400 meters. The range of the radios from the front to the back of the platoon will be significantly less than 400 meters except in the case of split or join. The close following modes will have very tight ranges and the best immunity to increased noise.

Radios operating in the ISM band are limited in transmit power. Any interferers will be significantly farther away from a desired transmitter since the closest a competing transmitter will get is the conventional lanes. A vehicle would have to pace the platoon in an adjacent lane, and meet all the criteria of frequency, time slots, and synchronization to jam. PATH should avoid publishing details of the radio operation, including specific frequencies and time slot configurations until after the demo.

The primary mitigating factor to combat increased noise will be in the vehicle control algorithm. The host computer must have a method for detecting lost or erroneous data. This data must be anticipated and a procedure established to allow continued safe operation. The vehicle-vehicle headway can be increased, speeds decreased, or manual control can be established. The approach to data errors can be based on the number and frequency of messages lost.

Attachment H - EMI/EMC Considerations (Continued)

Cellular Phones

We do not plan to mitigate jamming on cellular phones since this is a public utility. The cellular phone link is not safety critical. The issue of availability of cellular phone channels is another topic, which will be addressed as part of the demonstration and exhibition production effort.

Attachment I - Voice Communications Contingency Plan

Voice Communications Contingency Plan

July 11, 1997

Automated Highway System

1997 Demonstration

TECHNICAL OWNER: **Aimee Cochran**
Communications Coordinator

APPROVED: ______________________________
Theresa Quinlan
AHS '97 Demonstration Task Leader

PURPOSE:
The Voice Communications Contingency Plan documents the procedures which will be followed in the event of a failure in the voice communications network supporting the Automated Highway Systems (AHS) 1997 Demonstration of Technical Feasibility.

SCOPE:
This document covers use of the National Automated Highway Systems Consortium (NAHSC) Command Net and the Caltrans SOLEDAD Net. The NAHSC Command Net operates using the NAHSC repeater and the Caltrans SOLEDAD Net operates using the SOLEDAD repeater. The operating frequencies and channel assignments for the networks are described in Appendix A.

The contingency plan does not apply to the UHF and VHF radios loaned by the California Office of Emergency Services (OES) radios. The OES radios are assigned to sub nets for use at the North Staging Area, South Control Yard, Expo and Mini Demos. The OES sub nets are used for administrative purposes and are not safety critical communications nets.

NAHSC Repeater Failure
The NAHSC repeater channel shall be the primary frequency for command and control of live vehicle operation during the 1997 demonstration. The SOLEDAD repeater channel shall be the secondary frequency.

Command Center Communications
In the event that the NAHSC repeater becomes inoperable during the demonstration, the command center radio shall be switched to the SOLEDAD frequency for the duration of the scenarios on the lanes. No additional vehicles shall be released until a roll call has been completed on the secondary repeater channel.

The Vehicle Lead shall contact the Corridor Safety Officer via the Caltrans SOLEDAD net to verify the loss of the NAHSC repeater and the switch to the SOLEDAD net. The Corridor Safety Officer shall have the authority to approve continuation of the demonstration runs using the SOLEDAD repeater.

The Vehicle Lead shall contact the North Staging Area (NSA) coordinator and the South Control Yard (SCY) coordinator to verify the switch to the SOLEDAD repeater. The Vehicle Lead shall relay the message to the NSA and SCY coordinators via cell phone or pager, or use the Vehicle Production or Vehicle Operations Leads as couriers.

The NSA and SCY coordinators shall be responsible for contacting each of the vehicle radio operators to verify the switch to the SOLEDAD repeater. Each coordinator shall perform a roll call of each vehicle in the respective staging area. The coordinators shall report back to the command center Vehicle Lead at the conclusion of the SOLEDAD channel roll call.

The Vehicle Lead may resume release of scenarios following verification of vehicle roll calls. The use of the SOLEDAD channel for continuation of scenario sequences shall be contingent on approval for use of the SOLEDAD channel by the Corridor Safety Officer.

Vehicle Communications
In the event that the NAHSC repeater becomes inoperable during the demonstration, the command center radio shall be switched to the SOLEDAD frequency for the duration of the scenarios on the lanes. The vehicle radio operators shall be contacted by an agent of the Vehicle Lead via pager to notify of the switch to the SOLEDAD channel. A message code shall be established that will indicate to the vehicle radio operators that the SOLEDAD channel should be selected. Radio communication shall be returned to the Command channel when instructions are received from the Vehicle Lead via the Corridor Safety Officer.

Command Center Radio Failure
An alternate radio will be available in the event that the command center radio fails. The SCY communications lead will connect the backup radio and verify communications to the Corridor Safety Officer, the Kearny Mesa TMC, and the NSA and SCY coordinators. The SCY and NSA coordinators will monitor the progress of vehicles on the lanes during the interim period until command center radio communications are re-established. No additional vehicles shall be released until the Vehicle Lead notifies the NSA and SCY coordinators that the command center radio is operational.

Vehicle Radio Failure
If interference or jamming is experienced which prevents communications on the Command Net, vehicle radio operators shall switch to the Caltrans SOLEDAD channel. The vehicle radio operator shall notify the other vehicles in the scenario via the scenario administrative voice communications of the switch to the SOLEDAD channel by one of the vehicles. The lead vehicle in the scenario shall report to the Vehicle Lead at the command center which vehicle in the scenario is operating on the SOLEDAD channel. If the Command channel failure occurs in the lead vehicle in the scenario, then the last vehicle in the scenario shall make the report to the Vehicle Lead. The Vehicle Lead shall report to the Corridor Safety Officer that a vehicle on the lanes has switched to the SOLEDAD channel. The problem shall be reported to the NSA or SCY coordinator at the conclusion of the scenario.

The NSA or SCY Communications Lead shall diagnose the radio failure. A spare radio will be available, and may be substituted if necessary. The NSA or SCY coordinator shall notify the Vehicle Lead when the voice communications are restored to the Command channel for that vehicle.

If radio communication is not possible on either the Command or SOLEDAD channel, use an alternate means of communication to advise the Vehicle Lead of the loss of voice communications. The back-up communications device shall be the team administrative radio. In the event that an emergency occurs and voice communications can not be established with the Vehicle Lead at the control center using the communications available in the vehicle, roadside emergency call boxes may be used to contact emergency services.

Appendices:
A - Voice Radio Specifications

Appendix A - Voice Radio Specifications

The voice radio specifications are as follows:

Frequency
Receive: 851-869 MHz (repeater operation)
Transmit: 806-824 MHz (repeater operation)
851-869 MHz (direct talk around operation)

Squelch
Switchable between carrier operated and decoder operated squelch. Shall be able to use any of the standard EIA CTCSS tones on both transmit and receive.

Power Output:
15 watts nominal RF power output; 5 watts to 35 watts power output acceptable.

User Interface:
- Frequency switchable between operating frequencies.
- Switchable between direct and repeater modes of operation.

NAHSC Command Net Operating Frequencies
For primary control, safety, and operational communications (NAHSC Repeater)
Receive: 868.0375 MHz
Transmit: 823.0375 MHz (NAHSC Repeater)
868.0375 MHz direct (talk-around) operation
Decoder operated squelch: 192.8 Hz - Both Transmit and Receive

Caltrans SOLEDAD Net Operating Frequencies
For Backup Emergency Communications from Vehicles (SOLEDAD Repeater)
Receive: 857.1000 MHz
Transmit: 812.1000 MHz (SOLEDAD Repeater)
Decoder operated squelch: 110.9 Hz - Both Transmit and Receive

APPENDIX E Key Demonstration Messages

THEME STATEMENT -- The AHS Demonstration will show how automated highway technologies will be a smart choice to solve transportation problems

Supporting statements:

- AHS integrates ITS technologies and benefits to solve these traffic problems.

- The main traffic problems AHS promises to solve: * relieve highway traffic congestion
- reduce wasted time/lost productivity associated with driver stress
- reduce the high percentage of traffic accidents caused by human error, inattentiveness/fatigue
- varying temperament and degrees of driver skills * poor judgment
- gawking/"rubber-necking"
- lower vehicle emissions and fuel consumption through more efficient traffic flow
- going to make highway travel more reliable * reduce travel time
- lower the unpredictable traffic flow due to incidents and heavy demand

- AHS is an efficient use of public funds: * how:
- in many places it will cost less than to build more highways * addresses the most pressing transportation problems
- eases traffic safety enforcement
- emergency response
- systemizes vehicle violations (due to check in) * driver violations including substance abuse
- AHS will increase the nation's economic vitality
- dollars lost in productivity due to traffic congestion
- dollars lost to disabling injuries, fatalities and subsequent litigation

- AHS implementation is beneficial to the U.S. economy * AHS leverages and stimulates ITS investment
- positions the U.S. to be an exporter of this useful technology
- facilitates efficient movement of people goods information and services throughout the U.S.

- AHS improves quality of life:
- creating a option for drivers
- less injuries/fatalities
- more people have better lives
- stress relief
- allows for "quality time" for motorists
- eases traffic
- AHS promises to increase ability to conduct preventative maintenance and operation

APPENDIX F Demonstration Benefits

1.0 INTRODUCTION

Identifying Automated Highway System (AHS) benefits and linking AHS Demonstration Scenarios and the Exposition Center to many of the identified benefits is an important goal for the Consortium. This report will identify automation attributes in an attempt to link scheduled demonstration activities to all applicable benefits. Consequently, if scheduled demonstration activities do not represent all applicable benefits, (whether by scenario, technology, visual display, or exhibit) they will be identified and recommended for inclusion or modification.

2.0 OVERVIEW

AHS will have favorable impacts on a number of economic, environmental, social, institutional, technical, safety, and reliability issues that are closely related to current transportation problems. Consequently, the National Automated Highway System Consortium must demonstrate AHS is an appropriate, achievable, and desirable solution for solving many of these problems.

The Demonstration activities will include scenarios and exhibits to isolate each activity involved within an AHS driving experience. Each scenario and exhibit is designed to show feasibility characteristics that will allow the nation's current transportation system to become more efficient by reducing current transportation problems.

3.0 Demonstration Activities

The 1997 Demonstration will demonstrate free-agent, platooning, and maintenance and construction activities.

3.1 Free-Agent Activities

- Check-in
- Automated Travel
- Obstacle Avoidance
- Exit

Free-Agent Control Elements:

• **Check-in**	non-stop process, trip planning, route guidance, route diversion, accept/reject process, enforcement, malfunction management operator/driver interface (message sign, in-vehicle display, audio)
• **Automated Travel**	automated (hands off, feet off) control of the vehicle
• **Obstacle Avoidance**	obstacle detection, collision warning, lane change, malfunction management, operator/driver interface
• **Exit**	operator/driver interface, transfer of lateral and longitudinal control, split, diverge, malfunction management

3.2 Platooning Activities

- Entry
- Lateral and Longitudinal Control of a Platoon

Platooning Control Elements:

• **Entry**	incremental transfer of control, merge, join, vehicle communications to infrastructure and other vehicles, lateral and longitudinal control, enforcement malfunction management, operator/driver interface
• **Lateral and Longitudinal Control**	merge, join, diverge, split, obstacle avoidance, lane change/passing, lateral control, longitudinal control, modulation of speed, communication to and between vehicles, malfunction management, operator/driver interface

3.3 Maintenance

- System Operational Status
- Obstacle Removal

Maintenance Control Elements:

Maintenance	automated-incident response team, continuous monitoring, diagnosis, preventive care through DPC to vehicle and infrastructure communication, on the fly inspection

Note: Malfunction management, traffic operations, and driver interface are control elements that occur during every functional scenario.

Free-agent, platooning, and maintenance functions shown throughout many of the demonstration activities will target the benefits achieved from various internal and external attributes firmly associated with automation.

Internal attributes are activities that interact with the user when operating an automated vehicle. Internal attributes include (but are not restricted to) audio devices, easy to read control panels, and light/sound sensors.

External attributes can simply be explained as spin-off activities from which the benefits of various internal attributes are gained. For example, the use of audio devices, easy to read control panels, and light/sound sensors, can increase a driver's ability to adapt to varying travel conditions (congestion, rain, snow, etc.).

4.0 Internal and External Benefits

Listed below are benefits which will be influenced by the internal and external attributes of AHS.

- **Internal benefits:** decreased driver related stress and fatigue, reliable transportation, comfortable driving, convenient

- **External benefits:** improved safety, enhanced mobility, increased savings (fuel, insurance, etc.), decreased trip times, better trip time predictability, decreased congestion, environmental advantages

As a result, demonstration scenarios and exhibits are intended to show a number of the attributes listed above. In addition, the attributes along with the overall AHS benefits should be apparent throughout the demonstration.

4.1 AHS Benefits

AHS benefits are the improvement of transportation from its current form, into a more effective and efficient form in the future. AHS benefits address some of the economic, environmental, social and institutional, technical, safety, and reliability issues which will be positively impacted by automation.

AHS benefits are as follows:

Economic
- reduces need for new construction
- favorable ROI for state and regional transportation agencies compared to transportation alternatives
- improves productivity of commercial users "just-in-time" delivery, which enhances competitiveness and growth
- improves efficiency and facilitates intermodal and multimodal transportation
- positively impact insurance rates due to reduced numbers/severity of crashes
- reduces need for law enforcement expenses needed to deter speeding and unsafe driving.
- improves fuel economy and reduces fossil fuel consumption

Environment
- reduces emissions (per vehicle kilometer traveled)
- reduces noise pollution
- improves air quality in support of community air pollution policies
- reduces congested interstate, urban and inter-city highways
- supports alternative fuel vehicles to support future vehicle propulsion and fuel designs

Social and Institutional
- improves and predicts transit trip times and travel efficiency
- smoother flow of traffic and possible higher speeds to decrease travel time and improve travel time predictability
- reduces driver related stress and fatigue caused by congested and long distance commutes
- enhances mobility in cases of special needs (elderly, handicapped, enforcement & emergency services)
- supports sustainable transportation policies
- supports interstate, inner-city, urban, suburban, and rural roadways
- user friendly displays, controls, and operations

Technical

- advanced GPS, cruise control, collision avoidance, and object detection features
- supports a wide range of vehicle types
- fail-soft and fail-safe designs in case of systems failure
- supports travel demand management and transportation management policies

Safety

- reduces driver generated errors and incidents
- provides complete analysis of vehicle system status
- reduces the frequency of collisions
- reduces vehicle crashes (per highway kilometer) by as much 50 to 80 percent
- reduces fatal and major injury crashes at least one half the current rate
- reduces driver errors caused by fatigue, inattentiveness, drowsiness, and delayed reaction times

Mobility

- predicts travel times
- ensure on-time performance
- increases efficiency

Many of the AHS benefits listed above also represent a variety of opportunities and strengths associated with automated highway systems. The usefulness of each benefit as an opportunity and/or strength is needed to encourage any efforts to revitalize the nation's transportation system. All AHS benefits are not restricted to those listed.

4.2 Link Exposition Center to All Identified Benefits

The Exposition Center is the center of activity for the 97 Demonstration. Exposition attendees will view and experience various aspects of automation.

The Exposition Center will contain the items listed below.

Exposition Content: (Core and Associate)

- AHS Exhibits
- Technical Presentations
- Small Operating Demonstrations
- Mini-Demonstrations of systems and technology applications
- Equipment Displays
- Computer Simulations
- Outreach Materials
- AHS Transportation Management Center

BENEFITS / EXPOSITION CONTENT	Economic	Environment	S&I	Technical	Safety	Mobility
AHS Exhibits			✓	✓		
Technical Presentations	✓	✓	✓	✓	✓	✓
Mini-Demonstrations			✓		✓	✓
Equipment Displays			✓		✓	✓
Computer Simulations	✓	✓	✓	✓	✓	✓
Outreach Materials	✓	✓	✓	✓	✓	✓
AHS Demonstration Presentation Center				✓		✓

4.3 Link Demonstration Scenarios to All Identified Benefits

Demonstration scenarios are scripted technical demonstrations which will be used to depict an outline or model of an expected activity or a proposed sequence of events.

To link the demonstration scenarios to most of their benefits, an evaluation of each free-agent, platooning, and maintenance and construction activity is included.

The outline of each evaluation is provided below.

- I. Activities related to the given scenario
- II. Listing of the Scenario Control Elements that should be identified
    - a. Identified Control Elements
    - b. Unidentified Control Elements
- III. Listing of the Internal, External, and AHS Benefits that should be identified
    - a. Identified Internal, External, and AHS Benefits
    - b. Unidentified Internal, External, and AHS Benefits

The basis for the evaluations are conclusions drawn from the master scenario and the additional information provided in the Demonstration Content Document.

All assumptions will specify whether the control elements and benefits are identified or unidentified as a result of the given scenario. The identified control elements and the identified benefit categories represent the control elements and benefits provided in the scripted scenario. As a result, if a control element or benefit appears in either category it is obviously apparent within the given scenario. The unidentified control elements and the unidentified benefit categories represent the control elements and benefits not provided in the scripted scenario. As a result, if a control element or benefit appears in either category it is not obviously apparent within the given scenario. Consequently, if a control element or benefit is classified as unidentified does not mean it is not present, but simply that it is not obviously apparent.

A number of control elements and benefits may not be apparent during every activity, due to the nature of the given scenario.

Some of the unidentified control elements and benefits need special considerations (video coverage, literature, announcements, etc.) to make their presence apparent. The symbol below will be used to identify some of the control elements and benefits that may need special considerations.

- **Symbol: Φ**
  The Greek letter Phi

Note: The unidentified AHS Benefit category will need special considerations to make apparent all benefits which are listed.

A number of internal, external, and AHS benefits are identified in each evaluation. Therefore, reliable transportation, convenience, improved safety, enhanced mobility, increased savings, **(the numbers inside the parenthesizes are references to the AHS Benefits from the previous two pages)** economic (1,4), environment (4), technology (1), safety (1), and reliability (3), are all found in each evaluation.

REASON: There are basic characteristics that accompany the use of automated highway systems. As a result, these characteristics are accomplished by automation and assumed to be evident in each evaluation.

Free-Agent Check-in Evaluation

- The scenario will start with four GM passenger sedan vehicles in the South Yard or the North Staging Area. Each vehicle will manually drive separately from the staging area onto the entrance ramp and pass through a check-in station which verifies each vehicle's health and equipment status. The sedan without passengers will be rejected and depicted to return to the manual lanes.

Check-in Control Elements to be identified	non-stop process, trip planning, route guidance, route diversion, accept/reject process, enforcement, malfunction management operator/driver interface (message sign, in-vehicle display, audio)
Apparent Check-in Control Elements non-stop process accept / reject process malfunction management operator / driver interface (Traffic Operations)	Not Apparent Check-in Control Elements Φ trip planning Φ route guidance enforcement

Internal Benefits to be identified	**External Benefits to be identified**	**AHS Benefits to be identified**
decreased driver related stress, reliable transportation, comfortable driving, convenient	improved safety, enhanced mobility, increased savings, decreased trip times, decreased congestion, environmental advantages	AHS benefit identities are listed under their appropriate subtitle followed a number that directly relates to the scenario.
Apparent Internal Benefits reliable transportation convenient	Apparent External Benefits improved safety enhanced mobility increased savings	Apparent AHS Benefits Economic (1,4) Environment (4) S&I (3) Technical (1) Safety (1) Reliability (3)
Not Apparent Internal Benefits Φ decreased stress Φ comfortable driving	Not Apparent External Benefits Φ decreased trip time decreased congestion Φ environmental advantages	Not Apparent AHS Benefits Φ Economic (2,3,5) Environment (1,2,3) S&I (1,2,4) Technical (2,3) Safety (2,3,4) Reliability (1,2)

(evaluations will be reviewed further)

Platooning Entry Evaluation

- Ten GM full size four door sedans will drive north on the entrance ramp under manual control, enter the right HOV lane of I-15, and transfer to automated control.

Entry Control Elements to be identified	incremental transfer of control, merge, join, vehicle communications to infrastructure and other vehicles, lateral and longitudinal control, malfunction management, operator/driver interface
Apparent Entry Control Elements transition merge join lateral and longitudinal control	Not Apparent Entry Control Elements Φ communication with other vehicles Φ malfunction management operator/driver interface

Internal Benefits to be identified	**External Benefits to be identified**	**AHS Benefits to be identified**
decreased driver related stress, reliable transportation, comfortable driving, convenient	improved safety, enhanced mobility, increased savings, decreased trip times, decreased congestion, environmental advantages	AHS benefit identities are listed under their appropriate subtitle followed a number that directly relates to the scenario.
Apparent Internal Benefits reliable transportation convenient	Apparent External Benefits improved safety enhanced mobility increased savings decreased congestion	Apparent AHS Benefits Economic (1,4) Environment (4) S&I (0) Technical (1) Safety (1) Reliability (3)
Unidentified Internal Benefits Φ decreased stress Φ comfortable driving	Unidentified External Benefits Φ decreased trip time Φ environmental advantages	Unidentified AHS Benefits Φ Economic (2,3,5) Environment (1,2,3) S&I (1,2,3,4) Technical (2,3) Safety (2,3,4) Reliability (1,2)

(evaluations will be reviewed further)

Platooning Lateral and Longitudinal Control Evaluation

- Platoon vehicles will proceed up the lanes: an additional vehicle will "catch-up" and join the back of the platoon. At the far end, the vehicles will return to manual control, stop, turn around, and regroup. Once repositioned heading the opposite direction, they will accelerate in unison, transfer back to fully automated control, and return to the entrance point.

Lateral and Longitudinal Control Elements to be identified	merge, join, diverge, split, obstacle avoidance, lane change/passing, lateral control, longitudinal control, modulation of speed, communication to and between vehicles, malfunction management, operator/driver interface
Apparent Lateral and Longitudinal Control Elements	Not Apparent Lateral and Longitudinal Elements
merge	diverge
join	split
lateral and longitudinal control	obstacle avoidance
modulation of speed	lane change/passing
communication to and between vehicles	malfunction management
operator/driver interface	

Internal Benefits to be identified	**External Benefits to be identified**	**AHS Benefits to be identified**
decreased driver related stress, reliable transportation, comfortable driving, convenient	improved safety, enhanced mobility, increased savings, decreased trip times, decreased congestion, environmental advantages	AHS benefit identities are listed under their appropriate subtitle followed a number that directly relates to the scenario.
Apparent Internal Benefits	Apparent External Benefits	Apparent AHS Benefits
reliable transportation	improved safety	Economic (1,4) Environment (1,2,3)
convenient	enhanced mobility	S&I (1,2) Technical (1,3)
	increased savings	Safety (1) Reliability (3)
Not Apparent Internal Benefits	Not Apparent External Benefits	Not Apparent AHS Benefits Φ
Φ decreased stress	decreased trip time	Economic (2,3,5) Environment (4)
Φ comfortable driving	decreased congestion	S&I (1,2,4) Technical (2)
	Φ environmental advantages	Safety (2,3,4) Reliability (1,2)

(evaluations will be reviewed further)

Free-Agent Obstacle Avoidance Evaluation

- The vehicles will all be traveling at slightly different highway speeds: the first to enter I-15, the slowest, the second, next fastest, and the third, the fastest. This will result in the vehicles' order on the lanes changing as passing maneuvers occur.

- In addition, the lead vehicle will detect the obstacle and simultaneously notify the DPC while beginning an avoidance maneuver. The other two vehicles will also be notified of the lead vehicle's obstacle detection. They will then maneuver around the obstacle.

Obstacle Avoidance Control Elements to be identified	obstacle detection, collision warning, lane change, malfunction management, operator/driver interface
Apparent Obstacle Avoidance Control Elements	Not Apparent Obstacle Avoidance Control Elements
obstacle detection collision warning lane change	Φ malfunction management operator/driver interface

Internal Benefits to be identified	**External Benefits to be identified**	**AHS Benefits to be identified**
decreased driver related stress, reliable transportation, comfortable driving, convenient	improved safety, enhanced mobility, increased savings, decreased trip times, decreased congestion, environmental advantages	AHS benefit identities are listed under their appropriate subtitle followed a number that directly relates to the scenario.
Apparent Internal Benefits	Apparent External Benefits	Apparent AHS Benefits
reliable transportation convenient	improved safety enhanced mobility increased savings	Economic (1,4) Environment (4) S&I (4) Technical (1) Safety (1,2,3) Reliability (3)
Unidentified Internal Benefits	Unidentified External Benefits	Unidentified AHS Benefits Φ
Φ decreased stress Φ comfortable driving	decreased trip time decreased congestion Φ environmental advantages	Economic (2,3,5) Environment (1,2,3) S&I (1,2,3) Technical (2,3) Safety (4) Reliability (1,2)

(evaluations will be reviewed further)

Vehicle Rejection (Not Performed Live)

A sedan without automation will be rejected and directed to return to the manual lanes from the on-ramp. (This sedan does not have additional instrumentation and will only be used to simulate a rejection from the system for passengers and video by merging away from the express lanes.)

Free-Agent Exit Evaluation

- The driver will pass the test prior to returning to manual control. The other two vehicles will return to manual control and exit the left ramp towards the South Yard.

Exit Control Elements to be identified	operator/driver interface, transfer of lateral and longitudinal control, split, diverge, malfunction management
Apparent Exit Control Elements operator/driver interface transfer of control malfunction management	Not Apparent Exit Control Elements split de-merge

Internal Benefits to be identified	**External Benefits to be identified**	**AHS Benefits identified**
decreased driver related stress, reliable transportation, comfortable driving, convenient	improved safety, enhanced mobility, increased savings, decreased trip times, decreased congestion, environmental advantages	AHS benefit identities are listed under their appropriate subtitle followed a number which directly relates to the scenario.
Apparent Internal Benefits reliable transportation convenient	Apparent External Benefits improved safety enhanced mobility increased savings	Apparent AHS Benefits Economic (1,4) Environment (4) S&I (2) Technical (1) Safety (1) Reliability (3)
Not Apparent Internal Benefits Φ decreased stress Φ comfortable driving	Not Apparent External Benefits decreased trip time decreased congestion Φ environmental advantages	Not Apparent AHS Benefits Φ Economic (2,3,5) Environment (1,2,3) S&I (1,3,4) Technical (2,3) Safety (2,3,4) Reliability (1,2)

(evaluations will be reviewed further)

Maintenance

- The maintenance vehicle will travel north and south on the lanes verifying the presence of functioning magnetic markers. A faulty or missing marker will be part of the script: the IDV will identify the location of the marker, notify the observing passengers on-board and also communicate this to the DPC at the Exposition Center.
- Before the maintenance demonstration, a manual vehicle will enter the HOV lanes and a crew will "plant" some debris. The IDV will detect the obstacle and notify the DPC. The obstacle removal vehicle will be dispatched to the obstacle on the lanes immediately from a convenient staging point, retrieve the debris, and exit.

Maintenance Control Elements to be identified	automated-incident response team, continuous monitoring, diagnosis, preventive care through DPC to vehicle and infrastructure communication, on the fly inspection
Apparent Maintenance Control Elements automated-incident response team, diagnosis, preventive care through DPC to vehicle	Not Apparent Maintenance Control Elements none

Internal Benefits to be identified	**External Benefits to be identified**	**AHS Benefits identified**
decreased driver related stress, reliable transportation, comfortable driving, convenient	improved safety, enhanced mobility, increased savings, decreased trip times, decreased congestion, environmental advantages	AHS benefit identities are listed under their appropriate subtitle followed a number which directly relates to the scenario.
Apparent Internal Benefits items not relevant to given scenario	Apparent External Benefits items not relevant to given scenario	Apparent AHS Benefits Economic Environment S&I Technical Safety Reliability
Not Apparent Internal Benefits	Not Apparent External Benefits	Not Apparent AHS Benefits Φ Economic Environment S&I Technical Safety Reliability

(evaluations will be reviewed further)

APPENDIX G Traffic Mitigation Plan

June 2, 1997

Mr. Lynn Barton
Caltrans District 11
Mail Station B-8
2829 Juan Street
San Diego, CA 92110

Re: Final Traffic Management Plan (TMP) for I-15 NAHSC Demonstration Project

Dear Lynn:

Attached are six copies of the subject report for your approval. Comments from the meeting on March 28, 1997 are incorporated into this Final TMP document.

The report presents our methodology, analysis and recommended TMP measures for the stated traffic conditions. Further, a cost estimate showing order of magnitude costs for implementing these TMP measures is also discussed.

The traffic conditions analyzed for this TMP includes the closure of northbound I-15 Ted Williams Parkway off-ramp; and early closure in the AM commute and late opening in the PM commute of the I-15 HOV lanes. The following paragraphs illustrate the need for the closures and the exact time and dates of the closures:

- I-15 HOV Lanes - Closing the HOV lanes 1/2 hour earlier in the AM commute (0845 instead of 0915) and opening the lanes 1/2 hour later in the PM commute (1500 instead of 1430) on the following dates:
    - Thursday and Friday, August 7 and 8, 1997.

- I-15 Ted Williams Parkway NB Off-ramp detour - from 0830 through 1500 on weekdays and 0700 to 1900 on the weekends for the following dates:
    - Thursday - Sunday, July 17-20, 1997
    - Tuesday - Sunday, July 22-27, 1997
    - Thursday - Sunday, July 31- August 3, 1997
    - Thursday - Sunday, August 7-10, 1997

Justification for the above closures

The NAHSC's Proof-of-Technical-Feasibility Demonstration showing the latest highway-vehicle automation technologies is national in scope. There will be hundreds of transportation officials, elected officials, and media personnel from
across the nation and from around the world attending this event. As part of the live vehicle demonstration, rides are being arranged for these officials and the media in the NAHSC prototype vehicles.

To provide rides to as many guests as possible, NAHSC is asking for the above HOV lane closures. The NAHSC is expecting over 400 VIPs Thursday and Friday, August 7 & 8. The extra hour each day will permit the NAHSC to accommodate and additional 50 passengers per day for a total of 300 rides as opposed to the 200 total rides possible without the extra hour per day. As it is the NAHSC will be unable to meet the expected demand, therefore, the extra hour each day is vital to the success of the demonstration.

The demonstration has been designed to minimize any impact to the I-15 facility. The traffic analysis indicates that a 1/2 hour early closure and 1/2 hour late opening of the HOV lanes will have little or no impact on the HOV lanes, conventional lanes, and local roads.

Because of safety and liability concerns, the NAHSC must avoid co-mingling NAHSC prototype vehicles with privately owned cars. For this reason a detour has been designed at the Ted Williams Parkway NB off-ramp so that the NAHSC vehicles may safely exist the I-15 HOV facility during the live vehicle demonstrations and go directly to the North Staging area while vehicles in the conventional lanes may exit the freeway slightly farther north of the normal merge lane. Field inspection by Caltrans District 11 and Headquarters personnel confirmed that there is adequate space to safely accommodate the detour with conventional traffic control measures.

The original traffic analysis was performed under the assumption that Ted Williams Parkway would be closed. Results showed that use of traffic police and other TMP measures would mitigate any impacts to the local streets upstream and downstream of Ted Williams Parkway off-ramp. The scenario where Ted Williams Parkway is closed is more conservative that the current detour scenario, therefore we can conclude that with adequate traffic management the detour will cause little or no impact to Ted Williams Parkway and the surrounding streets.

It has been a pleasure and challenge to serve the needs on the project thus far. Should you have any questions, please do not hesitate to contact me or Kevin Haboian at (714) 973-4880.

Sincerely,

Vijay Mididaddi, P.E.

Final
Traffic Management Plan

Interstate 15
Proof of Technical Feasibility Demonstration Project
Between SR-163 and SR-56

Prepared For
National Automated Highway System Consortium

May, 1997

Prepared By
Parsons Brinckerhoff Quade & Douglas, Inc.

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Appendix A - Capacity Requirements

EXECUTIVE SUMMARY

A Traffic Management Plan (TMP) is a program designed to reduce the impacts of highway construction. This report presents a TMP plan for the Proof-of-Technical Feasibility demonstration project being conducted by the National Automated Highway System Consortium (NAHSC) required by the Intermodal Surface Transportation Efficiency act of 1991 (ISTEA) on I-15 HOV lanes in San Diego, California. This demonstration will be a full scale live vehicle exhibition on a segment of interstate highway, integrating the latest technological achievements of the participants of the NAHSC and the transportation industry in general. This full scale live vehicle demonstration will show that the goal of automating the vehicle-highway system can be made practical reality by integrating presently existing technologies and concepts to provide a proof-of-technical feasibility.

The site chosen for this demonstration is located approximately 10 miles north of downtown San Diego on I-15 between SR-56 and SR-52. The demonstration will be conducted from Thursday August 7, 1997 to Sunday August 10, 1997 within the I-15 HOV facility which consists of two reversible HOV lanes approximately 7.6 miles long. Although this demonstration project does not include any active highway construction, it requires the complete or partial closure of some highway facilities which will impact business as usual on I-15. To reduce any inconvenience to the general users of the I-15 freeway, this Traffic Management Plan (TMP) was developed. It included analysis for the following three demonstration scenarios:

Scenario 1 - HOV facility closed and traffic detoured.
Scenario 2 - HOV lanes remain open and demonstration conducted between the HOV commute hours during the weekdays and all day on the weekend.
Scenario 3 - HOV lanes closes earlier in the AM and opens later in the PM with the demonstration conducted between morning and evening commute hours on Thursday and Friday and all day on the weekend.

Of the three scenarios studied only scenario 3, with a 30 minute early closure in the AM commute and a 30 minute late opening in the PM commute, meets the needs of the NAHSC to hold a successful demonstration without affecting the normal LOS along this stretch of the I-15.

Levels of service on the freeway in the pre-demonstration traffic conditions are at unacceptable levels for most of the AM and PM commute hours. These unfavorable conditions can be improved using TMP techniques. In addition, the demonstration activity will create other impacts which can also be minimized using a Traffic Management Plan. The TMP strategies used for this study include:

- Public Awareness Campaign - which communicates project information to residents, employers, commuters, the media or the public officials.
- On-Site TMP Measures - which can be implemented on the freeway to improve throughput or mitigate capacity degradation on the freeway during the project.
- Off-Site TMP Measures - implemented off the freeway which contribute to decreases in mainline vehicle demand or which assist in increasing average vehicle ridership.

These TMP measures should be coordinated and executed to mitigate the impacts of this project. Implementation of the TMP is a team effort and the success of it lies in the consensus that is forged between agencies and the affected communities. Although various TMP measures are proposed for this project, no one or two TMP measures will effectively achieve the TMP goals. However, a combination of all the TMP measures specified, along with the teamwork and cooperation of all the agencies involved can achieve the TMP goals. As a first step, it is recommended that a I-15 Corridor TMP Team be organized.

A cost estimate showing order of magnitude costs for implementing various recommended TMP elements within the three measures is as follows:

- News Bureau/Project Information Center - Estimated Cost: $50,000.

- Brochures/Mailers - Estimated Cost: $10,000.
- Newspaper Advertisement - Estimated Cost: $17,000.
- Mobile Changeable Message Signs - Estimated Cost: $10,000.
- Tow Service - Estimated Cost: $4,000 for four days of demonstration period.
- California Highway Patrol for COZEEP - Estimated Cost: $5,000 at $55/hr for 3 officers all through the demonstration period.
- Traffic Police - Estimated Cost: $3,000 at $55/hour.

Other TMP measures considered but rejected for this project include HAR, Rideshare Promotion, Transit, Traffic Screens and Ramp Metering.

1. INTRODUCTION

A Traffic Management Plan (TMP) is a program designed to reduce traffic congestion impacts associated with the construction of a highway project, or in this case, the demonstration of a project. It is basically a combination of Transportation System Management (TSM) strategies and Transportation Demand Management (TDM) strategies applied to a specific period of time with a definitive source attributing to operational deficiencies. A TMP typically includes a public information program, motorist information techniques, incident management program, construction strategies, demand management strategies, and specific traffic control and detour measures.

This TMP report presents a plan for the Proof-of-Technical Feasibility demonstration project conducted by the National Automated Highway System Consortium (NAHSC) required by the Intermodal Surface Transportation Efficiency act of 1991 (ISTEA) on I-15 HOV lanes in San Diego, California. In addition, a traffic impact analysis and details of proposed TMP elements specific to the demonstration on this freeway segment are included.

The goal of this Traffic Management Plan is to ensure that congestion along both I-15 and the local street network is no worse during the demonstration than it was before the demonstration.

1.1 The Project

In August 1997, the National Automated Highway System Consortium (NAHSC) will conduct a Proof-of-Technical Feasibility Demonstration, required by the Intermodal Surface Transportation Efficiency act of 1991. This demonstration will be a full scale live vehicle exhibition on a segment of interstate highway, integrating the latest technological achievements of the participants of the NAHSC and the transportation industry in general. The interstate chosen for this demonstration is the I-15 HOV lanes in San Diego, California. This demonstration will show that the vision of an automated highway system can be made practical reality and will focus on existing technologies and concepts that can be integrated quickly to provide a solid proof-of-technical feasibility.

The site chosen for this demonstration is located approximately 10 miles north of downtown San Diego on I-15 between SR-56 and SR-52. Exhibit 1 shows the location of the project, study limits, project route and the major streets in the vicinity. The demonstration will be conducted within the I-15 HOV facility, which consists of two reversible HOV lanes approximately 7.6 miles long. These HOV lanes, which operate southbound in the morning peak period and northbound in the evening peak period, are barrier separated from the general purpose lanes (the HOV facility is closed during

off-peak periods on weekdays and all-day on weekends). The access points for these HOV lanes are located at each end with no other access for the entire length. The geometry of the HOV facility includes two 12-foot lanes with two 10-foot shoulders. Currently the I-15 HOV lanes are heavily used by local traffic for three hours in the morning and for four hours in the afternoon.

The live demonstration will be conducted from Thursday August 7, 1997 to Sunday August 10, 1997. In addition, dress rehearsals will be conducted for three weekends prior to the actual demo. These dress rehearsals will be identical to the actual demo with respect to number of vehicle run scenarios. However, the 1/2 hour early closure of the HOV lanes in the AM and 1/2 hour late opening of the HOV lanes in the PM will not be required. In addition, the dry runs and dress rehearsals will require shuttles or buses for transporting people.

It has not been determined whether the I-15 HOV lanes will be closed on Thursday and Friday of the demonstration, or, whether the demonstration will be conducted between the existing HOV commute hours on the above days. For this reason, we have prepared the TMP for the following three scenarios:

Scenario 1 - HOV facility closed and traffic detoured.
Scenario 2 - HOV lanes remain open and demonstration conducted between the HOV commute hours during the weekdays and all day on the weekend.
Scenario 3 - HOV lanes closes earlier in the AM and opens later in the PM with the demonstration conducted between the revised HOV commute hours during the weekdays and all day on the weekend.

1.2 Traffic Management Plan Team

An I-15 Corridor Traffic Management Plan Team is necessary to formulate and implement the traffic management plan. The TMP team should be formed to include public agencies within the study limits and other agencies that would contribute to the success of the TMP. The I-15 TMP Team should include, but not be limited to, the following agencies and groups:

- Caltrans District 11 (Maintenance, Operations and Public Outreach)
- City of San Diego
- County of San Diego
- City of Poway
- SANDAG
- Traffic Management Associations
- Federal Highway Administration (FHWA)
- California Highway Patrol (CHP)
- San Diego County Transit District
- San Diego County Fire Department
- Automobile Club of Southern California
- Metropolitan Transit Development Board (MTDB)
- Consultants (Design & Demonstration)

The TMP Responsibility Matrix and TMP Team Matrix shown in the following pages should be completed and distributed among the TMP team.

1.3 Traffic Management Plan Approach

The following summarizes the TMP approach for this project:

1. Establish the study limits.
2. Review demonstration plan and schedule.
3. Traffic impact analysis specific to this live demonstration project:
   - Collect existing traffic data;
   - Determine existing and pre-demonstration levels of service;
   - Identify adjacent projects under construction simultaneously with this project;
   - Determine traffic diversion volumes due to demonstration;
   - Perform traffic analysis during demonstration; and
   - Identify critical impacts.
4. Identify and develop TMP strategies, tasks and workplan.
5. Develop the TMP cost.

The study limits were dictated by the demonstration activities. The TMP evaluated impacts on the I-15 corridor between SR-163 and Carmel Mountain Road. In addition, local streets and intersections impacted along this corridor were studied. Since the reversible HOV lanes connect to SR-163 at the south end of the study corridor, impact to local streets and intersections at this end is minimal. However, at the north end of the corridor demonstration activity impacts the local street network. This study analyzed impacts to the local street network at the north end.

Since the very nature of a TMP requires consensus building, teamwork and cooperation, the most effected agencies were involved from the beginning of this TMP. Caltrans District 11 and the City of San Diego were informed about the demonstration project, its schedule, and the possible impacts. Closures during both the scenarios were discussed. In addition, the proposed closure of the I-15 northbound Ted Williams Parkway off-ramp and the possible detour routes for this closure were discussed with Caltrans and the City of San Diego. It was logical to use the I-15 northbound off-ramps at Poway Road and Carmel Mountain Road during the closure of the I-15 Ted Williams Parkway off-ramp. Traffic from these off-ramps can be detoured via Sabre Springs Parkway, Rancho Penasquitos Boulevard, Carmel Mountain Road, and Rancho Carmel Drive to their ultimate destinations.

TMP Responsibility Matrix

Agency/Group	News Bureau/ Information Center	Brochures/Mai lers	News Ads	CMS	Tow Service	CHP	TP	Lane
Caltrans District 11								
Maintenance								
Operations								
Public Outreach								
City of San Diego								
County of San Diego								
City of Poway								
SANDAG								
Traffic Management Associations								
Federal Highway Administration (FHWA)								
California Highway Patrol (CHP)								
San Diego County Transit District								
San Diego County Fire Department								
Automobile Club of Southern California								
Metropolitan Transit Development Board (MTDB)								
Consultants (Design & Demonstration)								

TMP Team Matrix

Agency/Group	Contact Person	Telephone/ Fax Number	e-mail
Caltrans District 11			
Maintenance			
Operations			
Public Outreach			
City of San Diego			
County of San Diego			
City of Poway			
SANDAG			
Traffic Management Associations			
Federal Highway Administration (FHWA)			
California Highway Patrol (CHP)			
San Diego County Transit District			
San Diego County Fire Department			
Automobile Club of Southern California			
Metropolitan Transit Development Board (MTDB)			
Consultants (Design & Demonstration)			

2. TRAFFIC IMPACT ANALYSIS

This section addresses the impacts of the demonstration activities on the freeway mainline and the local street network. It includes discussion of the existing or pre-demonstration traffic conditions, during demonstration traffic conditions, impacts at Miramar College, and mitigation measures necessary to minimize the impacts.

2.1 Existing or Pre-demonstration Traffic Conditions

Capacity analysis for the freeway mainline, ramps, arterial network, and intersections for existing or pre-demonstration traffic conditions during the weekdays and weekends were performed. The LOS analysis for the freeway mainline, ramps, and arterial network were accomplished via volume/capacity ratios. The LOS at intersections were computed using procedures in the Caltrans 1994 Highway Capacity Manual.

Freeway

The I-15 facility within the project limits typically has four general purpose lanes in both the northbound and southbound directions and two reversible HOV lanes. Within the project limits, I-15 can be accessed at seven different interchanges. Additionally, ramp meters and HOV by-pass lane are also provided at the on-ramps within the project limits.

The existing traffic volumes (August 1996) for weekdays and weekends on I-15 were obtained from the Caltrans District 11. These traffic volumes were used for analyzing both the existing or pre-demonstration and during demonstration traffic conditions. The LOS analysis assumed a general purpose lane capacity of 2200 vehicles per hour (vph) and auxiliary lane capacity of 1000 vph. The off-ramp lane capacities were assumed to be 2050 vph for speeds between 41 and 50 miles per hour (mph) and 2000 vph for speeds between 31 and 40 mph. For this analysis, a speed limit of 45 mph was assumed for the Ted Williams Parkway and Poway Road northbound off-ramps and a speed limit of 35 mph was assumed for the Carmel Mountain Road northbound off-ramp.

Table 1 summarizes the existing or pre-demonstration LOS for the freeway segments within the project study limits. The existing or pre-demonstration weekday general purpose lane traffic LOS on I-15 within the project limits ranges from LOS B to LOS F in the NB direction and LOS D to LOS F in the SB direction for both AM and PM peak hours. On the weekend the LOS ranges from LOS B to LOS E in the NB direction and LOS C to LOS E in the SB direction during the peak hour.

Table 2 summarizes the existing off-ramp LOS. All the northbound off-ramps within the study area are operating at LOS B or better during AM, PM and Midday peaks in both weekdays and weekends.

TABLE 1 - Freeway Segment Level of Service

POST MILE	ANALYSIS PERIOD	# OF LANES		EXISTING OR PRE-DEMONSTRATION				DURING DEMONSTRATION							
								SCENARIO 1				SCENARIO 2			
		General Purpose Lanes	*Auxilary Lanes*	*Peak Hour*	*Capacity*	*v/c*	*LOS*	*Peak Hour*	*Capacity*	*v/c*	*LOS*	*Peak Hour*	*Capacity*	*v/c*	*LOS*
12.12	**NB I-15 at RTE 163**														
	AM Weekday Peak	4	4	9528	12800	0.74	C	11302	12800	0.88	D	10009	12800	0.78	C
	PM Weekday Peak	4	4	11284	12800	0.88	D	13480	12800	1.05	F	11853	12800	0.93	E
	Midday Weekday Peak	4	4	8149	12800	0.64	B	-	12800	-	-	8149	12800	0.64	B
	Weekend Peak	4	4	8193	12800	0.64	B	-	12800	-	-	8193	12800	0.64	B
12.12	**SB I-15 at RTE 163**														
	AM Weekday Peak	4	4	15148	12800	1.18	F	16922	12800	1.32	F	15629	12800	1.22	F
	PM Weekday Peak	4	4	13183	12800	1.03	F	15379	12800	1.20	F	13752	12800	1.07	F
	Midday Weekday Peak	4	4	10114	12800	0.79	C	-	12800	-	-	10114	12800	0.79	C
	Weekend Peak	4	4	11585	12800	0.91	E	-	12800	-	-	11585	12800	0.91	E
15	**NB I-15 at Carroll Canyon Rd**														
	AM Weekday Peak	4	1	6722	9800	0.69	B	8496	9800	0.87	D	7203	9800	0.74	C
	PM Weekday Peak	4	1	9836	9800	1.00	F	12032	9800	1.23	F	10405	9800	1.06	F
	Midday Weekday Peak	4	1	7279	9800	0.74	C	-	9800	-	-	7279	9800	0.74	C
	Weekend Peak	4	1	8357	9800	0.85	D	-	9800	-	-	8357	9800	0.85	D
15	**SB I-15 at Carroll Canyon Rd**														
	AM Weekday Peak	4	1	11116	9800	1.13	F	12890	9800	1.32	F	11597	9800	1.18	F
	PM Weekday Peak	4	1	8205	9800	0.84	D	10401	9800	1.06	F	8774	9800	0.90	D
	Midday Weekday Peak	4	1	6846	9800	0.70	B	-	9800	-	-	6846	9800	0.70	B
	Weekend Peak	4	1	8374	9800	0.85	D	-	9800	-	-	8374	9800	0.85	D
15.92	**NB I-15 at Mira Mesa Blvd.**														
	AM Weekday Peak	4	0	-	8800	-	-	-	8800	-	-	-	8800	-	-
	PM Weekday Peak	4	0	7478	8800	0.85	D	9674	8800	1.10	F	8047	8800	0.91	E
	Midday Weekday Peak	4	0	-	8800	-	-	-	8800	-	-	-	8800	-	-
	Weekend Peak	4	0	-	8800	-	-	-	8800	-	-	-	8800	-	-

TABLE 1 - Freeway Segment Level of Service

POST MILE	ANALYSIS PERIOD	# OF LANES		EXISTING OR PRE-DEMONSTRATION				DURING DEMONSTRATION							
								SCENARIO 1				SCENARIO 2			
		General Purpose Lanes	*Auxilary Lanes*	*Peak Hour*	*Capacity*	*v/c*	*LOS*	*Peak Hour*	*Capacity*	*v/c*	*LOS*	*Peak Hour*	*Capacity*	*v/c*	*LOS*
15.92	**SB I-15 at WB Mira Mesa Blvd.**														
	AM Weekday Peak	4	0	9245	8800	1.05	F	11019	8800	1.25	F	9726	8800	1.11	F
	PM Weekday Peak	4	0	-	8800	-	-	-	8800	-	-	-	8800	-	-
	Midday Weekday Peak	4	0	-	8800	-	-	-	8800	-	-	-	8800	-	-
	Weekend Peak	4	0	-	8800	-	-	-	8800	-	-	-	8800	-	-
20.57	**NB I-15 at Carmel Mtn Rd**														
	AM Weekday Peak	4	0	6441	8800	0.73	C	8215	8800	0.93	E	6922	8800	0.79	C
	PM Weekday Peak	4	0	9086	8800	1.03	F	11282	8800	1.28	F	9655	8800	1.10	F
	Midday Weekday Peak	4	0	5927	8800	0.67	B	-	8800	-	-	5927	8800	0.67	B
	Weekend Peak	4	0	6435	8800	0.73	C	-	8800	-	-	6435	8800	0.73	C
20.57	**SB I-15 at Carmel Mtn Rd**														
	AM Weekday Peak	4	0	9165	8800	1.04	F	10939	8800	1.24	F	9646	8800	1.10	F
	PM Weekday Peak	4	0	7681	8800	0.87	D	9877	8800	1.12	F	8250	8800	0.94	E
	Midday Weekday Peak	4	0	5785	8800	0.66	B	-	8800	-	-	5785	8800	0.66	B
	Weekend Peak	4	0	6696	8800	0.76	C	-	8800	-	-	6696	8800	0.76	C

Note:
Existing Traffic volumes for all peak periods not available at (Post Mile 15.92) Mira Mesa Boulevard interchange

TABLE 2
Ramp level of Service

Ramp Capacity	Existing Conditions												During Construction (Scenario 2)					
	Weekday									Weekend			Weekday			Weekend		
	AM			PM			Midday			Peak			Midday			Peak		
	Vol	LOS	v/c	Vol	LOS	v/c	Vol	LOS	v/c	Vol	LOS	v/c	Vol	LOS	v/c	Vol	LOS	v/c
4100	706	A	.17	1683	A	.41	1010	A	.25	1044	A	.25	1235	A	.30	1561	A	.38
4100	327	A	.08	1033	A	.25	449	A	.11	1033	A	.25	-	-	-	-	-	-
2000	712	A	.36	1334	B	.67	915	A	.46	991	A	.50	1140	A	.57	1508	B	.75

Intersections

Exhibit 2 shows the intersections which were analyzed for the TMP study. The exhibit also shows the intersection controls at each intersection. Each intersection has been assigned a number, as shown in the exhibit and will be utilized throughout this report for identification purposes.

The weekday intersection AM and PM peak hour traffic volumes were obtained from three different sources (City of San Diego for City intersections, traffic counts dated January/February/March 1997; Southland Car Counters for the remaining intersections, traffic counts dated January 1997; and Caltrans for ramps, traffic counts dated August 1996). The weekday mid-day peak traffic volumes were estimated using the weekday average daily traffic volumes provided by the City of San Diego. These ADT volumes were analyzed for the percentage difference between the PM peak hour and mid-day peak hour traffic to estimate the mid-day peak period intersection traffic volumes. This comparison indicated an average difference of 30 percent between the PM peak hour and mid-day peak hour traffic volumes.

The weekend intersection traffic volumes for a single highest peak period were estimated using the weekday and weekend average daily traffic volumes provided by the City of San Diego. These ADT volumes were compared for the percentage difference between the highest peak hour traffic volume on a weekday and the highest peak hour traffic volume on a weekend. This comparison indicated an average difference of 30 percent between the highest peak hour traffic volume on a weekday and the highest peak hour traffic volume on a weekend.

A capacity analysis was then performed on the study area intersections with the TRAFFIX software using the Highway Capacity Manual (HCM) method. Table 3 summarizes the existing or pre-demonstration LOS of the project study area intersections. As shown in Table 3, all the study area intersections analyzed are functioning at an acceptable LOS D or better in the existing or pre-demonstration traffic conditions during the weekday and weekend peak periods.

Local Streets

Exhibit 2 depicts the surrounding local street network. It also illustrates the existing street characteristics including number of lanes within the study area limits. The City of San Diego provided the existing or pre-demonstration average daily traffic (ADT) volumes and these volumes were used to analyze the existing or per-demonstration traffic conditions. The capacity requirements for the local streets were provided by the City of San Diego. The City of San Diego also stated that LOS D is the acceptable level of service for all the city streets. Table 4 summarizes the traffic volumes, capacities and LOS's for the local streets during the existing or pre-demonstration traffic condition. The capacity analysis indicates that the city streets within the study area limits function at an acceptable LOS D or better in existing or pre-demonstration traffic conditions during both weekdays and weekends.

(Existing Geometrics - Exhibit 2)

TABLE 3 - Intersection Level of Service

No.	Intersection	Existing LOS and Delay*				During Construction (Scenario 2) LOS and Delay*	
		Weekday			Weekend	Weekday	Weekend
		AM	PM	Midday	Peak	Midday	Peak
1	Poway Road / Sabre Springs Parkway	C / 15.6	B / 12.5	B / 7.7	B / 7.7	B / 9.0	B / 9.0
2	I-15 NB Ramps / Poway Road	B / 10.3	C / 21.7	B / 10.5	B / 10.5	C / 20.7	C / 20.7
3	I-15 SB Ramps / Poway Road	A / 2.5	C / 15.6	B / 7.6	B / 7.6	B / 8.1	B / 8.1
4	SR-56 EB Ramps / Rancho Penasquitos Blvd	B / 7.5	B / 9.5	B / 7.0	B / 7.0	B / 6.9	B / 6.9
5	SR-56 WB Ramps / Rancho Penasquitos Blvd	C / 17.7	D / 27.3	C / 18.3	C / 18.3	C / 19.5	C / 19.5
6	I-15 SB Ramps / Carmel Mountain Road	B / 11.0	B / 13.7	B / 9.3	B / 9.3	B / 9.9	B / 9.9
7	I-15 NB Ramps / Carmel Mountain Road	B / 10.2	B / 14.3	B / 9.8	B / 9.8	B / 13.2	B / 13.2
8	Carmel Mountain Rd / Rancho Carmel Drive	C / 16.0	C / 17.5	B / 13.5	B / 13.5	B / 14.1	B / 14.1
9	I-15 SB Ramps / SR-56	A / 1.8	A / 2.8	A / 1.9	A / 1.6	A / 2.0	A / 1.4
10	SR-56 EB / Sabre Springs Road	A / 4.4	B / 8.8	B / 7.3	B / 7.3	-	-
11	SR-56 WB / Sabre Springs Road	A / 4.8	A / 3.5	A / 3.1	A / 3.1	-	-

Note:
* - Delay in Seconds.

TABLE 4 - Local Street Level of Service

No.	Roadway Segment	Existing OR Pre-demonstration				During Demonstration (Scenario 2)			
		ADT	Capacity	v/c	LOS	ADT	Capacity	v/c	LOS
1	***Poway Rd - Between I-15 & Sabre Springs Rd***								
	Weekday Peak	37,236	60,000	0.62	B	38,002	60,000	0.63	B
	Weekend Peak	33,043	60,000	0.55	A	35,986	60,000	0.60	A
2	***Rancho Penasquitos Dr - Between I-15 & SR-56***								
	Weekday Peak	26,397	50,000	0.53	A	26,757	50,000	0.54	A
	Weekend Peak	-	50,000	-	-	-	50,000	-	-
3	***Sabre Springs Pkwy - Between Poway Rd & SR-56***								
	Weekday Peak	11,530	50,000	0.23	A	11,913	50,000	0.24	A
	Weekend Peak	9,600	50,000	0.19	A	11,072	50,000	0.22	A
4	***Carmel Mountain Rd***								
	Weekday Peak	-	50,000	-	-	-	50,000	-	-
	Weekend Peak	-	50,000	-	-	-	50,000	-	-
5	***Rancho Carmel Dr***								
	Weekday Peak	-	40,000	-	-	-	40,000	-	-
	Weekend Peak	-	40,000	-	-	-	40,000	-	-

Note:

- Existing ADT Volumes on Carmel Mountain Road and Rancho Carmel Drive for weekdays and weekends and on Rancho Penasquitos Drive for weekends are not available.
- Capacity requirements from City of San Diego

Mass Transit

The San Diego Transit of the Metropolitan Transit System (MTS) and County Transit operates local and commuter express bus services through the study area. Local bus service is provided by Route 20 (Downtown San Diego-North County Fair). Express bus services are provided by Route 210 (Downtown San Diego-Mira Mesa premium Express), Route 810 (Escondido-San Diego Express), Route 820 (Poway- San Diego Express), and Route 850 (Rancho Penasquitos-San Diego Express) and Routes 860 (North County Fair/Rancho Bernardo-San Diego Express) within the TMP study limits.

The demonstration of this project does not impact any of the above Transit Routes. However, these transit services could be extended through the detour areas and could used to reduce congestion on I-15 during demonstration as one of the TMP measures.

2.2 Summary of Existing/Pre-demonstration Traffic Conditions

The above analysis indicates that the off-ramps, local streets and intersections are currently operating at acceptable LOS. However, the I-15 general purpose lanes experience heavy congestion and LOS F operating conditions in the southbound and northbound directions in the AM and PM peak hours respectively. Considering these freeway results, it is expected that substantial delays will be experienced on the freeway in the existing conditions prior to the commencement of demonstration at certain locations within the project limits.

2.3 Neighboring Projects and Roadway Improvements

Neighboring Projects

There are no planned projects that will be under construction during this project's demonstration schedule that will have an adverse impact on the street network. However, the I-15 Congestion Pricing Demonstration Project which is already in operation results in increase traffic on the HOV lanes. The congestion pricing project enables single occupancy vehicles to use the HOV lanes by purchasing a monthly decal for a fee of $70 each. Decals have been sold to 700 customers. Hence, the HOV lane traffic volumes can potentially increase by as many as 700 vehicles from what the August 1996 traffic counts indicated. However, the volume counts following the sale of the decals observed that only 30 percent to 40 percent of the customers who bought these decals were using this facility. To be conservative in analyzing the demonstration activity impacts, this study included a 700 vehicle increase on the HOV lanes in each direction and no decrease in the number of vehicles on the general purpose lanes.

The demonstration activity will impact the Congestion Pricing decal holders if the HOV lanes are closed. Measures should be taken during the implementation of TMP to mitigate these impacts.

Roadway Improvements

The City of San Diego and Caltrans District 11 identified that they have no planned roadway improvements in the study area prior to the NAHSC demonstration project in August 1997.

2.4 During-demonstration Traffic Conditions

A traffic assessment similar to the existing or pre-demonstration condition was also conducted for the during demonstration condition. In addition, impacts at the Miramar college and mitigation measures to minimize the demonstration activities were identified.

2.4.1 Demonstration Schedule

In Scenario 1, the live demonstration will be conducted on the I-15 for four days between Thursday August 7, 1997 and Sunday August 10, 1997. In Scenario 2, the demonstration will be conducted between the HOV lane operating hours during weekdays and all day on the weekend between Thursday August 7, 1997 and Sunday August 10, 1997. In Scenario 3, the HOV lanes will close 1/2 hour early in the morning peak hour and open 1/2 later in the evening peak hour. The demonstration will be conducted between the elongated HOV lane non-operation hours during weekdays and all day on the weekend.

2.4.2 Freeway, Ramp and Street Closures

Freeway Closures

Caltrans has special provisions that permit lane closures or freeway closure. The decision to close lanes or close the freeway is solely subject to the magnitude of traffic volumes utilizing the freeway. This TMP analyzes two potential lane closure scenarios. First, Scenario 1 proposes to close the HOV lanes on Thursday August 7 and Friday August 8, 1997. Second, Scenario 3 proposes closing the HOV lanes 1/2 hour earlier in the morning peak hour and opening 1/2 hour later in the evening peak hour on Thursday August 7 and Friday August 8, 1997.

Ramp and Street Closures

The conceptual demonstration plan for the live demonstration project identifies the closure of the I-15 northbound Ted Williams Parkway off-ramp within the project limits. No other street or ramp closures are proposed. The reason for I-15 northbound Ted Williams Parkway off-ramp closure during the demonstration is to reduce the conflicts between the northbound Ted Williams Parkway general purpose off-ramp traffic and the northbound Ted Williams Parkway HOV lane off-ramp demonstration vehicle traffic. Another alternative to reduce these conflicts is to build a temporary off-ramp for the freeway users.

2.4.3 Diversion Estimates

The traffic diversion estimates for the local street network were determined for the previously described closure of the I-15 northbound Ted Williams Parkway off-ramp. The basic assumptions used in the diversion analysis are as follows:

- the existing turning movement percentages at the closed ramps will be used at the detoured ramp terminals
- the traffic volumes from the closed I-15 northbound Ted Williams Parkway were diverted 50% to the I-15 northbound Carmel Mountain Road off-ramp and the remaining 50% to the I-15 northbound Poway Road off-ramp. Traffic at the above off-ramps were detoured via Sabre Springs Parkway, Rancho Penasquitos Boulevard, Carmel Mountain Road, and Rancho Carmel Drive to their ultimate destinations. However, due to the general tendency and driving habits of the freeway users, more traffic may exit to northbound Carmel Mountain Road off-ramp compared to the northbound Poway Road off-ramp. To minimize these potential impacts at Carmel Mountain Road, mitigation measures should be taken.

2.4.4 Impacts to Freeway Mainline

Impacts to the freeway mainline will be different with various scenarios of demonstration activity. The following three scenarios were analyzed for this study:

Scenario 1: HOV lanes closed

Impacts discussed in this scenario are based on the demonstration activities within the project limits. The demonstration activities will be conducted all day weekdays and weekends from August 7 to August 10, 1997. This scenario assumes the closure of the reversible HOV lanes and the closure of the I-15 northbound Ted Williams Parkway off-ramp.

Pre-demonstration capacity analysis on weekdays for I-15 indicated that the freeway segments within the project limits will be operating at LOS F in the AM peak in the SB direction and LOS F during the PM peak in the NB direction on weekdays. These unfavorable LOS will result in slower travel speeds and delays. By closing the HOV lanes, most if not all of the traffic using the HOV lanes will be diverted onto the mainline general purpose lanes. This would result in an additional 1774 vehicles/hour in the AM peak and 2196 vehicles/hour in the PM peak on the general purpose. The above increase in traffic volumes takes into account the traffic from the congestion pricing project.

However, the general purpose lanes will not have any additional capacity to absorb the diverted traffic without creating an adverse impact. This adverse impact on the freeway is illustrated in Table 1. The implementation of the corridor-wide TMP elements would not be adequate to mitigate the anticipated deterioration in the LOS associated with the HOV facility closure. It is for the above reasons that this scenario was not studied further in this report.

Scenario 2: HOV lanes are open

In this Scenario, the demonstration will be conducted between the HOV lane operating periods on weekdays and all day on the weekend. Similar to Scenario 1, the I-15 northbound Ted Williams Parkway off-ramp will be closed during the demonstration periods on the weekdays and all day on the weekend.

AHS team will be running seven different vehicle demonstration scenarios with seven different sequences. To accommodate all the scenarios and sequences, the AHS team would need more time than what is available between the current HOV facility operating periods. Due to the time limitations and constraints, this Scenario would not be feasible and was not studied further in this report.

Scenario 3: HOV lanes are open (Reduced Hours)

In this Scenario, the demonstration activities will be conducted between the HOV lane operating periods on weekdays and all day on the weekend. These activities will result in the closure of the reversible HOV lanes 1/2 hour earlier in the morning peak hour and their opening 1/2 hour later in the evening peak hour during weekdays. Similar to Scenarios 1 and 2, the I-15 northbound Ted Williams Parkway off-ramp will be closed during the demonstration periods on the weekdays and all day on the weekend. The early closure and late opening of the HOV lanes will result in longer demonstration periods for NAHSC. According to our analysis the 1/2 hour early closure in the AM and 1/2 hour late opening in the PM has minimal to no impact on traffic on the facility and gives the NAHSC critical time to perform additional live vehicle runs. Any further reduction of HOV operating hours is not feasible given the high traffic volumes on the HOV lanes and capacity constraints on the general purpose lanes.

The reduced operating hours of the reversible HOV lanes may result in increasing the traffic on the general purpose lanes. This may not happen if the users that are affected by the reduced operating hours complete their trip earlier in the morning and later in the evening. However to be conservative in analyzing the demonstration activity impacts, the traffic volumes within these 1/2 hour closure periods are assumed to be using the I-15 general purpose lanes. This results in additional traffic of 481 vehicles/hour in the AM peak and 569 vehicles/hour in the PM peak on the general purpose lanes during the weekdays. This increase in traffic volumes takes into account the traffic from the congestion pricing project. During the weekends the HOV lanes are closed, so there will not be any additional traffic diverted onto the general purpose lanes.

The closure of the I-15 northbound Ted Williams Parkway off-ramp will divert the traffic to other off-ramps namely northbound Poway Road off-ramp and northbound Carmel Mountain Road off-ramp. Using the 50-50 split between the two off ramps as discussed before, the additional traffic on these two off-ramps will be equivalent to 278 vehicles/hour in the midday peak during weekdays and 358 vehicles/hour in the midday peak during weekends. In addition, this diversion of traffic will decrease traffic volumes on the freeway between Poway Road and SR-56 and increase in traffic volumes on the freeway between SR-56 and Carmel Mountain Road. These changes in volumes and the resulting changes in LOS on the freeway are shown in Table 1.

The change in the volume/capacity ratios between the pre-demonstration and during demonstration periods is very small and does not require any mitigation measures. The additional traffic diverted from the HOV lanes and from the closure of the NB I-15 Ted Williams Parkway off-ramp is not creating an adverse impact on the general purpose lanes.

Table 2 summarizes the changes in traffic volumes on the off-ramps during this scenario. The additional traffic from the closure of the Ted Williams Parkway off-ramp will not create an adverse impact on the northbound Poway Road and Carmel Mountain Road off-ramps. Both these off-ramps function at a LOS C or better during this traffic condition.

2.4.5 Impacts to Local Streets and Intersections

Scenario 1: HOV lanes closed

As discussed in the previous section, Scenario 1 is no longer being considered as a viable option for the demonstration. Consequently, local street and intersection impacts were not assessed for this condition.

Scenario 2: HOV lanes are open

As discussed in the previous section, Scenario 2 is no longer being considered as a viable option for the demonstration. Consequently, local street and intersection impacts were not assessed for this condition.

Scenario 3: HOV lanes are open (Reduced Hours)

A capacity analysis was performed for the study area intersections utilizing the Highway Capacity Manual (HCM) method. Table 3 summarizes the during demonstration LOS for intersections. A comparison of the capacity analysis for the study area intersections between the pre- demonstration traffic condition and during demonstration traffic condition indicates all the intersections function at LOS C or better.

A capacity analysis was conducted for the local street network to study the impacts of this demonstration scenario. Table 4 summarizes the during demonstration LOS for local streets. A comparison of the capacity analysis for the local street segments between the pre- demonstration traffic condition and during demonstration traffic condition indicates that all the city streets within the study area limits function at an acceptable LOS D or better during both weekdays and weekends.

2.4.6 Impacts at Miramar College

During the demonstration, there will be many concurrent events being conducted at the Miramar College campus including seminars, conferences and display events. People and participants, including VIP's from all over the country, are expected to visit this campus during the demonstration period. Adequate signing on the freeway to and from Miramar College should be provided to facilitate the influx of visitors.

In addition, adequate parking should be provided at Miramar College for public and participants visiting the demo sites, conferences, and display events. The college campus at present has a capacity of approximately 1100 paved parking spaces between two lots that are not reserved for faculty. The college will not be open at the time of demonstration. Hence, these two lots will be available for use by the demonstration visitors. Additionally, unpaved fields in Miramar College and the parking lots in the high school across from Miramar College will be available for parking use as a contingency plan. The parking requirements at the demo site can be reduced by providing bus or shuttle alternatives for visitors from their hotels to the Miramar college demo site.

In addition, separate parking should be provided for the demonstration and display event exhibitors. Adequate signing should provided to facilitate this parking requirement. By adopting these measures, impacts due to parking at Miramar College can be minimized.

2.5 Mitigation Measures

In Scenario 1, the closure of HOV lanes is resulting in heavy traffic diversion on to the general purpose lanes and causing freeway breakdown conditions. Hence, this scenario was not studied further so mitigation measures were not identified.

In Scenario 2, the time available on the HOV lanes for demonstration during the weekdays will not be adequate for the AHS demonstration scenarios. Hence, due to the time constraints this scenario was not studied further so mitigation measures were not identified.

In Scenario 3, the capacity analysis indicated that the demonstration activities would not have significant impact on the local streets and intersections which are operating below capacity in pre-demonstration traffic condition. However, levels of service on the freeway in the pre-demonstration traffic conditions are at unacceptable levels. These unfavorable conditions can be mitigated using TMP techniques.

Mitigation measures that help minimizing the parking and circulation impacts in this scenario include:

- Adequate provision of signing for the NB I-15 Ted Williams Parkway off-ramp closure.
- Adequate signing at the Miramar College for improving circulation and parking during the demo period.

In addition to the above measures, the following should be considered:

- Provide an alternate northbound off-ramp at Ted Williams Parkway to reduce the conflicts between the northbound Ted Williams Parkway general purpose off-ramp traffic and the northbound Ted Williams Parkway HOV lane off-ramp demonstration vehicle traffic. conflicts . This alternate off-ramp will exit just south of the existing HOV lane off/on ramp merge with the mainline, and will merge with the existing off-ramp past the north control yard. The design of this scenario is being studied for feasibility and design standards. Construction of this off-ramp will result in minimizing the impact of the demonstration project and will eliminate the possibility of closing the Ted Williams Parkway off-ramp for traffic during demonstration.

- As discussed earlier, due to the general tendency and driving habits of the freeway users, more traffic may exit to northbound Carmel Mountain Road off-ramp compared to the northbound Poway Road off-ramp. To minimize the potential impacts at Carmel Mountain Road and provide adequate capacity for the detoured traffic, mitigation measures should be taken. These may include placing traffic police at the ramp intersection and switching the signal to flash and providing more time to the off-ramp traffic; and closing the Carmel Mountain off-ramp to traffic when full and detouring the traffic to the Camino Del Norte northbound off-ramp.

3. ELEMENTS OF A TMP

The primary function of a TMP is to manage construction impacts by minimizing reliance on the facility under construction, or in this case, demonstration. The general objective of the TMP includes:

- Provide project information for individuals and businesses
- Provision of alternate routes for impacted vehicles
- Maintain efficient movement of vehicles through the demonstration zone
- Increase vehicle occupancy through the project area

The above objectives are used to define the strategies to be included in the TMP program. These strategies include a public awareness campaign, on-site measures, and off-site measures.

Public Awareness Campaign involves measures which communicate project information to residents, employers, commuters, the media or public officials. Specific elements include:

- News Bureau
- Brochures/Mailers and Media Releases

On-site Measures are implemented on the freeway to improve throughput on the mainline during the project. These specific measures include:

- Mobile Changeable Message Signs (CMS)
- Tow Service
- Traffic Screens
- Ramp Metering
- Construction Zone Enhanced Enforcement Program (COZEEP)

Off-site Measures are implemented off the freeway and within the study area which contribute to decreasing the mainline vehicle demand and assist in increasing "people carrying" capacity or average vehicle ridership (AVR). Various TMP elements within the off-site measures that can be used on this project include:

- Highway Advisory Radio (HAR)
- Demand Management Program (Rideshare Promotion, Outreach to employers, and Transit etc.)
- Traffic Police
- Project Information Center

The elements of each of the different strategies are essential and should be applied and administered by the TMP Team to increase the overall efficiency of the TMP program. Description on each of these measures and how they apply to the demonstration project is included in the following sections.

3.1 Scenario 1: HOV Lanes Closed and Traffic Detoured

As discussed earlier in this report, the general purpose lanes on the freeway will not have additional capacity to absorb the diverted traffic without creating an adverse impact. The implementation of the corridor-wide TMP elements would not be adequate to mitigate the detoured traffic volumes. Consequently, this scenario was not studied further in this report.

3.2 Scenario 2: HOV Lanes are open

As discussed earlier in this report, the time limitations and constraints during the weekdays of the demonstration will not adequately serve the purpose of the AHS demonstration team. Consequently, this scenario was not studied further in this report.

3.3 Scenario 3: HOV lanes are Open (Reduced Hours)

As previously discussed, the scenario will result in the closure of the reversible HOV lanes 1/2 hour earlier in the morning peak hour and opening 1/2 hour later in the evening peak hour. In addition, the I-15 northbound Ted Williams Parkway off-ramp will be closed during the demonstration periods on the weekdays and all day on the weekend.

The traffic analysis indicated the intersections and local street segments have the additional capacity to absorb the traffic diverted due to the demonstration and still function at an acceptable level of service. For the freeway segments, the change in the volume/capacity ratios between the pre-demonstration and during demonstration periods is minor. The additional traffic from the reduced operating hours of the HOV lanes and from the closure of the NB I-15 Ted Williams Parkway off-ramp is not creating an adverse impact on the general purpose lanes. The increase in general purpose lane traffic may not occur if the HOV users affected by the reduced operating hours complete their trip earlier in the morning and later in the afternoon. To achieve this and to minimize other demonstration activity impacts, the following TMP measures should be implemented.

3.2.1 Public Awareness Campaign

One of the main objectives of the TMP is to provide project information including temporary closures and transportation system changes associated with the demonstration. This objective can be achieved by a Public Awareness Campaign. Through this program the commuters, local businesses and all the related agencies will be informed about the temporary changes in the transportation system of the I-15 corridor and will be advised about the means available to avoid or minimize any disruptive impacts. Procedures to facilitate feedback and communication from the highway users will also be a part of this program. The elements that comprise this program include a News Bureau and Project Brochures, which are discussed individually in the following paragraphs.

News Bureau

The focal point of the Public Awareness Campaign is a News Bureau which functions as an information clearinghouse. This center should be organized to coordinate, develop and distribute all information concerning the I-15 demonstration project to the public, media, and the various highway user groups impacted by the project in a timely manner. This center is responsible for both initiating contact with, and responding to, inquires from the media. News Bureaus provide both a steady stream of information and develop earned media or "free press" opportunities. Most media outlets welcome well written, newsworthy items that are formatted for easy use at the media outlet's direction.

Project Brochures

Informational material such as project fact sheets and brochures are developed and produced to communicate specific messages to targeted audiences. For example, media will require detailed project fact sheets about project segments, including demonstration information, cost, project limits and traffic mitigation measures. Residents and local businesses on the other hand may not need as much detailed information and will be primarily concerned with demonstration duration and impacts to local streets. Employers and commuters would want to know the impact of the demonstration on their daily commutes as well as receive park-n-ride, carpool and vanpool promotional information. To meet these different information needs, several types of informational pieces with varying quantities should be developed.
These include project fact sheets for media personnel and project brochures for residents.

An *information kit* or *project fact sheet* should be prepared and made available to the media to inform the public about the project prior to the demonstration and the TMP program elements during the demonstration. This exposure can be achieved through radio and TV broadcasts or newspaper columns.

A *project brochure* that is visually engaging and easy to understand is an important tool for communicating with residents and businesses within the corridor. Brochures should be sent out to residents, planners of special events and community groups to address their special circumstances and to present alternative route maps, project demonstration status and information about the TMP program. Special brochures should be prepared and mailed to the congestion pricing ticket holders informing them of the changes in HOV facility operating hours during the demonstration. This information dissemination to the congestion pricing ticket holders and the HOV lane users prior to the main event should provide adequate time for the users to consider alternating their commute (if affected) during the demonstration. This indirectly will help in reducing the diversion of HOV lane traffic on to the general purpose lanes.

3.2.2 On-site Measures

The following are the TMP elements in the On-site TMP Measures strategy which can be implemented within the study area to minimize traffic congestion and increase capacity.

Mobile Changeable Message Signs

Real-time motorist information displays provided on mobile changeable message signs (CMS) can play an important role in improving highway safety, operations and the use of existing facilities during the demonstration week. These control devices could be strategically located on the freeway and/or local streets for traffic warnings, routing and management. This allows motorists ample opportunity to take an alternative route that is less congested. These mobile CMS's can be very valuable in improving traffic flow in the demonstration zone.

One of the prime location a CMS may be placed within the demonstration study area is the I-15 northbound Ted William off-ramp. The CMS placed at this off-ramp should indicate its closure dates, times and detour routes during the demonstration. This CMS should be in operation one week before the demonstration to give the regular off-ramp users adequate time to make changes in their route.

Tow Service

Tow Service with periodic or continuous patrol of the highway construction zone, including the detour routes, has proven to be a quick and efficient method to enhance incident management. The I-15 TMP team should contract a new towing company or expand the existing roving tow service to patrol the I-15 demonstration corridor, including the detour routes, to clear disabled vehicles and perform minor repairs to remove stranded vehicles and motorists during the demonstration hours. This effort helps mitigate the amount of time lanes are blocked and helps reduce gawking from motorists.

The existing roving tow service patrolling the I-15 corridor provides two trucks for four hours each during the AM and PM peak hours, during weekdays only, between Camino Del Norte and I-15/SR-163 interchange. The demonstration corridor falls within the existing roving tow service limits. However, since the demonstration occurs during the weekdays between the morning and evening peaks and all day during the weekends, the existing roving tow service will not be operating during the demonstration. The I-15 TMP team should coordinate their efforts with the freeway service patrol to expand the existing roving tow service to include demonstration times.

Traffic Screens

Use of traffic screens is often effective when construction areas are immediately adjacent to the travel lanes. They can prevent slow downs resulting from the distraction caused by the adjacent construction activities. Traffic screens can be mounted on top of the temporary K-rails or existing barriers on I-15. This effort helps to reduce gawking from motorists on the general purpose lanes which slows traffic and causes congestion. This could be an effective TMP element that could be implemented during the demonstration project to maintain traffic speeds and help minimize congestion resulting from slow speeds of traffic. Caltrans standard special provisions have specific requirements about materials used as traffic screens and installation process of the traffic screens. However, due to short duration of this demonstration project, this TMP measure may not be a cost-effective alternative.

Ramp Metering

Ramp metering is a proven technique for improving traffic flow on freeways. Ramp meters regulate the flow of vehicles entering congested lanes of traffic. They can be set to cycle at specific time intervals or they can be made more responsive to current freeway conditions through the use of detector loops placed in the freeway pavement. Ramp meters can also be used during the demonstration to restrict the flow of vehicles entering the freeway during an incident or in the rush hour. The demonstration activity on I-15 can disrupt traffic flows and cause congestion. During these periods ramp meters can be effectively used to regulate traffic entering the freeway to reduce congestion. Utilizing and maintaining the existing ramp metering operations at all on-ramps during the live demonstration of the project will allow for continued regulation of the mainline traffic flow and serve as a basic on-site element of the TMP.

Construction Zone Enhanced Enforcement Program (COZEEP)

Police assistance has always been a key element of highway construction projects in efficient movement of traffic. The presence of law enforcement officers can have a positive effect on slowing down traffic in the demonstration zone and can help implement the traffic control plan by providing enforcement, guidance and emergency response support. The I-15 TMP team should work closely with the California Highway Patrol during the live demonstration of the project to ensure adequate police assistance for enforcement of traffic control plans and for guidance and emergency response support.

3.2.3 Off-site Measures

The following Off-site TMP Measures may decrease mainline vehicle demand and/or assist in increasing the average vehicle rate in the surrounding communities within the study area and should be considered for the demonstration.

Highway Advisory Radio

Highway Advisory Radio is a low range broadcast station that provides construction and traffic information to the monitoring public in a specific area. HAR is commonly used to communicate traffic and parking information or to handle special traffic situations. HAR stations usually have a range of approximately 5 miles from the transmitter location, depending on the terrain. Because HAR stations are licensed by the FCC for traffic information only, messages are usually prepared at a broadcast station and then transmitted by data phone lines to the transmitter. The radio operates 24 hours per day and seven days a week, transmitting information on construction or demonstration activities which is updated daily. During the rush hours, the CHP accesses the radio and provides real time traffic updates. In addition to traffic reports and demonstration information, ridesharing and other public service type announcements are broadcasted. Additionally, the HAR system includes a number of signs outfitted with flashing beacons which advise motorists to tune to the radio when special conditions exist.

During the demonstration project, highway advisory radio can provide up-to-date information on traffic and road conditions, traffic hazard and travel advisories 24 hours a day on the low frequency broadcast channels. Such a system can result in increased diversion of traffic to alternate routes, faster resumption to normal traffic patterns and improved communications. An example information message that can be related on HAR can be "I-15 NB Ted Williams Parkway off-ramp is closed, use I-15 NB Poway Road off-ramp". However, since the Caltrans District does not have an existing HAR station serving the demonstration area, this measure may not be feasible.

Demand Management Program

The main purpose of a Demand Management Program is to move the same number of people through the demonstration zone as before demonstration. This can be accomplished by increasing the ridership of commuter traffic through carpool, vanpool, transit, and park-and-ride schemes. This should be planned and coordinated by the I-15 TMP team. This program should target road users through the demonstration influence areas via an extensive rideshare marketing programs using flyers, brochures and events.

To be effective, rideshare incentives such as carpool matching should be implemented with other elements of demand management elements such as park-and-ride lots, preferential carpool and vanpool parking. An increase in existing transit service and additional routes along the I-15 demonstration project corridor will help accomplish the goal of demand management program of the TMP. As discussed previously in this report, the San Diego Transit of the Metropolitan Transit System (MTS) and County Transit operates various local and commuter express bus services through the study area. The I-15 TMP team should coordinate with the above transit services to increase the frequency or add additional routes to their service within the study area during the demonstration period. However, due to the short duration of the demonstration period, this measure may not be cost-effective solution.

Traffic Police

Manual traffic control by law enforcement officers or flagman for detour schemes may be required for short duration special tasks. Due to the demonstration activity along I-15 and the planned closure of the I-15 Ted Williams Parkway off-ramp, it is anticipated that additional traffic will travel into surrounding local streets. The presence of uniformed traffic control officers will ensure immediate attention to unexpected problems and help keep the traffic moving. Ideal locations for the presence of the uniformed officers during this demonstration activity may include the intersections of I-15 Poway Road off-ramp and I-15 Carmel Mountain Road off-ramp.

Project Information Center (PIC)

Project Information Center should be established to collect information about the I-15 demonstration project and serve as a command post for the I-15 TMP related information dissemination. The PIC differs from the function of the News Bureau, in that the News Bureau informs the general public of the construction or demonstration activities while a PIC is concerned with local agency coordination (although these functions can be combined at the same location). This PIC function is vital to the success of several TMP measures (ramp metering, detour management, tow service etc.) and plays a major role in the TMP system. A PIC can collect construction, maintenance and demonstration schedules and relay this information to affected agencies, e.g. CHP, Caltrans, City of San Diego, paramedics etc. It can include a help line which is staffed to answer questions regarding demonstration and construction closures. To perform all the above functions and to serve as a place for project related staff to meet and conduct day-to-day operations, the Project Information Center should be equipped with a office set-up including a phone and a FAX.

However, unlike the Traffic Operations Center (TOC), the PIC has little or no real-time control over operations on the mainline. Because the PIC does not receive real-time data on mainline conditions from loop detectors or CCTV, it relies on obtaining construction or detour information in advance of the event and disseminating to the appropriate agencies.

4. CONCLUSIONS AND RECOMMENDATIONS

There are resources currently available within the corridor to support this demonstration project. Many of these resources can be redirected or expanded to meet the needs of this project. A TMP requires consensus building, teamwork and cooperation. Rather than starting from scratch, the implementation of the required TMP elements is based on sharing, redirection or leveraging existing resources and expertise.

This TMP assumes that the main audiences that must be communicated with are the employers, commuters/motorists, residents and public officials. The TMP will communicate effectively with each of these audiences in several ways. TMP measures were classified by category - public awareness campaign, on-site and off-site measures. Of all the TMP measures that were studied, the measures that would be useful and helpful for this project are News Bureau, Project Brochures/Mailers and Media Releases, Mobile Changeable Message Signs, Tow Service, California Highway Patrol for COZEEP, and Traffic Police. In reviewing final recommendations, it became clear from the analysis that no one or two TMP measures will effectively achieve the TMP objectives. Rather, a combination of many elements as described in previous section should comprise the I-15 demonstration TMP.

4.1 TMP Implementation

The success of any TMP lies in the consensus which is forged between agencies and affected communities. Development of I-15 Corridor TMP Team should be initiated immediately. The TMP Team should develop general guidelines and coordinate TMP requirements. Coordination with local jurisdiction and general agreement of traffic detours and enforcement would be required at this stage. Prior to the demonstration, the TMP Team should oversee the refinement of the TMP elements due to any unforeseen changes and coordinate with the design teams to ensure incorporation of these elements. During the demonstration stage, the TMP Team should have a plan to implement procedures to ensure the TMP is efficiently executed. The TMP should be continuously monitored and updated during all stages of implementation.

To ensure proper day-to-day management and proper implementation of the I-15 TMP, coordination and communication is important between the all the TMP elements. This TMP assumes two critical points of contact. They are:

- Project Information Center
- News Bureau

Project Information Center should be established to collect information about the I-15 demonstration project and serve as a command post for the I-15 TMP related information dissemination. It should be responsible for monitoring TMP measures such as ramp metering, tow service, mobile changeable message signs, rideshare promotion, transit, HAR messages, traffic signal modifications, and contractor controls. To perform all the above functions and to serve as a place for project related staff to meet and conduct day-to-day operations, the Project Information Center should be equipped with a office set-up including a phone and a FAX. It is anticipated that the PIC will be staffed by a TMP coordinator, project management staff and representatives form all agencies.

The second point of contact for the management of the TMP is the News Bureau which provides the backbone of the public awareness effort. Project information is funneled through the News Bureau to the media and public. It is anticipated that two personnel would be required to effectively operate the bureau. News Bureau functions include providing information to public, handle media relations and event management activities. It should target media that serves the I-15 corridor within the limits and also adjacent communities.

In this project both the above points of contact can be merged into one. This News Bureau/Project Information Center will provide all the information regarding the public awareness campaign and will be responsible in monitoring the implementation of the TMP measures. This center will then become and serve as the centralized command post for all information dissemination for this project.

4.2 TMP Cost

The budgeting requirements of the Traffic Management Plan will include the cost associated with the implementation of recommended TMP measures. The funding for the implementation of the TMP should be included in the total cost of construction for the project. TMP costs should be compared to both construction costs and delay costs. Statistics have shown that the cost of implementing the TMP varies from 2 percent to 30 percent of the construction costs, with most at 2 percent to 10 percent. There should be a reasonable match between the ratio of TMP cost to construction cost and the project characteristics in terms such as ADT, expected delay, political sensitivity, public exposure, and anticipated reduction in vehicle capacity. Also, some of the recommended measures might already be in place, and thus expansion and improvement of these services may be needed to keep TMP costs low.

The following is a preliminary order of magnitude cost estimate developed for the implementation of TMP measures for this project:

News Bureau/ Project Information Center - This centralized command post should be established near the project site. This center should be a office set-up with all communication capabilities and equipped with public relation staff and can serve as a place for project related staff to meet and conduct day-to-day operations. It is assumed that NAHSC and Caltrans will provide the staff for the project and this center should be developed about four months prior to the demonstration. Estimated Cost: $50,000.

Brochures/Mailers and Media Releases - These can be prepared to explain the project in detail. Notices can be sent to residents, planners of special events, and community groups to address their circumstances, and to present alternate route maps, demonstration status, and information about available TMP program. Materials should be ready three months prior to demonstration. Estimated Cost: $10,000 for Brochures and $17,000 for one page newspaper advertisement.

Mobile Changeable Message Signs - One incident response vehicle carrying changeable message signs to support the TMP to provide motorists with information about mainline and detour conditions and two others changeable message signs for traffic handling. Equipment should be available two months in advance of demonstration to allow for familiarization. Estimated Cost: $10,000.

Tow Service - Tow Service stationed or patrolling the demonstration area to maintain throughout and remove stranded motorists from the mainline and the detour routes. Should be operational from day one of the demonstration. Expand existing service and include additional trucks for efficiency and contingency. Estimated Cost: $4,000 for four days of demonstration period.

California Highway Patrol for COZEEP - Police assistance has always been a key aspect of highway reconstruction. Help of CHP is needed during demonstration. Estimated Cost: $5,000 at $55/hr for 3 officers all through the demonstration period.

Traffic Police - Traffic control officers with the help of traffic engineers are necessary in the event of traffic detouring, street closures, arterial traffic control, and intersection control. This TMP allocates two officers working part-time on this project, mainly during the peak hours over the total demonstration period. Estimated Cost: $3,000 at $55/hour.

Appendix A - Capacity Requirements

Appendix H - D2D Statement of Work

STATEMENT OF WORK (WORK PLAN)

WBS: D2D

DATE: March 15, 1996
REV: A (July 18, 1996)

TITLE: ***Develop the Demonstration(s) System(s)***

ORGANIZATION: NAHSC
AUTHOR: Robert Smilgis
TASK LEAD: Terry Quinlan

PURPOSE:

Design, develop, integrate and test all systems to be demonstrated including: Vehicle sub-system, infrastructure sub-system, communication sub-system and the Traffic Management Center.

Develop the plans for and, to manage and execute the marketing and production aspects of the 1997 Demonstration along with managing the involvement of Associate and Outreach Participants.

Provide overall system integration to ensure that the objectives and requirements are satisfied in an integrated and polished demonstration. This activity is critical to ensure a demo that meets the expectations and real objectives within funding constraints.

INPUTS:

The following inputs will be utilized to identify, describe, specify, develop, test and integrate the systems, sub-systems, and components that are to be included in the 1997 Demonstration:

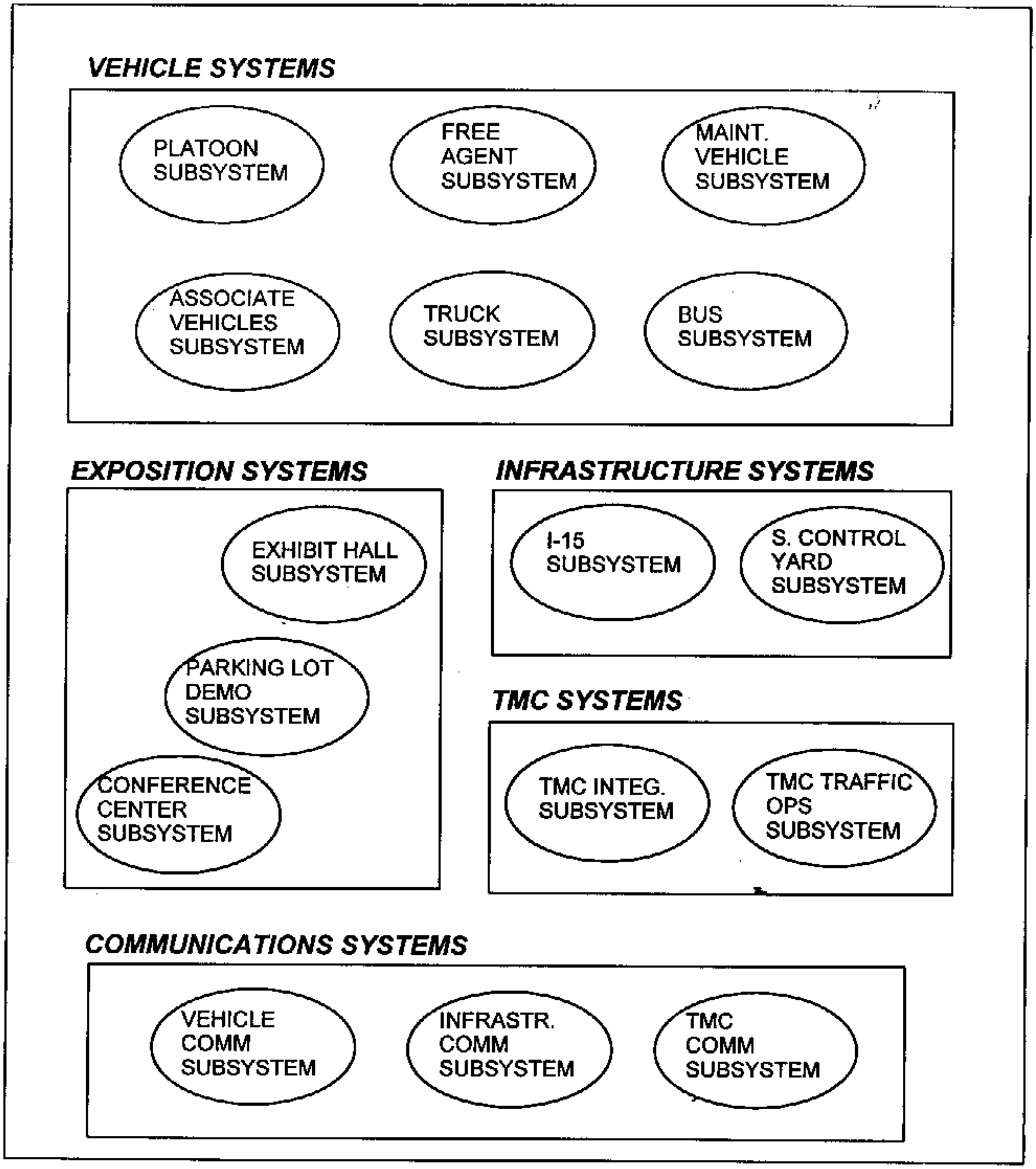
- WBS A5, Outreach (Recommendations and Comments)
- WBS B1A, AHS System Objectives and Characteristics
- WBS B2, Enabling Technologies Assessment
- WBS B3, Develop Critical Enabling Technologies and Address Institutional and Societal Issues - September 1995.
- WBS B6, S&I (Recommendations and Comments)
- WBS C2, - ongoing.
- WBS D2A, Identify Demo content and Prepare Demo Plan - February 1996.

DELIVERABLES:

1. Delivery of all developed components for the 1997 Demonstration - June 1997. Testing and integration of all developed components for the 1997 Demonstration - June 1997

DETAILED DESCRIPTION OF TASK:

'97 DEMO



Infrastructure sub-systems

- **Magnetic Markers**

Primary lateral guidance for the platooning scenario is provided by magnets embedded in the center of both driving lanes, and all ramps. The magnets are spaced at 1.2 meters along the centerline of the traveled way. There are approximately 16 lane miles of magnets (two lanes x 7.5 miles, plus ramps).

On bridge structures, rare earth magnets measuring approximately 1 inch diameter by 1 inch tall will be installed in holes drilled 1 1/2 inches deep, and secured with epoxy. The top of the hole will be sprinkled with sand to match the color of the concrete so as not to confuse drivers.

On open highway (non structure) areas, four stacked ceramic magnets approximately 7/8 inch diameter by 1 inch tall (total 7/8 by 4 inches) are installed in holes drilled 4 1/2 inches deep, and secured with epoxy. Sand is used as before to mask the holes. On areas of the road with pavement, black epoxy will be used to match the pavement color.

Single rare earth magnets will be used on bridge structures so the reinforcement steel is not damaged during drilling. This will also ensure that the steel does not interfere with the magnetic field. Stacks of four ceramic magnets are used in areas not containing reinforcing steel to save cost. The rare earth magnets cost approximately $10 each, while the ceramic magnets are approximately $0.50 each ($2 per hole).

There are approximately 24,000 holes with ceramic magnets (96,000 magnets) and 1,150 holes with rare earth magnets (1,150 magnets). Additional magnets have been purchased for minor changes or additions to the plan if needed.

Magnets have been ordered for delivery in mid June, with the construction contract being awarded on or before June 28, 1996. Construction is expected to begin in early July.

- Design being performed by Caltrans District 11, Procurement of Magnets by Caltrans New Technology, Marker installation and procurement specifications from PATH.

- **General Civil**

The general civil portion (design by Bechtel) includes design of the entry and exit routes, parking area, paving, fencing, lighting, traffic flows, and locating the footprint for two temporary buildings: a ±6000 sq. ft Service building, and a ±12,000 sq. ft storage building. Bechtel will provide initial investigation and development of conceptual drawings for the building design. Final selection of the building type and final building design will be done by Bechtel.

General Civil Construction elements:

- Lane Layout Drawings (From as builts, foundation for other projects)
- South Control Facility Grading, Paving, Fencing, Lighting
- Service Building Installation
- Storage Building Installation/Removal
- Install/Remove Temporary Ramp to Express Lanes Bridge Entry
- Construction Signage

This is a joint Caltrans/ Bechtel design effort with Bechtel doing the Final Design drawings and Caltrans preparing the PS & E and bid package. Caltrans will be responsible for managing all aspects of this contract including construction phase services. This portion of the project includes putting needed portions of the as built drawings onto CAD (by Bechtel) for use on other portions of the project.

The Environmental Categorical Exemption and the overall project report for the entire project are being driven by this project and are being done by Caltrans.

Design of the two buildings is included in this project, but either or both may have a separate contract.

Also part of the general civil portion of the project is the design of a temporary ramp and barrier from the south control property to the entry to the express lanes at gate 2. This ramp and its associated barrier will provide full bi-directional access to/from the express lanes for the duration of the demonstration, and with partial barrier implementation, may be able to provide protected access from the south control yard into the lanes all the time. During testing, return travel from the lanes to the south control yard will be via 163 and Kearny Villa Road, entering the yard via the south access.

- **Check In\out**

The design will consist of one or more of the following:

- Roadside RF Data Beacons
- CMS
- Entry Gate
- Entry Signal

The vehicle transponder has a range of approximately 100 feet, while the roadside system has a range of approximately 400 feet. This will allow the roadside system to "query" the vehicle far enough ahead of the antenna to allow the vehicle to perform its self checks and then respond as it approaches the reader antenna.

Technical Data and Electronic Design from Hughes, PS&E Package being done by Bechtel and the Bid package and construction phase services the responsibility of Caltrans.

- **General Lane Preparations and Restoration**

The design will consist of the following:

- Restriping, Remarkering, Shoulder Resealing
- Litter Pickup, Sweeping the Lane
- Graffiti Removal on the lanes and along the route to the Convention Center
- General and Demonstration Signage

This portion of the project is has three parts:

1) The restriping, remarkering, and shoulder resealing will enhance the operation of all the vision systems, as well as other technologies using current lane markings as a guidance mechanism.

2) General cleanup of the lanes and the route to the convention center. This portion, although small in dollar value, is extremely important, considering the intended audience.

3) Early discussions implied that some special signage would be needed. This still needs input and direction from the marketing and production team.

Support of the Exhibit Hall and Parking Lot Demonstrations can include sweeping, restriping, and so forth as required for minimal cost.

The PS&E, Bid package and construction phase services will be the responsibility of Caltrans.

- **Remediation, Removal, Restoration**

This portion of the project is the cleanup and restoration of the lanes and adjacent properties to the same condition as before we began the project. This will include, but is not limited to, removal of all non-standard paint striping and markings, removal of all gates, signals, and signage used for the demonstration, removal of Barrier, temporary paving, full restoration of operation of all gates, popups, and other items used during the demonstration,

Additionally, this project will remove the temporary ramp and barrier from the south control yard to the entry to the express lanes.

This project will restore, as requested by Caltrans District 11, the south control yard property to a condition satisfactory to District 11. This may include removing one or both buildings, or moving them to another location.

The PS&E, Bid package and construction phase services will be the responsibility of Caltrans.

- **Barriers**

The installation of the two miles of barrier will be performed as a Caltrans minor A project, minimizing time and cost. The contract is scheduled for award by June 30 in parallel with the magnetic marker installation.

Completion of the magnetic marker and barrier installation will clear the way for PATH and other consortium members to conduct full speed testing under both lateral and longitudinal control with complete barrier isolation from adjacent live traffic lanes. Both are scheduled for construction to be completed by early August 1996 allowing one full year for testing and validation before the demonstration.

The PS&E, Bid package and construction phase services will be the responsibility of Caltrans.

- **Radio Repeater**

Based on a radio site survey performed in December 1995, it was determined that reliable radio communications could not be maintained over the entire length of the express lanes without the use of a radio repeater. The installation of the repeater will require the following tasks:

- Perform site selection (Caltrans & Hughes)
- Acquisition of the repeater, antenna, coax, and miscellaneous hardware (Caltrans)
- Specification and acquisition of an equipment cabinet to house the repeater (Caltrans & Hughes)
- Contract for the installation of the Equipment cabinet and pad, antenna, coax and electrical wiring (Caltrans)
- Licensing of the repeater site (Caltrans)
- Installation of the repeater in the cabinet, connection to antenna and power, and FCC required checkout of installation. (Caltrans - general services)

Vehicle Sub-systems

- **FREE AGENT DEMO**

General Acronyms
FAD = Free Agent Demo

LC = Lateral Control
OA = Obstacle Avoidance
LT = Lane Transition
VC = Vehicle Coordination
HM = Headway Maintenance
CI = Check In/Entry
OD = Obstacle Detection
CO = Check Out/Exit
WS = Warning Systems
CSP = Computing and Sensing Platform
VSD = Vehicle Specification Document

Budget acronyms

VCSA = Vehicle Component and Subsystem Acquisition
IFI = Integration, fabrication, and installation
TDMS = Test Driving and Maintenance Support
II = Infrastructure Improvements
D1 =1997 World Congress Activities

Vehicle Specification Document

Vehicle Specification Document to developers. This document specifies actuator, power, cooling, and vehicle sensing requirements to the vehicle developer along with computing, communications, and user interface requirements. ***November 1, 1995***

Vehicle Design and Build

During this period, the vehicle developer will design and build the first FAD vehicle using the requirements set forth in the VSD. Interaction with the FAD integrators for clarification of requirements set forth in the VSD is expected. Monthly progress reports from the vehicle developers to the FAD integrators will be required to ensure that contingencies can be made if the schedule is slipping considerably. ***November 1, 1995 - February 28, 1996***

Computing/Sensing Platform Design and Build

During this period, the Computing/Sensing Platform (CSP) designers will develop plans for creating the computing hardware and sensing package required for successful completion of the FAD. The design will be based on the specifications set forth in the VSD. This process will include designing the system, acquiring computing and sensing components, and assembling the first unit. CMU will be responsible for all facets of this task except those relating to broadcast communications technology, voice radios, and remote video transmission. ***November 1, 1995 - February 28, 1996***

User interface design

To be completed by Delco in cooperation with vehicle builders, integrators, and Demo Team. ***January 1, 1996 - July 1, 1996***

FAD Milestone #1

Delivery of FAD vehicle #1 to CMU from supplier. Delivery of subsequent vehicles (#2 and #3) will take place at one month intervals. ***March 1, 1996***

Installation of the CSP

The installation will take place on each vehicle and initial hardware tests will be performed to ensure that CSP is working properly on the vehicle. CMU will be responsible for all installation and testing of the CSP on the FAD vehicle. The vehicle developer should be available for support during this period. The major area of effort during this period is expected to be the physical installation of the CSP into the vehicle and interfacing the vehicle state signals specified in the VSD to it.

After the CSP has been installed and verified to be working properly, current versions of the selected component software which is required for the 1997 will be installed and tested in a stand alone mode. The first systems to be integrated and tested are the vision based lateral control and vehicle hardware verification systems. ***March 1, 1996 - April 30, 1996***

All vehicles delivered to CMU - ***May 1, 1996***

FAD Milestone #2
Basic position estimation and vehicle control functionalities being used by lateral control system to autonomously control vehicle.

Test facility available for integrated and multi-vehicle testing. CMU will require access to a closed, two lane, test site over 1.5 miles in length. This site is required so that initial scenario

development and testing can begin. ***May 1, 1996***

New Component software development

During this period, development of new component software required for the FAD will take place. These components will mainly use radar based technology and will emphasize headway maintenance, and obstacle detection and avoidance. ***May 1, 1996 - July 31, 1996***

User Interface Installation

The first FAD vehicle will be sent to Delco electronics for user interface installation. Delivery of subsequent vehicles (#2 and #3) to Delco will take place at one month intervals. It is expected that Delco will complete each interface within a 1 month time frame so that CMU will always have at least two vehicle on which testing can be to conducted. ***July 1, 1996***

FAD Milestone #3 Obstacle detection and headway maintenance systems integrated and demonstrated on FAD vehicles

Assessment of radar with respect to obstacle detection and avoidance takes place. If unsatisfactory, alternatives need to be quickly identified and tested, or FAD scenario will need to be rethought.

One vehicle will be sent to the 1997 FAD test site in San Diego, CA to do limited tests designed to verify that the environmental assumptions built into the application modules are correct and that vehicle performs as expected. Special emphasis will be placed on determining problems area at the site for items like radar and communications. ***July 31, 1996***

Trial Demo preparation

This demo will be an early showcase of the capabilities of the FAD vehicles and will provide a preview of what can be expected in 1997. It will also allow us to become familiar with the expected integration effort which will be required for the 1997 FAD. The goal of this demo is to show integrated vision based lateral control, obstacle detection and avoidance, and headway maintenance. Check in/out and entry/exit procedures will be included. ***August 1, 1996 - October 15, 1996***

FAD Milestone #4 Execute the Trial Demo

The demo will be conducted and documented and the results will be assessed. As a result, we hope to determine which areas need to most attention and focus our effort on them. ***October 15, 1996***

Preparation specific to the 1997 FAD

Using the results from the Trial Demo, work will be concentrated on deficiency areas and remaining system software will be developed and tested. Integration will continues with an emphasis on determining which technologies are ready for demonstration. Near the end of this period, development work will slow and effort will be concentrated on integration and testing. ***December 1, 1996 - June 30, 1997***

Finalization of scenario

FAD scenario will be finalized, based on the current state of maturity of the component technologies. ***April 1, 1997 - July 15, 1997***

- **PLATOON**

<u>**Vehicle Development**</u>

Sensor development

- Improving the sensing scheme for extended range
- Purchase new magnetometers
- Test the new magnetic sensing scheme
- Improve O'conner radar
- Test alternative ranging sensor (Delco task)
- Develop an observer using motion sensors for dead reckoning between lanes

Design lateral control algorithms

- Model the new test vehicle (from the perspective of lateral dynamics and tire cornering force)
- Verify the vehicle lateral dynamic model through open loop tests
- Modify the existing lane keeping control algorithm
- Develop a robust lane keeping control algorithm
- Develop a merge and lane change control algorithm
- Simulate the new control algorithm using the verified dynamic model
- Debug of lateral control algorithm (intermediate experiments performed locally at RFS and potentially Crows Landing)
- Experiments on lateral control algorithm (performed on I-15)

Design the longitudinal control algorithm

- Model the new vehicle (from the perspective of engine dynamics and tire friction)
- Verify the vehicle dynamic model through open loop tests
- Improve the current space regulation algorithm (including split and join)
- Develop strategy and protocols for merge and diverge
- Simulate the space regulation control algorithm using the verified vehicle dynamic model
- Debug (locally)
- Experiments (I-15)

Combine the lateral and longitudinal control algorithms

- Software development for additional drivers and supporting algorithms
- Design additional control logic necessary for combined lateral control algorithm such as merge
- Simulation using a combined lateral and longitudinal control model
- Software integration
- Debug (locally)
- Experiments (I-15)

Vehicle development (First 2 vehicles)

- Procure components
- Design the steering actuator
- Develop the steering actuator
- Develop the inner-loop controller for the steering actuator
- Install steering actuator on the vehicle
- Design the throttle actuator
- Develop the throttle actuator
- Develop the inner-loop controller for the throttle actuator
- Install throttle actuator on the vehicle
- Design the brake actuator
- Develop the brake actuator
- Install brake actuator on the vehicle
- Wiring
- Human-machine interface
- Debug

Develop the communication link

- Finalize the specifications (PATH and Hughes)
- Develop/integrate the radio (Hughes)
- Develop protocols (Hughes)
- Develop message format for platooning and merge/lane changing
- Install communications link on the vehicle
- On-vehicle debug/tests

Vehicle Volume Build - GM:

Prepare system build documentation (1/1/96 - 9/1/96)
(consisting of: DEMO vehicle content, End to End Platoon's current Capability (ENDCAP), interfaces between PATH and added AHS components, validation requirements of added AHS components, vehicle packaging, vehicle master development plan, and interfaces to DEMO (Lockheed Martin) functions.)

- Start vehicle build
- Start GM test track modifications
- Install magnetic nails
- Provide infrastructure communication
- provide lane striping
- Complete GM test track modifications

- Check out GM test track modifications
- Start to build GM EMC test facility
- Build GM EMC test facility
- Complete GM EMC test facility
- Check out GM EMC test facility
- Build first GM vehicle per the DEMO vehicle requirements
- Perform system analysis of the vehicle components to meet DEMO vehicle requirements
- Perform power system analysis of the vehicle to meet DEMO vehicle requirements
- Perform health check system of the vehicle to meet DEMO vehicle requirements
- Check system interfaces of the vehicle components to meet DEMO vehicle requirements
- Perform system validation test of the vehicle to meet DEMO vehicle requirements
- Build second GM vehicle per the DEMO vehicle requirements
- Perform system analysis of the vehicle components to meet DEMO vehicle requirements
- Check system interfaces of the vehicle components to meet DEMO vehicle requirements
- Perform system validation test of the vehicle to meet DEMO vehicle requirements
- Perform two vehicle (platoon) test to meet DEMO requirements
- Validate two vehicle (platoon) test to meet DEMO requirements
- Build third GM vehicle per the DEMO vehicle requirements
- Perform system analysis of the vehicle components to meet DEMO vehicle requirements
- Check system interfaces of the vehicle components to meet DEMO vehicle requirements
- Perform system validation test of the vehicle to meet DEMO vehicle requirements
- Ship first vehicle to San Diego after completing validation tests
- Build three more GM vehicles per the DEMO vehicle requirements
- Perform system analysis of the vehicle components to meet DEMO vehicle requirements
- Check system interfaces of the vehicle components to meet DEMO vehicle requirements
- Perform system validation test of the vehicles to meet DEMO vehicle requirements
- Build seventh GM vehicle per the DEMO vehicle requirements

  - Perform system analysis of the vehicle components to meet DEMO vehicle requirements
  - Check system interfaces of the vehicle components to meet DEMO vehicle requirements
  - Perform system validation test of the vehicle to meet DEMO vehicle requirements
  - Build three more GM vehicles per the DEMO vehicle requirements
  - Perform system analysis of the vehicle components to meet DEMO vehicle requirements
  - Check system interfaces of the vehicle components to meet DEMO vehicle requirements
  - Perform system validation test of the vehicles to meet DEMO vehicle requirements
  - Build eleventh GM vehicle per the DEMO vehicle requirements
  - Perform system analysis of the vehicle components to meet DEMO vehicle requirements
  - Check system interfaces of the vehicle components to meet DEMO vehicle requirements
  - Perform system validation test of the vehicles to meet DEMO vehicle requirements
  - Build twelfth (the last) GM vehicle per the DEMO vehicle requirements
  - Perform system analysis of the vehicle components to meet DEMO vehicle requirements
  - Check system interfaces of the vehicle components to meet DEMO vehicle requirements
  - Perform system validation test of the vehicle to meet DEMO vehicle requirements
  - Ship vehicles 2 to 12 to San Diego after completing validation tests for full platoon tests
- Provide systems engineering support for vehicle build (GM) (9/96 - 6/97)

Experiments (1/97-8/97)

- **MAINTENANCE**

The Caltrans Maintenance Vehicle is important to the 1997 Demo to show that the team is also working the deployment and maintenance issues associated with an AHS system and to address specific concerns of state and local DOTs. The maintenance vehicle will demonstrate another candidate vision-based lateral control system that will complement the free-agent vehicle technology.

The Maintenance Vehicle or Infrastructure Diagnostic Vehicle is currently proposed by Caltrans for inclusion into the live-vehicle demo. This vehicle heightens awareness for the need to consider deployment as well as maintenance of an AHS system. The purpose of this vehicle in the 1997 Demo is to inspect the performance of the magnetic markers imbedded in the road. At the same time, Lockheed Martin would like to include its Advanced Location Tracking System (ALTS) on the vehicle. ALTS is a GPS-based maintenance/log system for workers in the field. When a maintenance item is identified, the ALTS system records its location automatically and manages the scheduling and dispatch for resolution. Both the magnetic field sensor and the ALTS system would be payloads in the maintenance vehicle. The maintenance vehicle (GM van) will arrive in Denver for integration with a steering actuator, cool air ducting into the trunk, and a power bus running into the trunk (provided by GM). We will integrate the LMC vision-based navigation system and the aforementioned payloads.

- Checkout Steering actuator.
- Install fly-by-wire service brake and throttle hardware (high-goal).
- Install electronics and VME rack into the trunk (including low level CPU, servo amps, power conditioner (if necessary), A/D, D/A, wire bundles, interface for upper level CPU (Sparc)).
- Mount camera, magnetometer, frame grabber, and upper level CPU.
- Integrate lateral/longitudinal (high-goal) software.
- Perform component, subsystem and system tests of navigation and performance of maintenance vehicle.
- Integrate payload (Infrastructure Diagnostics and ALTS system including GPS).
- Checkout payload performance.

Communications sub-systems

The communications effort is led by Hughes. Hughes is responsible for the specification and integration support of communications associated with automated highway system functions, including vehicle-to-vehicle and vehicle-to-infrastructure data links. Hughes will also specify hardware and support integration of communications providing telemetry data transfer from the vehicles to the mock TMC. Hughes will also perform technical evaluation of voice communications requirements. Hughes will provide technical consultation as required to related working groups, such as the infrastructure, integration, production, and TMC teams.

The communications effort will include evaluation of potential interference between each communications system. Integrated system tests will be performed prior to the live-demo dress rehearsals to verify operational compatibility among various systems. Potential interference sources such as video broadcast, news press communications, local short-wave radios, adjacent microwave systems, and cellular telephone traffic will be considered. A design review will be conducted to verify the integrated communication systems design. Communications system integration will include verification of functional performance and subsystem compatibility. The communications systems included on associate vehicles will be evaluated by the communications group to identify incompatibility and interference issues.

- **Vehicle-Vehicle Communications**

Hughes will develop a wireless communications system to support vehicle to vehicle transfer of control system data. The link access protocol will support the coordination of vehicle maneuvers that is required to demonstrate close-following modes such as platooning. The system specification will be derived from the control loop update rates and message transmit opportunity requirements necessary to implement longitudinal control algorithms for a ten vehicle platoon. The communication system will be based on existing commercial hardware with software modifications. The software based design will allow the flexibility to support independent vehicle communications, including requirements for free agent, truck, or bus scenarios.

Spread spectrum radios in the 902-928MHz unlicensed band will be mounted in each vehicle. The vehicle-vehicle link will allow vehicles to coordinate position control functions within a cooperative group of vehicles (platoon). The vehicle-vehicle link will support transfer of information such as velocity and acceleration data within the platoon. This communication link will also allow coordination of merge, separation, lane change, enter, and exit maneuvers. The risks of operating in the unlicensed bands and relative performance in the presence of interference from adjacent bands such as cellular telephone will be considered. The specific tasks are listed below.

- Define communication system requirements.
- Write communication system specification.
- Document vehicle control system interface.
- Evaluate COTS hardware and make vendor selection.

- Develop vehicle-vehicle link test plan and procedures.
- Develop lab and mobile test simulation.
- Design network protocol.
- Test radio to host computer interface in lab environment.
- Test communication system in mobile environment.
- Support on site integration with two PATH demo vehicles.
- Support on site test and evaluation.

- **Vehicle-Infrastructure Maneuver Coordination Communications**

Vehicle-roadside communications (VRC) will be provided to demonstrate the role of infrastructure support in AHS operations. The check-in and check-out functions will be used to illustrate the coordination of vehicle entry and exit maneuvers using two-way vehicle-infrastructure communications. This capability can be implemented with any demonstration scenario which includes check-in/check-out functions or entry/exit maneuvers.

The Delco/Hughes tag/beacon system will be implemented to support transfer of check-in/check-out information and vehicle status between roadside processors and the vehicles. Roadside readers (beacons) will be located at the check-in point and the check-out point. An RF transponder (tag) will be mounted in each vehicle. The VRC link will allow the infrastructure to poll the vehicle for current status at the check-in or check-out point, the vehicle to respond with self-test data, and the infrastructure to provide a go/no-go message to the vehicle.

The scope of the tag/beacon demonstration will focus on check-in and check-out, and is not intended to provide continuous communication between the infrastructure and the vehicles over the entire I15 route. The check-in and check-out functions will be integrated with the Delco human-machine interface (HMI) in the vehicle. Delco will provide the control interface to support generation of vehicle messages for transfer to the infrastructure reader. Delco will also generate HMI messages consistent with the data transferred to the transponder from the reader. Hughes will be responsible for developing the infrastructure instrumentation necessary to support the check-in and check-out scenarios. Specific activities are listed below.

- Evaluate reader and transponder capabilities.
- Document check-in and check-out script based on marketing and production inputs.
- Identify interface requirements.
- Develop vehicle-infrastructure link test plan and procedures.
- Support on site integration with CMU demo vehicles.
- Support on site test and evaluation.

- **Vehicle-Infrastructure Data Transfer**

The transfer of data from vehicles at the demonstration site to an off site location will be supported. Transfer of digital data will be possible along the entire length of the demonstration route. Connectivity will be provided from the vehicles to the mock TMC to support transfer of vehicle status updates for display or processing by the TMC integration team.

Data transfers are expected to include current vehicle position and automated subsystem status. The limited quantity of data and the non-safety critical nature of its use for display purposes makes this communication link a good candidate for a commercial wireless service such as cellular telephone or CDPD (cellular digital packet data). Local service providers will be surveyed to determine the most cost effective approach to supporting this function. Specific activities are listed below.

- Define data capacity requirements.
- Document interface specification.
- Define hardware requirements.
- Identify and select service provider.
- Coordinate hardware procurement and installation.

- **Site Voice Communications**

SMR band (800-860 MHz) mobile radios will be mounted in each vehicle to provide a voice link with Caltrans safety personnel. The voice radios will provide connectivity from the vehicles anywhere on the I15 HOV lanes to the staging area at the south control yard and the Kearny Mesa Caltrans TOC. The voice radios will be standard mobile voice radios compatible with existing Caltrans equipment. Hughes will specify vehicle radio models and will coordinate the radio purchase. Hughes will also provide technical support for a survey of voice radio site coverage and evaluate the need for a repeater.

The site survey conducted in December 1995 determined that a repeater is required to provide continuous coverage of the lanes. Radio coverage can be achieved using the Caltrans Soledad repeater, but this configuration compromises the effectiveness of ongoing Caltrans communications. Reliable full time coverage of the I15 lanes for dedicated AHS use will require a temporary repeater installed adjacent to the lanes. The repeater location was selected and a set of tests were run in February 1996 to verify RF coverage. Caltrans will be responsible for the design of the repeater mounting, and will perform wiring and installation of the infrastructure instrumentation. The selected repeater location will provide reliable voice communication for command and control of the demonstration, and will allow radio communication with the Caltrans TOC. Specific activities are listed below.

- Support demonstration site evaluation.
- Specify voice communication hardware.
- Support repeater simulation tests.
- Document site evaluation results.
- Coordinate procurement of mobile voice radios.

- **Integrated Communications**

The demonstration scenario will require independent communication systems for the vehicle-vehicle control loop, vehicle-infrastructure check-in/check-out, vehicle-infrastructure data transfer, and voice. The proposed communication systems are in adjacent bands, raising the issue of compatibility or mutual interference. An integrated test of the overall functionality must be performed to verify individual system performance with each system operating concurrently. The performance of each system will be evaluated with each of the other systems operating. The location and polarization of antennas will be an important consideration. Specific activities are listed below.

- Evaluate system interoperability requirements.
- Develop communication system test plan.
- Perform lab test and evaluation of overall communication system.
- Support demo system integration effort.
- Document demonstration results.

- **Infrastructure Processing**

A processor will be installed at the check-in station and check-out station. The processor location will be coincident with the reader location for the tag/beacon VRC system. The roadside processors will be used to perform real-time control over connected signals, changeable message signs (CMS), or gates.

A green/red traffic control signal can be used at the check-in station to indicate pass/fail of the vehicle check-in process. The roadside processor will provide a serial interface to control a traffic signal. A traffic control gate can be used to regulate access to the automated lanes at the check-in station. The roadside processor will provide a serial interface to control the raising and lowering of the gate during the check-in process. A changeable message sign can be used at the check-in and check-out stations to provide a text message indicating the result of the check-in and check-out processes. The roadside processor will provide a serial interface to control the changeable message sign.

The roadside processors will pass information received from the vehicles over the communications interface to the TOC. There is no existing wired (fiber/telephone) or wireless (microwave) connectivity to the I15 HOV lanes. Connectivity between the check-in and check-out points and the mock TMC will be made using commercial wireless services such as cellular or CDPD. This approach supports the low data rates and non-critical nature of the data transfer requirements with little investment in hardware or infrastructure.

The marketing and production team will provide input to the infrastructure team concerning the location of the check-in and check-out locations. The CMS, entry gate and entry signal selection will be performed by Caltrans. Procurement and installation of the CMS, gate, and/or signal will be performed by Caltrans. Design of the processor cabinet mounting location will be performed by Bechtel. Specific activities to be performed by Hughes are listed below.

- Define processor performance requirements.
- Write processor specification.
- Document processor interface specification.
- Coordinate processor procurement.
- Develop processor software.

Responsibility Matrix

	Design	Contract/Procure	Installation
Vehicle to Vehicle communications	Hughes	Hughes	Vehicle group
Vehicle to Roadside Communications (Check in\out)	HMI: Delco Reader: Hughes: Processor: Hughes Cell phone/modem: Hughes CMS, gate signal, cabinet: Bechtel/Hughes Telephone/modem: TMC group	Transponder: Delco Reader: Hughes: Processor: Hughes Cell phone/modem: Hughes CMS, gate signal, cabinet: Caltrans Telephone/modem: TMC group	Transponder: Vehicle group Reader: Caltrans/Hughes: Processor: Caltrans/Hughes Cell phone/modem: Caltrans/Hughes CMS, gate signal, cabinet: Caltrans Telephone/modem: TMC group
Vehicle to TMC Data transfer (Cell Phones)	Cell phone/modem: Hughes Telephone /modem: TMC group	Cell phone/modem: Hughes Telephone /modem: TMC group	Cell phone/modem: Vehicle group Telephone /modem: TMC group

TMC sub-system

Both Lockheed Martin and Parsons Brinckerhoff have experience, resources and capabilities in developing, deploying and operating current TMCs that meet local communities advanced traffic management and advanced traveler information needs. This task will build on these combined capabilities to demonstrate a vision of the TMC of tomorrow for AHS. In addition, Hughes and Caltrans will provide critical support in communication and transportation management essential to the ultimate success of the AHS TMC.

The Transportation Management Center is critical from both the operational and production aspects of the 1997 Demonstration. It will be used to address feasibility issues of state and local DOT operators as well as demonstrate the interoperability and evolutionary deployment aspects of AHS. We plan to showcase these by having existing TOCs' share data with one another while providing the development platform for the advanced AHS control functionality.

Lockheed Martin will integrate the Transportation Management Center (TMC) to be physically located at the Exhibition Hall. The TMC will be the focal point at the exhibition hall for all the presentations, including the live-vehicle demonstration. The TMC will show traditional maps and traffic flow simulations. We will have a map of the San Diego area and will feature all the major thoroughfares and arteries. We will have the capability to window and zoom to different regions or areas of interest. Of particular importance to our audience will be the I-15 corridor where the live-vehicle demo will take place. We will be able to bring up on the large overhead screens several different views of I-15 from the infrastructure cameras.

In addition to the basic state-of -the-art functions of a modern TMC, we will demonstrate AHS-specific functions that integrate the vehicles and infrastructure with the TMC. It's AHS capabilities include check-in, check-out, speed of AHS vehicles, vehicle flow, obstacle detection (vehicle-based or infrastructure-based), obstacle removal, and AHS maintenance. We will also be able to locate and follow selected vehicles in the live presentation on the map of the area. The TMC will be designed to address state and local DOT issues regarding traffic operations and integrating AHS into their current systems.

To effectively demonstrate the relationship between the vehicle and the infrastructure as well as working in concert with TOC's, the TMC must be designed with an open architecture to accommodate a variety of inputs and the ability to select appropriate outputs consistent with the demonstration script. A 3-layer structure has been chosen to meet the above requirements. (See Figure 1). This structure consists of the following:

1. Functional Layer

This layer entails the use and upgrade of several commercially available and/or IR&D products (The MIST®®, ATMS, and the San Diego TMC) to perform sets of scripted AHS TMC scenarios (reference the AHS TMC Scenarios Description Document) and their related functions (see Figure 2). These products will execute in concert with one another and pass outputs via a common interface format on to the Integration Layer.

2. Integration Layer

This layer will be developed to act as "conductor" of all AHS TMC activity. It will provide the means to initiate various Functional Layer products and coordinate the receipt and display of associated outputs. It will maintain and access the "Common Database" structures which will be used by all products to "share" traffic related information. It will also house the communications module which will handle all cell phone (and/or video phone) requirements. It has the ability to select the appropriate outputs from the Functional Layer and display them on any of the various devices represented in the Presentation Layer.

3. Presentation "Show & Tell" Layer

This layer consists of devices such large screen video monitors, variable message signs (VMS), kiosks, World Wide Web (WWW) connectivity, and graphic displays which will be used to present output from the AHS TMC (Integration Layer) to the audience in the Exhibition Hall. This development of this layer will involve interaction and participation from several different groups working to support the demonstration (Marketing and Production, Outreach) as well as a variety of equipment suppliers.

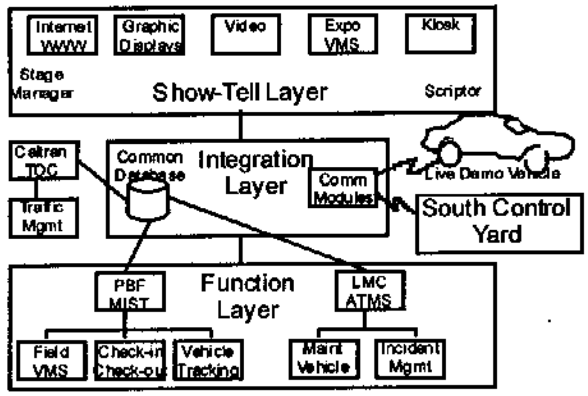


Figure 1. AHS TMC Architecture Layers

To accomplish the task under the time and budget constraints, work has been assigned to key team members as follows:

<u>Lockheed Martin</u>: Responsible for taking the lead role in integrating and producing an AHS TMC for use in the 1997 Technical Feasibility Demonstration. LMC will be the principle developer of the Integration Layer functions (building upon the ATMS Test Bed), the Common Relational Database, and the interfaces to the Presentation Layer devices. LMC will also handle development of Function Layer capabilities in the areas of Incident Management, Maintenance Operations and Malfunction Management.

<u>PBFI</u> The primary provider of Traffic Management created specifically to support AHS. PBFI will develop (using The MIST®® product as it's basis) AHS TMC unique capabilities in support of Check-In, Check-Out, and Vehicle Tracking functions as part of specified vehicle scenarios. PBFI will also participate actively in the Production aspects of the AHS TMC by helping to define TMC scenarios, scripts, filler products, and audience interaction techniques.

<u>Hughes:</u> This team member will provide the technical "know-how" regarding all aspects of data communications to be utilized by the AHS TMC. Hughes will assist in the creation of the communications module identified in the Integration Layer of the architecture which will be used to link the Live Demo Vehicles and the South Control Yard to the AHS TMC. Specific data communications needs identified at this time are as follows:

- *Vehicle Tracking ID*
  A means of uniquely identifying a vehicle on the AHS roadway. (This ID will not correspond to the vehicle License Plate number and as such will maintain the privacy of the vehicle occupants.) This ID will be used during the Live Demonstration to identify specific vehicles communicating with and sharing data with the TMC.

- *Location*
  Data identifying to the TMC the location on the I-15 corridor of the vehicle in question. It is understood that the various scenarios will be using differing techniques for establishing vehicle location (magnetic mile markers, GPS, other) but the onboard software for each scenario should translate location data into a TBD common location format prior to transmission to the TMC.

- *Status*
  This data field will be used as a catch-all to communicate status data unique to the various scenarios. Some scenarios may exchange a wealth of status data, others may not use this field at all. A relational data table will be developed which can be referenced to translate status codes into meaningful information which can then be displayed on a TMC screen. Examples of status data which would be desirable to track include:

Free-Agent Vehicle:	Check-In / Check-Out Status (Approved or Failure-Reason) Obstacle Detected, Obstacle Avoidance Complete
Platoon Vehicle:	Platoon Split Beginning, Platoon Split Completed
Maintenance Vehicle:	Marker Malfunction, Obstacle In Roadway
Associates:	TBD

- *Speed*
  All scenarios should be capable of transmitting current vehicle speed (in miles per hour) to the TMC.

- *Headway (Free Agent & Platoon)*
  For the two core scenarios involving multiple vehicles, the TMC would also like to be able to accept and display data regarding Headway. During the lane-change portion of the Free Agent scenario (faster vehicle passing slower vehicle), we would like to track the change in relative headway during the passing procedure. For the Platoon scenario, we would like to track data on headway between vehicles before, during and after the split activity.

- *Infrastructure to TMC Data Communication*
  In addition to the Vehicle to TMC data communication needs, we are planning several interfaces with other infrastructure based components including:

  - Infrastructure based Video Surveillance
  - Variable Message Signs
  - Weather Services
  - World Wide Web
  - Kiosks
  - Video Cassette Recorders
  - Video Monitors
  - Voice Communication with South Control Yard
  - Video Phone Communication with South Control Yard (desirable)

NOTE: Other data will be populated in relational tables resident on the AHS TMC in order to simulate more complex Infrastructure to Vehicle functionality BUT for purposes of the '97 Demo, the data detailed in this Action Item response represent the only "actual" data communications needs from selected Vehicles to the AHS TMC.

A Data Dictionary will be developed by LMC and PB and delivered (draft due in August 1996) as a part of this effort which will fully define the TMC "Common Database" tables. These tables will be populated by data coming in from the Live Vehicle Demos (via cell-phone lines), from AHS TMC functions and from "existing" TMCs (e.g. San Diego TMC).

Specific data message formats will be defined and documented in the System Integration Interface Control Document (draft currently scheduled for delivery in August 1996). All interface issues will be worked with the appropriate Vehicle scenario developers to ensure feasibility.

Caltrans: A key to the success of the Technical Feasibility Demo will be the ability to appeal to various state and local DOT stakeholders. Caltrans will support the creation of the AHS TMC with expert analysis (from a DOT point of view) of the system being created. They will be primary players in Maintenance Operations, Vehicle to Roadway Communications, Incident Management and TMC-TOC functional scenarios. Caltrans will be our primary interface with the District 11 representatives and with the San Diego TMC in our efforts to include them in the Technical Feasibility Demo.

The goal of the AHS TMC Team is to capitalize on the areas of expertise that each team member brings to the table in such a way as to maximize the capabilities we'll be able to display in August of 1997.

AHS TMC Functions and Responsibilities ● = Lead Role ○ = Support Role

FUNCTION	Free Agent	Platoon	Maint	Truck	Bus	Lockheed Martin	PBFI	Hughes	Caltrans
Integration Layer & USI									
- GUI	●	●	●	●	●	●	○		
- pop-up integrated video	●	●	●	●	●	●			
- expert system	●	●	●	●	●	●			
- workstations	●	●	●	●	●	●			
- large screen displays	●	●	●	●	●	●			
Architecture - client/server, open arch., data bus, CORBA	●	●	●	●	●	●			
Check-in	●					○	●	○	
Check-out	●						●	○	
Vehicle tracking	●	●	●	●	●		●	○	
Maintenance Operations - maintenance dispatch operations			●			● ALTS			○
Malfunction Management - real-time interface with maint. (diagnostics) vehicle, magnetometer, paint stripe & comm. - TMC diagnostics - Expert system - Fault tolerance			●			● ALTS		○	
Vehicle to roadway comm.		●	●					●	○
Intra-TMC comm.			●					●	
Inter-TMC comm.			●					●	
Traffic management (status)	●	●	●	●	●		●		○
Incident management - detection - verification/classification - resolution planning - resolution execution & management	●		●			● video based expert system	○ loop based		○
Data dissemination - kiosk	●	●	●	●	●	●	○		
Data dissemination - large screen displays	●	●	●	●	●	●	○		
Data dissemination - WWW	●	●	●	●	●	●			
Data dissemination - HAR			●				●		
Data dissemination - VMS	●	●	●	●	●		●		
Develop TMC-TMC Interfaces			●			●	○		○
Live Vehicle Dry Run TMC participation	●	●	●	●	●	●	○	○	○

TMC SUBTASKS

Subtask 1. Document AHS Requirements via Analysis & Design
Duration: 2/12/96 - 9/13/96

Analysis work will be accomplished up front to determine AHS TMC scenarios as they relate to the various Live Vehicle demonstrations. This scripting of scenarios will result in the following products:

a) Documented TMC scenarios
b) Detailed AHS TMC schedules which can be integrated into the overall '97 Demo schedule
c) A set of real-time data communications requirements (over vehicle cell phones)
d) A set of simulated data communications requirements
e) Identify "Production Support" requirements for Exhibition Center
f) Requirements definitions for screen development
g) Requirements definitions for inter-TMC data communication
h) Overall requirements list categorized by "Must Have", "Must Simulate", "Nice to Have"

Subtask 2. Develop AHS Software
Duration: 3/25/96 - 3/29/97

The development activity will be further broken down into three phases:

Phase 1: Basic graphics illustrating a selected site and basic AHS functions.
Duration: 3/25/96 - 8/17/96 (Provides screens and simulations for ITS World Congress)

A number of graphics representing an AHS site will be created using aerial photos of I-15 in San Diego, California. These graphics will then have overlays of icons to demonstrate AHS functions including: check-in, check-out, vehicle tracking, unfit vehicle management, and traffic data based on simulated input or recorded video.

Phase 2: Enhance and add to existing AHS functional capabilities.
Duration: 8/17/96 - 12/22/96

This phase combines an upgrade of Phase 1 and special functions to address unique AHS needs. The above AHS functions will be upgraded to real-time and live video capability for selected scenarios. Additionally, software will be developed to demonstrate: obstacle/incident detection and resolutions, demand management and flow control, access queuing and costing, guidance system and environmental factor management.

Phase 3: Integrate AHS TMC with existing TMCs (ATMS, The MIST®, San Diego TMC)
Duration: 1/2/97 - 3/10/97

This activity is directed specifically at the State & Local Department of Transportation stakeholder audience for the '97 demo. The requirements identified in Subtask 1 for AHS TMC to TMC communication will be developed, integrated and verified. Any remaining development work required to satisfy Production Support requirements will also be completed during this phase.

Subtask 3. Participate in Live Vehicle Dry Runs and in the '97 Demo Dress Rehearsal
Duration: 3/10/97 - 7/29/97

Exercise the AHS TMC capabilities during vehicle dry runs and dress rehearsals. Focus will be on verifying interoperability with the various vehicle scenarios. Ensure Production Support aspects of the TMC (variable message sign manipulation, large screen video displays, etc.) are operating properly. Documentation of all software activity will be completed during this subtask.

System Integration

Technical integration includes: statusing and reviewing of the live demo (i.e. free agent vehicles, platooning vehicles, associate vehicles), verifying demo requirements, verifying interfaces between parallel efforts, creation and maintenance of an integration test plan, performance validation (vehicle, infrastructure, and communications), conducting safety reviews, conducting system level design reviews, and contingency planning to include risk mitigation.

A key aspect of system integration is to fill any gaps and voids that were not considered during early planning yet are required for proper execution of the demonstration. This "picking-up of loose ends" will be reflected in the risk mitigation and contingency plans done under technical integration.

Lockheed Martin will lead the System Integration Group in accomplishing the following:

- Provide system level plans (Integration, Risk Management, Safety) and schedules including milestones.
  Conduct working reviews of each parallel effort that makes up the 1997 Demo. Working reviews are to validate system level interface requirements and expected system level performance specifications.
- Coordinate and/or conduct required safety reviews.
- Develop system level interface control documentation.
- Assist in the vehicle subsystems dry run activities.
- Confirm the vehicle subsystems are ready for the live vehicle portion of the Demo by coordinating and conducting an end-to-end dress rehearsal.

Marketing & Production

Develop Marketing Plan

A preliminary marketing plan was drafted by the Test and Demonstration Team and published in the Content Document. This plan will be further revised such that it can serve as a statement of work for contracting a Marketing / Media / Public Relations firm or supplementing the statement of work for an exhibition / demonstration management firm. Substantial input to the statement of work will be obtained from experienced exhibition and demonstration management firms. The statement of work will include descriptions of tasks:

- Media Relations - Identifying the local, national, and international trade and general media; educating the media regarding the benefits of AHS and the Demonstration in San Diego (prior to any stories/events planned), preparing media kits and releases, preparing B-roll, monitoring and analyzing reports, any necessary follow-up with reports, preparing for the events, educating Consortium personnel in dealing either the media, and coordinating activities and requirements with the production firms, Demo Team and NAHSC Program Office.

- Public Relations - Assisting with analyzing the presentation of the Demonstration to the public, reactions from the public as a result of media events, support the project at public forums and local government meetings such as SAN DAG, input for the NAHSC Home Page, etc

- District / Government Relations - Working in concert with the Caltrans District 11 Community Affairs Officer, San Diego Association Of Governments, Assemblymen, and other appropriate local / municipal organizations. Developing the materials and providing any information necessary for local government officials to support the Demonstration program by communicating effectively with their constituents and the media.

- Develop Transportation Mitigation Plans - In conjunction with Caltrans District 11, the Demo Team, any appropriate Associate Participants, and I-15 demonstration production managers, develop and publicize a mitigation plan for users of I-15 and concerned citizens and organizations.

- Develop Demonstration Mitigation Plans - In conjunction with the Vehicle, Infrastructure and Systems Integration Groups, provide media and public relations strategies in the event that Demonstration plans are revised due to any variety of circumstances.

Production Plan

A detailed plan will be developed in conjunction with an experienced exhibition / demonstration management firm which addresses preparing for the live vehicle demonstrations on I-15, other mini-demos, the exposition center activities, and all logistic activities such as transportation, security, safety, catering, and accommodations. Additional scope of the plan and the responsibilities are defined in the "Automated Highway Systems Exposition " section below. The firm will also perform a requirements analysis with respect to the exposition center, scheduling, budget, planning and layout, sponsor prospects, negotiate and reserve an appropriate expo center. Due to the nature of having both an exposition center and an on-road live vehicle demonstration, distinct specialized management firms may need to be contracted.

Production activities include: planning for lodging, security, internal demo-specific communications, transportation plans, exhibit layout, logistics, catering, work schedules and assignments, site preparation, printed matter, demo week dry runs, consumable plans, checkout of video and public address system.

- Work the 1997 Demo program such that key messages are depicted and highlighted under the auspices of the program office and DOT.
- Coordinate with the logistics subcontracts for security, maintenance, sanitation, catering, transportation, parking permits, consumable resupply, emergency plans, lodging, video, VIPs, logistic contingencies, insurance, miscellaneous service contracts, communications, etc.
- Contribute to the Exhibition Hall, including layout for the Traffic Management Center, core booth space, associate booth space, other booths and related exhibits. Categorize the needs of all the exhibitors and document display requirements, i.e. power, VCRs, monitors, tables, chairs, etc.
- Support the development of printed matter in relationship to the demo, i.e. invitations, reservations, handouts, maps, schedule of events, etc.
- Point-of-contact for 1997 Demonstration Logistics. Update data base of contacts, VIPs, visitors, and booths for the 1997 Demo.
- Site preparation and coordination leading up to the demo.
- Build detail agendas, sequence of events and workplans for the period preceding the demo, as well as detailed schedules with responsibilities for the actual demo period.
- Work internal logistics in terms of traffic flow in exhibition hall, roped off areas, restrooms, information center, message board, public telephones, registration area, and maps to depict such amenities.
- Conduct coordination meetings (internal), live-vehicle dry runs, and formal dress rehearsals for 1997 Demo.
- Prepare/support exhibition and live-vehicle demonstration operating procedures and operational scripts.
- Support and coordinate video productions subcontract: video set-up at the exhibition hall and at the live-vehicle demo site, live video script, follow-up video script.
- Work with audience, AHS operational concepts (C2), and associates on a as-needed basis to support the demo and ensure that the demo activity maximizes it's contribution to the overall program objectives.

Other similar events will be studied as part of the production and marketing planning process. International demonstrations such as the Japan AHS and Prometheus Final Demonstration will be studied. Participants, organizers, and contractors will be interviewed for input to the NAHSC P & M plans.

Production Integration Plans

The purpose of the production integration efforts for the AHS Demo are to provide activities to the individual work areas: A] Vehicle which includes the 1) platooning development vehicles, 2) platooning production vehicles, 3) free agent vehicle development, 4) maintenance vehicle development, and 5) check-in vehicle development, B] Infrastructure, C] Traffic Operations.
The production integration activity will ensure that each work area has addressed the following tasks that are critical to a successful Demonstration:

- Specific or cross-cutting performance and validation requirements and documentation.
- Risk mitigation plans.
- Safety.

The production integration effort will also:

- Produce the documentation for Consortium status reports and reviews.
- Coordinate the final development, validation, and rehearsals prior to the demo and finalize the Demonstration Plans (scripts, scheduling, etc.).

Develop an attendee estimate

An initial attendee estimate has been developed which will be continually revised as additional information is gathered. As part of the Marketing, Exhibition and Demonstration management firms' contracts will be to further revise the tabulation. Also, as plans are defined regarding any additional complementary events such as a technical conference focused on AHS / AVCS and the Association of Unmanned Vehicle Systems Autonomous Vehicle Student Competition, the attendee estimate will be revised accordingly.

Define and Develop the Demonstration Audience Estimates

The Marketing firm will develop and analyze the potent Audience for the 1997 Demonstration and levels of participation and involvement. As part of the Precursor Systems Analyses of Automated Highway Systems / Activity Area O, Battelle studied and mapped the six levels of public involvement. These six levels of public involvement represent diverse groups with varying interests. As a result, each interest must be represented in the 1997 Demonstration in order to maintain stakeholder involvement and support. The marketing activity's consulting firm will be tasked to classify the immediate and secondary audience members into the appropriate level (see below). The firm will coordinate with the Demo Team and Groups regarding any audience sensitive input relative to the content and presentation of the demonstration.

<u>Levels of Public Involvement</u>

- Co-decision makers
- Technical Reviewers
- Active Participants
- Commenters
- Observers
- Unsurprised Apathetics

- Demonstration Content Document

In conjunction with the marketing firm, the Production & Marketing Group will analyze the Content Document and scenarios to further define the presentation of AHS functions which will satisfy the objective of the Demonstration.

Automated Highway Systems Exposition
In conjunction with the Production & Marketing Group, the exposition management firm will be tasked to manage the exposition components:

- Operations and Logistics (decorations, freight handling, signage, move-in, on-site, move-out details, contract negotiations with subs, accommodations, security, catering, etc.)
- Sales (execute the entire sign-up, contracting, payment for exhibitors)
- Marketing (work with the Marketing firm to develop the promotional materials for the exposition and if applicable, technical conference and student competition)
- Sponsorships (develop relationships with organizations interested in sponsoring portions of the event, contract, accept payment, and establish advertisement requirements)
- Exposition Configuration (layout the exposition center to arrange the exhibitors booths)
- Mini-Demos (layout the exposition center parking lot or any other available areas to conduct planned mini-demos)
- The exposition management contractor will develop an event schedule and deadlines checklist for the exhibitors. This will contain key dates for payment, labor authorizations, badging, rental material forms, electric and telephone service requests, etc.
- The expo management contractor will develop the Demonstration and Exhibitor registration guides and forms along with all the necessary general information such as location, show hours, installation and dismantling plans, security and safety information, insurance, etc..
- The exposition management and if applicable, demonstration management firm will define the appropriate rule and regulations of the Demonstration such as age restrictions, equipment removal passes, work permits, lighting and sound restrictions, Americans with Disabilities Act requirements, compliance with any Occupational and Safety Administration Act regulations, use of convention center equipment, photography regulations, literature disbursements, music licensing, display rules , etc.
- The exhibition management firm will develop the shipping and material handling plans for demonstrations, exhibitors, and support organizations.
- Installation and Dismantling hours, crate removal, storage, and return procedures will be established d by the management firm.
- All necessary forms will be developed and provided by the exhibition management firm or designated contractor.
- The demonstration and exposition management firms(s) will generate a list of required or recommended contractors for the exhibitors.

Participation

Associate Participation will be managed by the Production & Marketing Group. The Group will develop a detailed Associate Participation Packet, as defined in the D1X workplan. An Associate participation workshop was held; additional briefings will be held along with mailings educating

Safety and Security Services

The Production and Marketing Group in conjunction with the appropriate management contractors will arrange for security services, emergency medical service, fire protection, Highway Patrol personnel necessary to conduct the Demonstration.

Insurance

The production & Marketing Group in conjunction with the NAHSC Program Office, Legal Staff, and management firms will determine the need and procure any event insurance.

Communications

Any communications equipment and systems necessary for the production activity will be contracted /leased by the P & M Group or management firm and will be in compliance with the firm's specifications.

Video

Videos are being developed by various groups and teams within the NAHSC which are sued for outreach and educational purposes. Video's produced which focus on Test and Demonstration activities will be reviewed by appropriate members and contractors to the Production and Marketing Group.

Plans to video, record and transmit images to the expo center will be developed by the Production and Marketing Group with input from the other Groups for the Demo Team. Contracts for recording, transmission, displays, editing, and post production will be let by the P & M Group or will be included as part of the exposition / demonstration management contract. Video records of the events will be included in the Demonstration Documentation / Summary Report.

Documentation Plan Preparation

To completely satisfy the Milestone 2 Objective, the Demo Team will generate a report, "Summary of the Automated Highway System 1997 Proof of Technical Feasibility Demonstration". This report will include data from the event such as attendance, performance, media clippings, video and sound recordings, electronic data from products demonstrated, descriptions of events, and a financial report.

Data required for the documentation of the Demonstration will be defined in D2D and will obtained and documented from both Consortium Participants and Contractors in D2E.

Included in both the live vehicle / highway events management firm's and exposition management firm's contracts will be reports which will provide input to the Demo Team's summary report.

<u>RESPONSIBILITIES</u>

	System Integration	Vehicles Group	Infrastructure Group	Transportation Management Center	Marketing & Production
Bechtel			○		○
Caltrans	○	○	○	○	○
CMU		○			
Delco		○			
GM		○			
HAC	○	○	○	○	○
LMC	●	○		●	○
PB				○	●
Path		○			
USDOT					
Pgm Off.	○	●	●	○	○
Associates		○			

MEASURABLE SUCCESS INDICATORS

Generic Indicators:

1. Outputs provided on schedule and within budget

DESCRIPTION	SUCCESS INDICATORS
Technical Integration	1. Completion of Working Reviews with live-demo vehicle teams, infrastructure group, communications team 2. Draft & Final of ICD, System Integ. Plan, Risk Mitigation Plan, Integ. Test Plan, Safety Plans 3. Successful Vehicle Dry Runs
Marketing & Production	4. Value-added contributions to the 97 Demo Marketing & Production effort leading to stakeholder/VIP attendance & enthusiasm
Infrastructure	5. Successful completion of the infrastructure contracts on schedule and within budget.
Platoon	6. Hardware/Software Integrated 7. Vehicle checked and operational 8. Successful Vehicle Dry Runs
Free agent	9. Hardware/Software Integrated 10. Vehicle checked and operational 11. Successful Vehicle Dry Runs
Traffic Management Center	12. AHS-specific software modules debugged 13. TMCs interfaced and talking together 14. Integrated TMC with Live Demo
Maintenance Vehicle Integration	15. Hardware/Software Integrated 16. Maintenance Payload Integrated 17. Vehicle checked and operational 18. Successful Vehicle Dry Runs

APPENDIX I Tool Availability On-Site

Company	Bechtel	Caltrans	CMU	Delco	Hughes	GM	LMC	PATH	PBF	Honda	Toyota	OSU	Houston Metro	Tot.
Items														
Average Number of People Onsite	0		6	10	2	2	6	8						34
Telephone Lines				1			3	1						5
Modem Lines- 14.4			1	1		1	1	1						5
T1 Line >56K			1											1
Desks in Office			3	3		1	6	3						16
Work Cart			1	1										2
Bringing SPARC							1							1
Bringing # Macs														0
Bringing # PCs			3		2			4						9
# Mac Powerbook/LAN Connections														0
# Laptops/ LAN Connections			2	4		1	2	3						12
Bringing Printer MAC														0
Bringing Printer PC			1					1						2
Need Printer Access MAC														0
Need Printer Access PC				x										0
(CMU PCs running QNX)														0
Spectrum Analyzer					1									1
Oscilloscope				1	1									2
Power Meter					1									1
12v 5A Power Supply				3										3
Multimeter				3										3
Soldering Iron				2										2

Company	Bechtel	Caltrans	CMU	Delco	Hughes	GM	LMC	PATH	PBF	Honda	Toyota	OSU	Houston Metro	Tot.
Bench in Electronic Lab			1	3	1	1		2						8
Bench in Mechanical Lab						1		2						3
Bench in Shop Area								2						2
Storage Lockers			1	1	1	3		2						8
Shelves or additional Lockers						3		2						5
Company Trailer			no	no		*	no	no		1	1	1	1	5
Conference Room with Bulletin Boards and White Boards														
Office for Site Coordinator														
Office for I-15 Demo Coordinator														
Receptionist/ clerk														
Rolling Toolbox						1		1						2
Bench Grinder														
Bench Drill Press														
Bench Vise														
Vehicle Lift														

* Motor Home

APPENDIX B Test/Certification Plan for Operations

National Automated Highway System Consortium
Technical Feasibility Demonstration
Test/Certification Plan

for the

Automated Highway System
System Definition Phase
Cooperative Agreement Number:
DTFH61-94-X-00001
Amendment 1

April 7, 1997

Prepared by:

National Automated Highway System Consortium
3001 West Big Beaver Road, Suite 500
Troy, Michigan 48084

Approval:

Ron Colgin,
Certification Team Chairman

Date

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NAHSC Test/Certification Plan

4/07/97

I-15 On-Lane Test Schedule

Version 12

1.0 PURPOSE

The purpose of this Demonstration Test/Certification Plan, is to provide an overview of the National Automated Highway System Consortium Technical Feasibility Demonstration Test/Certification process. The Demonstration system validation and certification process described will be implemented to support informal and formal validation and certification during the preliminary and formal certification phases. This Test/Certification plan also identifies and describes the tasks to be accomplished by the Demonstration System Safety/Certification team during the various phases of certification. Test/certification procedures are attached which focus on validating the requirements as represented in the final version of the National Automated Highway System Consortium Technical Feasibility Demonstration Specification. Those procedures do not address the informal engineering development test performed by the Demonstration vehicle/system developers.

2.0 DOCUMENT OVERVIEW

This plan, the Demonstration Test/Certification Plan, contains general information of how the validation/certification program will be conducted, controlled, and reported. This plan contains organization and responsibilities of the Demonstration Safety/Certification Team, a description of requirement validation methodologies to be used in the validation/certification process and the locations, scope and schedule of the preliminary certification ("pre-cert") and formal certification activities.

3.0 APPLICABLE DOCUMENTS

National Automated Highway System Consortium Technical Feasibility Demonstration Specification, dated April 1997.

National Automated Highway System Consortium Technical Feasibility Demonstration Performance and Safety Certification Procedure, dated April 1997.

National Automated Highway System Consortium Technical Feasibility Demonstration Interface Document, dated March 1997.

National Automated Highway System Consortium Technical Feasibility Demonstration Safety Plan, dated March 1997.

4.0 DEMONSTRATION SAFETY/CERTIFICATION TEAM

Responsible for the day-to-day contact with the Demonstration Team for all Test and Certification issues. This team will be responsible for finalizing and implementing the Demonstration Test/Certification Plan and associated certification procedures. It will finalize the Demonstration requirements and ensure their inclusion in vehicle certification procedures. This group will also develop recommended "pass / fail criteria" for each step in the certification process.

The Demonstration Safety/Certification Team will also serve as part of the Safety Review Team. In that capacity the Demonstration Safety/Certification Team provide test/certification procedures and criteria to the Safety Board for their approval.

Proposed Demonstration Safety/Certification Team Membership:

Name	Organization	Responsibilities
Ron Colgin	NAHSC P.O.	Safety/Certification Team Chair, Vehicle Integration Engineer
Joe Meyer	LMC	Safety/Certification Team Co-Chair, Safety Integration Engineer
Pat McKenzie	LMC	Demonstration Integration Engineer
Phil Coopman	CMU	Software Engineer
Andrew Segal	PATH	Software Engineer
Bill Stevens	NAHSC P.O.	Software Engineer
Bob Battersby	CALTRANS	I-15 Corridor Safety Engineer
TBD	GM	Vehicle Engineer for Platoon, Multi-Platform Free Agent and Maintenance Certification
Damon Delorenzis	Honda	Vehicle Engineer for Control Transition and Alternate Technology Certification
Michael Wolterman	Toyota	Vehicle Engineer for Evolutionary Certification
Michael Lesher	Eaton VORAD	Vehicle Engineer for Truck Certification
Bill Kennedy	LMC	Development Engineer for Truck and Alternate Technology Certification
Wei-Bin Zhang	PATH	Development Engineer Evolutionary and Multi-Platform Free Agent Certification
Todd Jochem	CMU	Development Engineer for Control Transition, Maintenance and Platoon Certification
Tommy Viner	NAHSC P.O.	Alternate Demonstration Integration Engineer
Pat Langley	LMC	Alternate Demonstration Integration Engineer

5.0 TEST/CERTIFICATION OBJECTIVES

This section describes the phases of testing and certification and requirements validation methods to be performed during the Demonstration Test/Certification process. This includes engineering development test, preliminary certification and formal qualification or certification of Demonstration scenarios, systems and vehicles to be performed during the Demonstration Test/Certification process.

5.1 Informal Tests

The following paragraphs describe the informal tests that will be performed during the demonstration vehicle and system development. Informal tests include all tests conducted to obtain information to aid the design process and are not qualification or certification tests.

5.1.1 ***Engineering Development Test*** - During the engineering development activities, the development engineers will test and evaluate Commercial Off-the-Shelf (COTS), or developmental items, hardware and software products. The engineering development tests will consist of running informal functional and performance validations to ensure that the selected items will meet the Demonstration functional, performance and safety requirements called out in the National AHS Consortium Technical Feasibility Demonstration Specification.

5.1.2 ***Preliminary Certification*** - After the development of the test/certification procedures, the Demonstration Safety/Certification Team will conduct Preliminary Certification process to determine the status of vehicle and other demonstration system development design and the readiness of the Demonstration vehicle and system to enter formal test/certification activities. The Preliminary Certification process is intended to be conducted at the vehicle/system development site. (Refer to Demonstration Test/Certification Schedule - Attachment A) Certain requirements of the Test/Certification Procedure may be certified during this preliminary certification phase. Wherever possible safety requirements will be verified during these preliminary certifications. This preliminary certification process will also serve to validate the established test/certification procedures for each demonstration vehicle and system.

5.1.3 ***Dry Runs*** - Dry Runs will be conducted by each demonstration vehicle and system developer at the I-15 High Occupancy Vehicle (HOV) Express Lanes in San Diego, California. Dry Runs include, continued development, experiments, test and scenario validation for demonstration vehicle and system developer.

5.2 Formal Test/Certification

The objective of the Formal Test/Certification is to validate the implementation of all functional, performance and safety requirements as specified in the Demonstration Specification, Test/Certification procedures and the prescribed scenario. Formal test/certification will be executed in a structured and controlled test environment, following specific test/certification procedures, administered and witnessed by the Demonstration Safety/Certification Team and test results documented in a test/certification report. Three elements will constitute the formal test structure:

5.2.1 ***Certification Run*** - A certification run is the execution of the demonstration scenario using the test/certification procedures to certify demonstration vehicles/systems or re-certify demonstration vehicles/systems after corrective actions have been implemented to a previously tested vehicle/system. The number of runs will vary for each scenario based on need.

5.2.2 ***Dress Rehearsal*** - A dress rehearsal is a composite certification run of all demonstration sequence of scenarios after demonstration vehicle/system certification wherein accompanying demonstration logistics support is exercised.

5.2.3 ***Regression Tests*** - Regression tests will be conducted after certification and dress rehearsals but prior to the demonstration for the re-certification and re-validation of demonstration vehicles/systems requirements. When changes or corrections are made to the certified / validated demonstration vehicles / systems, the Safety/Certification Team will conduct and witness regression testing.

5.3 Test/Certification Guidelines

5.3.1 ***Vehicle Certification***

All vehicles shall be subject to the provisions of the National Automated Highway System Consortium Technical Feasibility Demonstration Test/Certification and Safety requirements.

As part of the vehicle certification process, a Safety/Certification team shall visit each vehicle developer site to conduct an on-site evaluation of all vehicles prior to delivery of the vehicles to the San Diego I-15 lanes.

All vehicle "On-Lane" certification shall be accomplished prior to the first scheduled Dress Rehearsal in July 1997. Completion of vehicle "On-Lane" certification is a pre-requisite for participation in the first Dress Rehearsal.

5.3.2 *"On-Lane" Test Plan*

Each Live Vehicle Demonstration participant shall submit an "On-Lane" Test Plan for proposed testing on the I-15. On-Lane Test Plans shall be submitted not later than two weeks prior to a Vehicle Developer's scheduled on-lane testing.

All vehicles shall be subject to the provisions of the Automated Highway System (AHS) 1997 Demonstration Performance, Safety and Certification Requirements.

5.3.3 *"On - Lane" Dry Runs*

Vehicles shall participate in dry runs at the I-15 demonstration site for the purposes of validating that vehicles meet functional, performance and safety requirements as specified in the Demonstration Specification ("the Requirements").

5.3.4 *Dress Rehearsals*

The Vehicle Developer shall participate in all Consortium sponsored "Dress Rehearsals" during the month of July, 1997. Each dress rehearsal shall take place in a period of time not to exceed a week (7 days) in duration.

5.3.5 *Exclusion from Demonstration*

Vehicles and personnel which do not participate in all scheduled Dress Rehearsals shall be excluded from the live vehicle demonstration.

The Consortium shall exclude from the Demonstration any vehicle or personnel that fails to meet the "Requirements" as specified by the National Automated Highway System Consortium Technical Feasibility Demonstration Specification, and Performance and Safety certification procedures.

5.4 Test/Certification Reporting

After each major event in the certification process, a report will be prepared which summarizes the results. This report will include appropriate comments, discrepancies and recommendations (example: number of requirements verified during a certification event). As the Safety/Certification Team chair, Ron Colgin will present the findings to the Safety Board along with appropriate recommendations. The Safety Board will then make the final decision regarding a scenario's readiness to proceed to the next step in the process (pre-certification to dry runs, certification to dress rehearsals, dress rehearsals to Demonstration participation). Certification status presentations will also be given at Demonstration Team meetings and Program Manager's Council (PMC) meetings as appropriate.

6.0 PERFORMANCE AND SAFETY CERTIFICATION PROCEDURES

The National Automated Highway System Consortium Technical Feasibility Demonstration Performance and Safety Certification Procedure, dated April 1997 documents the step-by-step instructions to verify vehicle/scenario functional, performance and safety requirements at levels that assure the Demonstration vehicles/scenarios performs repeatedly as certified.

6.1 Requirement Validation Methods

The methods of validation to be used are: Inspection, Analysis, Demonstration, and Test.

Inspection - Certification or validation by visual examination of the item, reviewing descriptive documentation, and comparing the appropriate characteristics with a reference standard to determine conformance to requirements. This includes the mechanical inspection of equipment, validation of accuracy and completeness of documentation.

Analysis - Certification or validation by evaluation or simulation using mathematical simulations representation, charts, graphs, circuit diagrams, or data reduction. This includes analysis of algorithms independent of computer implementation, analytical conclusions drawn from test data, and extension of test produced data to untested conditions.

Demonstration - Certification or validation by operation, movement, or adjustment of the item under a specific condition to perform the deigned function. This includes the content of displays, comparison of vehicle/system products with independently derived test cases, and prompt vehicle/system recovery from induced failure conditions.

Test - Certification or validation through systematic exercising of the applicable item under all appropriate conditions with instrumentation and collection, analysis, and evaluation of quantitative data.

6.2 Pass / Fail Criteria

Pass/Fail criteria specify results that must be obtained to determine that a requirement has been satisfied as defined by the applicable test/certification procedure verifying the requirement. Pass/Fail criteria may be binary in nature or employ tolerance and limits. A validation method having a pass/fail criterion verifies a performance and/or design requirement as specified in the Demonstration Specification with no deviation or exceptions or when the results are specified to be within a pre-determined range.

Attachment A:

NAHSC Technical Feasibility Demonstration Test/Certification Schedule

A1 Pre-Certification Schedule Overview

Participant	Pre-Certification Date	Pre-Certification Location	Certification Date
Eaton Vorad	5/6	I-15, San Diego	TBD
Honda	4/29	Honda Test Track, Mojave	6/10
Toyota	4/24	Toyota Test Track, Phoenix	5/21
Cal/LMC	5/4	I-15, San Diego	7/12
OSU	5/15	TRC, Marysville	6/21
PATH	6/12	I-15, San Diego	7/2
CMU/Metro	6/?	TRC, Marysville	7/15

A-2 Pre-Certification, Certification, Dry Runs, Dress Rehearsals Schedule Overview

Participant	Date	Location	Event
Toyota	4/24	Toyota Test Track, Phoenix	Pre- Certification
Honda	4/29	Honda Test Track, Mojave	Pre- Certification
Cal/LMC	5/4	I-15, San Diego	Pre- Certification
Eaton Vorad	5/6	Surface Streets, San Diego	Pre- Certification
OSU	5/15	TRC, Marysville	Pre- Certification
Toyota	5/21	I-15, San Diego	Certification
PATH	6/12	I-15, San Diego	Pre- Certification
CMU/Metro	6/?	TRC, Marysville	Pre- Certification
OSU	6/21	I-15, San Diego	Certification
Honda	6/10	I-15, San Diego	Certification
PATH	7/2	I-15, San Diego	Certification
Cal/LMC	7/12	I-15, San Diego	Certification
CMU/Metro	7/15	I-15, San Diego	Certification
Eaton Vorad	7/12	I-15, San Diego	Certification
All Participants	7/17-7/20	I-15, San Diego	Dress Rehearsal
All Participants	7/24-7/27	I-15, San Diego	Dress Rehearsal
All Participants	7/31-8-3	I-15, San Diego	Dress Rehearsal
All Participants	8/7-8/10	I-15, San Diego	Demo

MAR/APR		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		330	331	401	402	403	404	405	
7:30	1 N								
	1 S								
9:30	2 N	Caltrans	EATON	EATON	EATON	EATON	EATON		
	2 S	Caltrans	EATON	EATON	EATON	EATON	EATON		
11:30	3 N	Caltrans	EATON	EATON	EATON	EATON	EATON		
	3 S	Caltrans	EATON	EATON	EATON	EATON	EATON		
1:30	4 N	Caltrans							
	4 S	Caltrans							
3:30	5 N	Caltrans							
	5 S	Caltrans							
5:30	6 N								
	6 S								
Night	7								

APRIL		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		406	407	408	409	410	411	412	
7:30	1 N								
	1 S								
9:30	2 N		Caltrans	Caltrans	Caltrans	EATON	EATON	PATH	
	2 S		Caltrans	Caltrans	Caltrans	EATON	EATON	PATH	
11:30	3 N		Caltrans	Caltrans	Caltrans	EATON	EATON	PATH	
	3 S		Caltrans	Caltrans	Caltrans	EATON	EATON	PATH	
1:30	4 N							PATH	
	4 S							PATH	
3:30	5 N							PATH	
	5 S							PATH	
5:30	6 N								
	6 S								
Night	7								Lane Survey

APRIL		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		413	414	415	416	417	418	419	
7:30	1 N								
	1 S								
9:30	2 N	PATH	CMU	CMU	CMU	CMU	CMU	CMU	
	2 S	PATH	PATH	PATH	PATH	PATH	PATH	PATH	
11:30	3 N	PATH	CMU	CMU	CMU	CMU	CMU	CMU	
	3 S	PATH	PATH	PATH	PATH	PATH	PATH	PATH	
1:30	4 N	PATH						CMU	
	4 S	PATH						PATH	
3:30	5 N	PATH						CMU	
	5 S	PATH						PATH	
5:30	6 N								
	6 S								
Night	7								Shoulder Work

APRIL		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		420	421	422	423	424	425	426	
7:30	1 N								
	1 S								
9:30	2 N	CMU	CMU	CMU	CMU	CMU	CMU	PATH	
	2 S	CMU	CMU	PATH	PATH	PATH	PATH	PATH	
11:30	3 N	CMU	CMU	CMU	CMU	CMU	CMU	PATH	
	3 S	CMU	CMU	PATH	PATH	PATH	PATH	PATH	
1:30	4 N	CMU						PATH	
	4 S	CMU						PATH	
3:30	5 N	CMU						PATH	
	5 S	CMU						PATH	
5:30	6 N								
	6 S								
Night	7								

APR/MAY		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		427	428	429	430	501	502	503	
7:30	1 N							CAL/LMC	
	1 S							TOYOTA	
9:30	2 N	PATH	TOYOTA	TOYOTA	TOYOTA	TOYOTA	TOYOTA	CAL/LMC	
	2 S	PATH	CAL/LMC	CAL/LMC	CAL/LMC	CAL/LMC	CAL/LMC	TOYOTA	
11:30	3 N	PATH	TOYOTA	TOYOTA	TOYOTA	TOYOTA	TOYOTA	CAL/LMC	
	3 S	PATH	CAL/LMC	CAL/LMC	CAL/LMC	CAL/LMC	CAL/LMC	TOYOTA	
1:30	4 N	PATH						CAL/LMC	
	4 S	PATH						TOYOTA	
3:30	5 N	PATH						CAL/LMC	
	5 S	PATH						TOYOTA	
5:30	6 N							CAL/LMC	
	6 S							TOYOTA	
Night	7								

MAY		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		504	505	506	507	508	509	510	
7:30	1 N	CAL/LMC						CAL/LMC	
	1 S	CAL/LMC						CAL/LMC	
9:30	2 N	CAL/LMC	PATH	PATH	PATH	PATH	PATH	CAL/LMC	
	2 S	CAL/LMC	TOYOTA	TOYOTA	TOYOTA	TOYOTA	TOYOTA	PATH	
11:30	3 N	CAL/LMC	PATH	PATH	PATH	PATH	PATH	CAL/LMC	
	3 S	CAL/LMC	TOYOTA	TOYOTA	TOYOTA	TOYOTA	TOYOTA	PATH	
1:30	4 N	CAL/LMC						CAL/LMC	
	4 S	CAL/LMC						PATH	
3:30	5 N	CAL/LMC						CAL/LMC	
	5 S	CAL/LMC						PATH	
5:30	6 N	CAL/LMC						CAL/LMC	
	6 S	CAL/LMC						CAL/LMC	
Night	7								

MAY		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		511	512	513	514	515	516	517	
7:30	1 N	CAL/LMC							
	1 S	CAL/LMC							
9:30	2 N	CAL/LMC	TOYOTA	TOYOTA	TOYOTA	TOYOTA	TOYOTA	HONDA	
	2 S	PATH	PATH	PATH	PATH	PATH	PATH	PATH	
11:30	3 N	CAL/LMC	TOYOTA	TOYOTA	TOYOTA	TOYOTA	TOYOTA	HONDA	
	3 S	PATH	PATH	PATH	PATH	PATH	PATH	PATH	
1:30	4 N	CAL/LMC						HONDA	
	4 S	PATH						PATH	
3:30	5 N	CAL/LMC						HONDA	
	5 S	PATH						PATH	
5:30	6 N	CAL/LMC							
	6 S	CAL/LMC							
Night	7								

MAY		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		518	519	520	521	522	523	524	Bold/Italic = Cert
7:30	1 N	HONDA						CAL/LMC	
	1 S	HONDA						CAL/LMC	
9:30	2 N	HONDA	TOYOTA	TOYOTA	*TOYOTA*	TOYOTA	CAL/LMC	CAL/LMC	
	2 S	HONDA	TOYOTA	TOYOTA	*TOYOTA*	TOYOTA	CAL/LMC	CAL/LMC	
11:30	3 N	HONDA	TOYOTA	TOYOTA	*TOYOTA*	TOYOTA	CAL/LMC	CAL/LMC	
	3 S	PATH	TOYOTA	TOYOTA	*TOYOTA*	TOYOTA	CAL/LMC	CAL/LMC	
1:30	4 N	HONDA						CAL/LMC	
	4 S	PATH						CAL/LMC	
3:30	5 N	HONDA						CAL/LMC	
	5 S	PATH						CAL/LMC	
5:30	6 N	HONDA						CAL/LMC	
	6 S	PATH						CAL/LMC	Magnet
Night	7		Caltrans	Caltrans	Caltrans	Caltrans	Caltrans		Construction

MAY		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		525	526	527	528	529	530	531	
7:30	1 N	CAL/LMC	CAL/LMC						
	1 S	CAL/LMC	CAL/LMC						
9:30	2 N	CAL/LMC	CAL/LMC	HONDA	HONDA	HONDA	HONDA	Caltrans	
	2 S	CAL/LMC	CAL/LMC	PATH	PATH	PATH	PATH	Caltrans	
11:30	3 N	CAL/LMC	CAL/LMC	HONDA	HONDA	HONDA	HONDA	Caltrans	
	3 S	CAL/LMC	CAL/LMC	PATH	PATH	PATH	PATH	Caltrans	
1:30	4 N	CAL/LMC	CAL/LMC					Caltrans	
	4 S	CAL/LMC	CAL/LMC					Caltrans	
3:30	5 N	CAL/LMC	CAL/LMC					Caltrans	
	5 S	CAL/LMC	CAL/LMC					Caltrans	
5:30	6 N	CAL/LMC	CAL/LMC						Striping
	6 S	CAL/LMC	CAL/LMC						3M Tape Installation
Night	7			Caltrans	Caltrans	Caltrans	Caltrans		

JUNE		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		601	602	603	604	605	606	607	
7:30	1	CAL/LMC						CAL/LMC	
	1	PATH						PATH	
9:30	2	HONDA	HONDA	HONDA	HONDA	HONDA	HONDA	HONDA	
	2	Share	CAL/LMC	CAL/LMC	CAL/LMC	CAL/LMC	CAL/LMC	Share	
11:30	3	CAL/LMC	PATH	PATH	PATH	PATH	PATH	CAL/LMC	
	3	PATH	Share	Share	Share	Share	Share	PATH	
1:30	4	HONDA						HONDA	
	4	Share						Share	
3:30	5	CAL/LMC						CAL/LMC	
	5	PATH						PATH	
5:30	6	HONDA						HONDA	
	6	Share						Share	
Night	7		CAL/LMC	CAL/LMC	CAL/LMC	CAL/LMC	CAL/LMC		9:00-11:00 PM

JUNE		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		608	609	610	611	612	613	614	
7:30	1N	HONDA						OSU	
	1S	PATH						PATH	
9:30	2N	HONDA	HONDA	HONDA	HONDA	HONDA	OSU	HONDA	
	2S	PATH	PATH	PATH	PATH	PATH	PATH	Share	
11:30	3N	HONDA	HONDA	HONDA	HONDA	HONDA	HONDA	OSU	
	3S	PATH	PATH	PATH	PATH	PATH	Share	PATH	
1:30	4N	HONDA						HONDA	
	4S	PATH						Share	
3:30	5N	HONDA						OSU	
	5S	PATH						PATH	6/13-6/14
5:30	6N	HONDA						HONDA	3M Tape Installation
	6S	PATH						Share	Contingency
Night	7		PATH	PATH	PATH	PATH	PATH		9:00-11:00 PM

JUNE		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		615	616	617	618	619	620	621	Bold/Italic = Cert
7:30	1N	OSU						OSU	
	1S	OSU						OSU	
9:30	2N	OSU	PATH	PATH	PATH	PATH	OSU	*OSU*	
	2S	OSU	OSU	OSU	OSU	OSU	OSU	*OSU*	
11:30	3N	OSU	PATH	PATH	PATH	PATH	OSU	*OSU*	
	3S	OSU	OSU	OSU	OSU	OSU	OSU	*OSU*	
1:30	4N	OSU						OSU	
	4S	OSU						OSU	
3:30	5N	OSU						PATH	
	5S	OSU						PATH	
5:30	6N	OSU						PATH	
	6S	OSU						PATH	
Night	7		OSU	OSU	OSU	OSU	OSU		9:00-11:00 PM

JUNE		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		622	623	624	625	626	627	628	
7:30	1 N	PATH						PATH	
	1 S	PATH						PATH	
9:30	2 N	PATH	PATH	PATH	PATH	PATH	PATH	PATH	
	2 S	PATH	PATH	PATH	PATH	PATH	PATH	PATH	
11:30	3 N	PATH	PATH	PATH	PATH	PATH	PATH	PATH	
	3 S	PATH	PATH	PATH	PATH	PATH	PATH	PATH	
1:30	4 N	PATH						PATH	
	4 S	PATH						PATH	
3:30	5 N	PATH						PATH	
	5 S	PATH						PATH	
5:30	6 N	PATH						PATH	
	6 S	PATH						PATH	
Night	7		CAL/LMC	CAL/LMC	CAL/LMC	CAL/LMC	CAL/LMC		9:00-11:00 PM

JUN/JUL		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		629	630	701	702	703	704	705	Bold/Italic = Cert
7:30	1 N	PATH							
	1 S	PATH							
9:30	2 N	PATH	PATH	PATH	*PATH*	PATH			
	2 S	PATH	PATH	PATH	*PATH*	PATH			
11:30	3 N	PATH	PATH	PATH	*PATH*	PATH			
	3 S	PATH	PATH	PATH	*PATH*	PATH			
1:30	4 N	PATH							
	4 S	PATH							
3:30	5 N	PATH							
	5 S	PATH							
5:30	6 N	PATH							7/4-7/6
	6 S	PATH							Lanes Closed
Night	7		PATH	PATH	PATH	PATH	PATH		9:00-11:00 PM

JULY		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		706	707	708	709	710	711	712	
7:30	1 N							CAL/LMC	Bold/Italic = Cert
	1 S							CAL/LMC	
9:30	2 N						CAL/LMC	*CAL/LMC*	
	2 S						CAL/LMC	*CAL/LMC*	
11:30	3 N						CAL/LMC	*CAL/LMC*	
	3 S						CAL/LMC	*CAL/LMC*	
1:30	4 N							CAL/LMC	
	4 S							CAL/LMC	
3:30	5 N							CAL/LMC	
	5 S							CAL/LMC	
5:30	6 N							CAL/LMC	
	6 S							CAL/LMC	
Night	7								

JULY		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		713	714	715	716	717	718	719	Bold/Italic = Cert
7:30	1 N	CMU/MET							
	1 S	CMU/MET							
9:30	2 N	CMU/MET	CMU/MET	CMU/MET	CMU/MET	REHEAR	REHEAR	REHEAR	
	2 S	CMU/MET	CMU/MET	CMU/MET	CMU/MET	REHEAR	REHEAR	REHEAR	
11:30	3 N	CMU/MET	CMU/MET	CMU/MET	CMU/MET	REHEAR	REHEAR	REHEAR	
	3 S	CMU/MET	CMU/MET	CMU/MET	CMU/MET	REHEAR	REHEAR	REHEAR	
1:30	4 N	CMU/MET						REHEAR	
	4 S	CMU/MET						REHEAR	
3:30	5 N	CMU/MET						REHEAR	
	5 S	CMU/MET						REHEAR	
5:30	6 N	CMU/MET							
	6 S	CMU/MET							
Night	7					REHEAR	REHEAR		Veh Rtn to So. Yard

JULY		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		720	721	722	723	724	725	726	
7:30	1 N								
	1 S								
9:30	2 N	REHEAR	CMU/MET	CMU/MET		REHEAR	REHEAR	REHEAR	
	2 S	REHEAR	CMU/MET	CMU/MET		REHEAR	REHEAR	REHEAR	
11:30	3 N	REHEAR	CMU/MET	CMU/MET		REHEAR	REHEAR	REHEAR	
	3 S	REHEAR	CMU/MET	CMU/MET		REHEAR	REHEAR	REHEAR	
1:30	4 N	REHEAR						REHEAR	
	4 S	REHEAR						REHEAR	
3:30	5 N	REHEAR						REHEAR	
	5 S	REHEAR						REHEAR	
5:30	6 N								
	6 S								
Night	7					REHEAR	REHEAR		Veh Rtn to So. Yard

JUL/AUG		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		727	728	729	730	731	801	802	
7:30	1 N								
	1 S								
9:30	2 N	REHEAR	CMU/MET	CMU/MET	CMU/MET	REHEAR	REHEAR	REHEAR	
	2 S	REHEAR	CMU/MET	CMU/MET	CMU/MET	REHEAR	REHEAR	REHEAR	
11:30	3 N	REHEAR	CMU/MET	CMU/MET	CMU/MET	REHEAR	REHEAR	REHEAR	
	3 S	REHEAR	CMU/MET	CMU/MET	CMU/MET	REHEAR	REHEAR	REHEAR	
1:30	4 N	REHEAR						REHEAR	
	4 S	REHEAR						REHEAR	
3:30	5 N	REHEAR						REHEAR	
	5 S	REHEAR						REHEAR	
5:30	6 N								
	6 S								
Night	7					REHEAR	REHEAR		Veh Rtn to So. Yard

AUGUST		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		803	804	805	806	807	808	809	
7:30	1 N								
	1 S								
9:30	2 N	REHEAR				DEMO	DEMO	DEMO	
	2 S	REHEAR				DEMO	DEMO	DEMO	
11:30	3 N	REHEAR				DEMO	DEMO	DEMO	
	3 S	REHEAR				DEMO	DEMO	DEMO	
1:30	4 N	REHEAR						DEMO	
	4 S	REHEAR						DEMO	
3:30	5 N	REHEAR						DEMO	
	5 S	REHEAR						DEMO	
5:30	6 N								
	6 S								
Night	7					DEMO	DEMO		Veh Rtn to Se. Yard

AUGUST		SUN	MON	TUE	WED	THU	FRI	SAT	Comments
		810	811	812	813	814	815	816	
7:30	1 N								
	1 S								
9:30	2 N	DEMO							
	2 S	DEMO							
11:30	3 N	DEMO							
	3 S	DEMO							
1:30	4 N	DEMO							
	4 S	DEMO							
3:30	5 N	DEMO							
	5 S	DEMO							
5:30	6 N								
	6 S								
Night	7								

APPENDIX C Performance and Safety Certification Procedures

Technical Feasibility Demonstration Performance And Safety Certification Procedure

Revision A, Version 3

for the

Automated Highway System
System Definition Phase
Cooperative Agreement Number:
DTFH61-94-X-00001
Amendment 1

June 6, 1997

Prepared by:
National Automated Highway System Consortium
3001 West Big Beaver Road, Suite 500
Troy, Michigan 48084

Approvals:

James H. Rillings, NAHSC Program Manager	6-16-97 Date	Ron Colgin, Certification Team Chairman	6/16/97 Date

NAHSC Performance and Safety Certification Procedure
Revision A, Version 3
06/06/97

General: Revision A, Version 3 list Requirement Numbers for those Procedure Steps not previously linked to Demonstration Specification Requirements.

Revision A, Version 3 Revised or Added Procedures Steps

Step #	**Title**
1.4	**Vehicle Safety Provisions**
1.4.5	Added a 5 lbs fire extinguisher
3.7	**Maneuvering**
3.7.1	Inserted procedure step 3.7.1
3.7.2	Renumbered procedure step 3.7.1 to 3.7.2
3.7.3	Renumbered procedure step 3.7.2 to 3.7.3
3.7.4	Renumbered procedure step 3.7.3 to 3.7.4
3.9	**Steering Safety Control**
3.9.4	Clarified wording in procedure
3.10	**Deceleration Safety Control**
3.10.4	Clarified wording in procedure
4.4	**Run Results**
4.4.1 -10	Shorten procedure.
4.7	**Comments, Discrepancies and Recommendations**
	Changed to Comments and Recommendations

NAHSC Performance and Safety Certification Procedure
Revision A, Version 3
06/06/97

Revision A, Version 2, dated 5/29/97, Revised or Added Procedures Steps

Step #	Title
1.4	**Vehicle Safety Provisions**
1.4.5	Added a 5 lbs fire extinguisher
3.7	**Maneuvering**
3.7.1	Inserted procedure step 3.7.1
3.7.2	Renumbered procedure step 3.7.1 to 3.7.2
3.7.3	Renumbered procedure step 3.7.2 to 3.7.3
3.7.4	Renumbered procedure step 3.7.3 to 3.7.4
3.9	**Steering Safety Control**
3.9.4	Clarified wording in procedure
3.10	**Deceleration Safety Control**
3.10.4	Clarified wording in procedure
4.4	**Run Results**
4.4.1 -10	Shorten procedure.
4.7	**Comments, Discrepancies and Recommendations**
	Changed to Comments and Recommendations

NAHSC Performance and Safety Certification Procedure
Revision A, Version 3
06/06/97

Revision A, dated 5/16/97, Revised or Added Procedures Steps

Step #	Title
1.4	**Vehicle Safety Provisions**
1.4.1	
1.4.2	
1.4.3	
1.4.4	
1.4.5	
1.4.6	
1.4.7	
1.4.8	
2	**SAFETY ANALYSIS**
2.1	**Vehicle Block Diagram**
2.2	**Fault Analysis, Longitudinal Control System**
2.3	**Fault Analysis, Lateral Control System**
2.4	**Failure Effects Survey**
2.5	**Software Soundness Questionnaire**
2.6	**Vehicle-to-Vehicle Spacing**
3.2	**Scenario Execution Time and Maximum Speed**
3.2.1	
3.2.2	
3.2.3	
3.7	**Maneuvering.**
3.7.1	
3.7.2	
3.7.3	
3.8	**Emergency Assumption of Manual Control.**
3.8.1	
3.8.1.1	
3.8.1.2	
3.8.2	
3.8.2.1	
3.8.2.2	
3.8.3	
3.9	**Steering Safety Control**
3.9.1	
3.9.2	
3.9.3	
3.9.4	
3.10	**Deceleration Safety Control**
3.10.1	
3.10.2	
3.10.3	
3.10.4	

NAHSC Performance and Safety Certification Procedure
Revision A, Version 3
06/06/97

Preface

The purpose of this Performance and Safety Certification Procedure is to ensure that participant vehicles and scenarios meet certain minimum performance and safety requirements in order for them to participate in the live vehicle portion of the National Automated Highway System Consortium Technical Feasibility Demonstration.

The Safety and Certification Team will conduct a Preliminary Certification to determine the readiness of the Demonstration vehicles and scenario to enter formal certification activities. The Preliminary Certification process is intended to be conducted at the vehicle/system development site or on the I-15 Demonstration Lanes. Certain requirements of the Safety Certification Procedure may be satisfied during this preliminary certification phase. Wherever possible, performance and safety requirements will be verified during these preliminary certifications. This preliminary certification process will also serve to validate the established Safety Certification Procedure for each demonstration vehicle and scenario.

Following pre-certification, formal certification will be conducted on the I-15 Demonstration Lanes to verify the implementation of all functional, performance and safety requirements as specified in the Demonstration Specification and the prescribed scenario. Formal certification will be executed in a structured and controlled test environment, following specific certification procedures, administered and witnessed by the Safety and Certification Team. Validation results documented in a certification report will be submitted to the Safety Review Board.

The methods of validation to be used are: Inspection, Analysis, Demonstration, and Test defined as follows:

Inspection (I) - Certification or validation by visual examination of the item, reviewing descriptive documentation, and comparing the appropriate characteristics with a reference standard to determine conformance to requirements. This includes the mechanical inspection of equipment, verification of accuracy and completeness of documentation.

Analysis (A) - Certification or validation by evaluation or simulation using mathematical representation, charts, graphs, circuit diagrams, or data reduction. This includes analysis of algorithms independent of computer implementation, analytical conclusions drawn from test data, and extension of test produced data to untested conditions.

Demonstration (D)- Certification or validation by operation, movement, or adjustment of the item under a specific condition to perform the designed function. This includes the content of displays, comparison of vehicle/system products with independently derived test cases, and prompt vehicle/system recovery from induced failure conditions.

Test (T) - Certification or validation through systematic exercising of the applicable item under all appropriate conditions with instrumentation and collection, analysis, and evaluation of quantitative data.

Pass/Fail criteria specify results, including tolerances, that must be obtained to determine that a certification requirement has been satisfied, is defined in each step of Certification Procedure.

NAHSC Performance and Safety Certification Procedure
Revision A, Version 3
06/06/97

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NAHSC Performance and Safety Certification Procedure
Revision A, Version 3
06/06/97

Before proceeding with the Performance and Safety Certification Procedure, please provide the following information:

Scenario Name	
Lead Organization	
Date Certification Conducted	
Location Certification Conducted	
Certification Participants	
NAHSC Certification Team:	Scenario Certification Team:

Please provide the following information for every vehicle that will participate in the Technical Feasibility Demonstration (including spare vehicles):

Vehicle Number:	
Make, Model and MY	
Vehicle License No. and State	
Vehicle Registered to:	
Vehicle Identification No. (VIN)	
Check Below all that Apply:	
For Lateral Control	
Magnetic Markers	
Vision	
Laser	
Radar	
For Longitudinal Control	
Radar	
Laser	
Vision	
Not Automated	

Vehicle Number:	
Make, Model and MY	
Vehicle License No. and State	
Vehicle Registered to:	
Vehicle Identification No. (VIN)	
Check Below all that Apply:	
For Lateral Control	
Magnetic Markers	
Vision	
Laser	
Radar	
For Longitudinal Control	
Radar	
Laser	
Vision	
Not Automated	

Vehicle Number:	
Make, Model and MY	
Vehicle License No. and State	
Vehicle Registered to:	
Vehicle Identification No. (VIN)	
Check Below all that Apply:	
For Lateral Control	
Magnetic Markers	
Vision	
Laser	
Radar	
For Longitudinal Control	
Radar	
Laser	
Vision	
Not Automated	

Vehicle Number:	
Make, Model and MY	
Vehicle License No. and State	
Vehicle Registered to:	
Vehicle Identification No. (VIN)	
Check Below all that Apply:	
For Lateral Control	
Magnetic Markers	
Vision	
Laser	
Radar	
For Longitudinal Control	
Radar	
Laser	
Vision	
Not Automated	

Vehicle Number:	
Make, Model and MY	
Vehicle License No. and State	
Vehicle Registered to:	
Vehicle Identification No. (VIN)	
Check Below all that Apply:	
For Lateral Control	
Magnetic Markers	
Vision	
Laser	
Radar	
For Longitudinal Control	
Radar	
Laser	
Vision	
Not Automated	

Vehicle Number:	
Make, Model and MY	
Vehicle License No. and State	
Vehicle Registered to:	
Vehicle Identification No. (VIN)	
Check Below all that Apply:	
For Lateral Control	
Magnetic Markers	
Vision	
Laser	
Radar	
For Longitudinal Control	
Radar	
Laser	
Vision	
Not Automated	

Vehicle Number:	
Make, Model and MY	
Vehicle License No. and State	
Vehicle Registered to:	
Vehicle Identification No. (VIN)	
Check Below all that Apply:	
For Lateral Control	
Magnetic Markers	
Vision	
Laser	
Radar	
For Longitudinal Control	
Radar	
Laser	
Vision	
Not Automated	

Vehicle Number:	
Make, Model and MY	
Vehicle License No. and State	
Vehicle Registered to:	
Vehicle Identification No. (VIN)	
Check Below all that Apply:	
For Lateral Control	
Magnetic Markers	
Vision	
Laser	
Radar	
For Longitudinal Control	
Radar	
Laser	
Vision	
Not Automated	

Vehicle Number:	
Make, Model and MY	
Vehicle License No. and State	
Vehicle Registered to:	
Vehicle Identification No. (VIN)	
Check Below all that Apply:	
For Lateral Control	
Magnetic Markers	
Vision	
Laser	
Radar	
For Longitudinal Control	
Radar	
Laser	
Vision	
Not Automated	

Vehicle Number:	
Make, Model and MY	
Vehicle License No. and State	
Vehicle Registered to:	
Vehicle Identification No. (VIN)	
Check Below all that Apply:	
For Lateral Control	
Magnetic Markers	
Vision	
Laser	
Radar	
For Longitudinal Control	
Radar	
Laser	
Vision	
Not Automated	

Please provide the following information for every driver that will participate in the Technical Feasibility Demonstration (including spare drivers):

	Name:	Company:	Driver License and State:	Is driver familiar with vehicle operation, safety features and procedures?	How many hours experience does driver have driving vehicle?	Has driver taken a formal, hands on vehicle handling course?	Where and when was course taken?
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
1	GENERAL VEHICLE REQUIREMENTS				
1.1	**Driver Qualifications** Examine the driver questionnaire in the front part of the Certification Procedure	(I)	Verify that all scenario vehicle drivers are: 1) minimum of 40 hours of familiarity/experience with the Demo vehicle operation, safety features, procedures and driving the vehicle, and, 2) have taken a formal, hands on vehicle handling course.	X________	2526
1.2	**Vehicle Appearance**				
1.2.1	Inspect the exterior of all demonstration vehicles for a "production" appearance. Inspect for bulky, unsightly attachments mounted on the vehicle exterior.	(I)	No bulky or unsightly attachments shall be mounted on the vehicle exterior. Items such as antennas or radomes shall be pleasing integrated into the vehicle exterior.	X________	2527
1.2.2	Inspect the interior of all vehicles that will carry passengers for a "production" appearance. Inspect for loose equipment, bulky or unsightly attachments mounted in the vehicle interior passenger compartment.	(I)	No bulky or unsightly instrumentation , computer keyboards, wiring harness, etc. shall be visible.	X________	2527
1.2.3	Inspect vehicle controls and indicators added to the production vehicle for automated operation.	(I)	Control switches, buttons, indicators and displays shall be pleasingly integrated into the vehicle interior, and be easily accessible to the driver.	X________	2527

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
1.2.4	Inspect vehicle passenger compartment for crash-worthiness hazards	(I)	For example, no equipment, controls or displays are mounted on the steering wheel or IP that might cause a head injury or interfere with SIR deployment.	X ______	2527
1.3	**Controls and Indicators.**				
1.3.1	Verify that the automation controls, for all vehicles that carry passengers, are not readily accessible to passengers.	(D)	Passengers shall not be able to easily reach any of the automation controls.	X______	2525
1.3.2	Inspect the automated vehicles when the sun is shining on the lighted displays, indicators and controls to verify that they are still visible to the driver.	(I)	Displays, indicators and controls shall be visible to the driver under all ambient sun lighting conditions expected during the demonstration.	X______	2541
1.4	**Vehicle Safety Provisions**				
1.4.1	Inspect all vehicles for prescribed OEM or high performance tires in good conditions.	(I)	All vehicles shall be equipped with prescribed OEM or high performance tires in good conditions.	X ______	2627
1.4.2	Demonstrate that OEM safety equipment is operation.	(D)	All the below listed OEM safety equipment shall be operational: • Lights - headlights - tail lights	X ______	2640

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
			- CHIMSL - turn signal lights - brake lights - emergency flashers • Horn • Wind shield wash and wipe		
1.4.3	Has any vehicle OEM safety equipment (e.g. air bags, lights, etc.) been modified or disabled?	(I)	All vehicle OEM equipment shall perform their intended function. If yes, explain.	NO ______ YES _____	2641
1.4.4	Inspect all vehicles for anti-lock brakes.	(I)	All vehicles shall be equipped with anti-lock brakes.	X ________	2627
1.4.5	Inspect all vehicles for the presence of a Class B/C fire extinguishers mounted in the passenger compartment and the vehicle trunk. The fire extinguisher in the passenger compartment should not be obvious to passengers.	(I)	All vehicles shall be equipped with a mounted Class B/C fire extinguisher in the passenger compartment and a 5 lb fire extinguisher in the trunk.	X ________	2642

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
1.4.6	Inspect all vehicles for the presence of a First Aid kit mounted in the trunk.	(I)	All vehicles shall have a First Aid Kit sufficient to treat the maximum number of occupants to be carried in vehicle.	X ______	2643
1.4.7	Inspect Laser radar eye safety documentation.	(I)	Laser radar eye safety shall comply with IEC Standard ANSIZI36.1. Attach certificate.	X ______	2644
1.4.8	Inspect millimeter wave radar biological safety documentation.	(I)	If radar power density exceeds 2 mW/m^2, radar shall be interlocked so that it does not transmit when vehicle is in Park or Neutral gear.	X ______	2645
1.5	**Seat Belts.**				
1.5.1	Inspect all demonstration passenger automobile for the presence of seat belts and shoulder restraints.	(I, D)	Seat belts and shoulder restraints are installed for driver, narrator and passengers, and buckles and retractors work properly. Record number of passengers allowed to be carried.	X______ No.______	2531
1.5.2	Inspect all demonstration vans for the presence of seat belts and shoulder restraints.	(I, D)	Seat belts and shoulder restraints are installed for driver, narrator and passengers, and buckles and retractors work properly Record number of passengers allowed to be carried.	X______ No.______	2616

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
1.5.3	Inspect trucks for seat belts.	(I, D)	Seat belts are installed for driver, narrator and passengers, and buckles and retractors work properly Record number of passengers allowed to be carried.	X________ No.________	2617
1.5.4	Inspect transit busses for seat belts.	(I, D)	Seat belts are installed for driver and buckles and retractors work properly Record number of passengers allowed to be carried.	X________ No.________	2618
1.6	**Maintenance of Vehicle Log Book**				
1.6.1	Inspect for the presence of a vehicle log book with each automated demonstration vehicle.	(I)	A vehicle log book is present in each automated vehicle, and the log book is marked so that it is uniquely associated with that vehicle.	X________	2533
1.6.2	Examine vehicle log books for the recording of date of pre-certification.	(I)	Date of pre-certification evaluation is noted in vehicle log books.	date ______	2646

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
1.6.3	Examine vehicle log books for notations of all vehicle or component changes, after pre-certification, due to failure or modification that is performed on the vehicle after it has been pre-certified.	(I)	If/when a component is replaced due to failure or modification, vehicle log book is annotated with: – the reason for component replacement – old and new part and serial numbers, – date work was done, – name of who did the work, and – the vehicle odometer reading.	X_______	2534, 2535
1.6.4	Inspect vehicle log book for proper recording of vehicle anomalous operation, after pre-certification,.	(I)	If/when the vehicle anomalous operation is observed, vehicle log book must be annotated with: – a description of the problem, – date observed, – name of who observed it, and – the vehicle odometer reading.	X_______	2536
1.6.5	Inspect vehicle log book for recording of vehicle maintenance after pre-certification.	(I)	If/when routine vehicle maintenance is performed, vehicle log book must be annotated with: – what was done, – date, – name of who did it, and – the vehicle odometer reading.	X_______	2537

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
1.7	**Logo Display**				
1.7.1	Inspect each live demonstration vehicle for NAHSC logo display.	(I)	Each vehicle shall display the NAHSC logo provided by the Demonstration Team.	X________	2556
1.7.2	Inspect each live demonstration vehicle for any other logo display.	(I)	Each vehicle shall not display any other logo than the NAHSC logo provided by the Demonstration Team while operating on the I-15 demonstration lanes.	X________	2556
1.8	**Vehicle Communications**				
1.8.1	Inspect all vehicles that will participate in the demonstration for the presence of an installed or portable in-vehicle voice radio.	(I)	An installed or portable in-vehicle radio is present in all demonstration vehicles. The voice radio shall meet the following minimal requirements.	X________	2528
1.8.2	Inspect manufacturer's data plate or data sheet to verify the radio's: frequency range, number of channels, squelch, power output, user interface options.	(I)	**<u>Frequency</u>** Receive: 851-869 MHz - Repeater ops Transmit: 806-824 MHz - Repeater ops: 851-869 MHz (direct talk)	X________	2528
		(I)	**<u>Squelch</u>** Switchable between carrier operated and decoder operated	X________	2528

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
			squelch. Use any of the standard EIA CTCSS tones on both transmit and receive.		
		(I)	**Power Output:** 15 watts nominal RF power output (preferred). 5 watts to 35 Watts acceptable.	X________ _____Watts	2528
		(I)	**Frequency Switchable:** Frequency shall be switchable between operating frequencies. and repeater modes of operation.	X________	2528
1.8.3	Demonstrate that it is possible to communicate with each scenario vehicle, the Demonstration Control Center and the Caltrans Radio Net using the applicable radio nets, frequencies and operating procedures in the Demonstration Communications Operating Guidelines. Repeat the demonstration of radio operation three more times uniformly spaced along the lanes.	(D)	The installed or portable in-vehicle radio communications shall operate in the following nets and frequencies:		2528
		(D)	**NAHSC Demonstration Radio Net Operating Frequencies** Receive: 868.0375 MHz Transmit: 823.0375 MHz (NAHSC Repeater) 868.0375 MHz direct (direct talk)	X________	2528

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
			Decoder operated squelch: 192.8 Hz - Both Transmit and Receive		
		(D)	**<u>Caltrans Radio Net Operating Frequencies</u>** Receive: 857.1000 MHz Transmit: 812.1000 MHz (SOLEDAD Repeater) Decoder operated squelch: 110.9 Hz - Both Transmit and Receive	X________	2528
		(D)	**<u>Radio Operation:</u>** The vehicle narrator/radio operator is familiar with the operation of the radio equipment and operating procedures contained in the Demonstration Communications Operating Guidelines.	X________	2528
1.8.4	Verify that installed vehicle voice radio can operate on battery power with engine off.	(D)	Installed vehicle voice radio shall be capable of operating for at least 20 min of vehicle battery power with engine off.	X________	2528
1.8.5	Verify that the portable team radio is equipped with a headset and can operate using push-to-talk	(I)	**<u>Team Radio:</u>** Portable in-vehicle voice radio for	X________	2628

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
	operations		team support/coordination shall be equipped with headset and have push-to-talk voice activated transmit capability.		
1.9 1.9.1	**Vehicle to DPC Telemetry** For each vehicle equipped to transmit data to the DPC, demonstrate the proper message content.	(D)	Message content shall contain the following information: a) Vehicle identification b) Location on the lane c) Lane being used d) Vehicle speed	X_______	2620
1.9.2	For each vehicle equipped to transmit data to the DPC, demonstrate the proper message data update rate	(T)	Data shall be updated at least one per sec averaged over 5 min	X_______ _______ sec	2620
2	**SAFETY ANALYSIS**				
2.1	**Vehicle Block Diagram** Submit a current vehicle block diagram showing, at the component level, all components added to the vehicle for automated operation.	(I)	Vehicle Block diagram shall be up to date.	X _______	2647
2.2	**Fault Analysis, Longitudinal Control System** Submit a top level fault analysis, and show that any single failure in longitudinal control system will not induce a hazardous consequence.	(A)	The fault shall be consistent with the block diagram, and include all elements of the longitudinal	X _______	2548, 2557, 2558,

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
			control system such as: the sensor, vehicle computer and software, actuator, actuator controller and software, vehicle-to-vehicle communications (if applicable), safety circuitry or software, power sources, driver alert provisions, and manual takeover provisions. The Certification Team shall be satisfied that reasonable effort has been invested in proving a safe system.		2561, 2562, 2563, 2564, 2565, 2567, 2568
2.3	**Fault Analysis, Lateral Control System** Submit a top level fault analysis, and show that any single failure in lateral control system will not induce a hazardous consequence.	(A)	The fault shall be consistent with the block diagram, and include all elements of the lateral control system such as: the sensor, vehicle computer and software, actuator, actuator controller and software, safety circuitry or software, power sources, driver alert provisions, and manual takeover provisions. The Certification Team shall be satisfied that reasonable effort has been invested in proving a safe	X ________	2548, 2557, 2558, 2559, 2560, 2566, 2568

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
			system.		
2.4	**Failure Effects Survey** Review with the Certification Team, the Failure Effects Survey previously distributed. Attach the most current version to this Certification Procedure.	(A)	The Certification Team shall be satisfied that reasonable effort has been invested in proving a safe system.	X ______	2648
2.5	**Software Soundness Questionnaire** Review with the Certification Team, the answers to the Software Soundness Questionnaire previously distributed. Attach the most current version to this Software Soundness Questionnaire to this Certification Procedure.	(A)	The Certification Team shall be satisfied that reasonable effort has been invested in proving a safe software	X ______	2649
2.6	**Vehicle-to-Vehicle Spacing** Review with the Certification Team, an analysis showing that the selected vehicle-to-vehicle spacing, during performance of your scenario, allows for safe avoidance of all scenario vehicles in the event of a vehicle or longitudinal control failure. Attach the analysis to this Certification Procedure.	(A)	The Certification Team shall be satisfied that the combination of vehicle spacing, delay time and vehicle stopping capability provides a safe system. When operating at close spacing, vehicle-to vehicle communications may be used to achieve the necessary delay time. As a guide, the time delay between when a lead vehicle	X ______	2650

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
			starts to stop and the following vehicle starts to stop, should not exceed the following times for the vehicle spacing indicated and a $5 m/s^2$ stopping capability. Spacing — Delay Time 4 m — 0.1 sec 10 m — 0.3 sec 20 m — 0.6 sec 30 m — 0.9 sec 40 m — 1.0 sec Record the following for the closest vehicle spacing in the scenario: 1. spacing 2. delay time 3. highest automated stopping capability 4. Is vehicle-to-vehicle data communications used?	______ m ______ sec ______ m/s^2 Yes ______ No ______	
3	**VEHICLE PERFORMANCE DURING THE SCENARIO**				
3.1	**Safety Critical Maneuvers** Perform scenario as many times as required to demonstrate the following scenario performance requirements.	(D)	At no time, during performance of this Certification Procedure, shall any vehicle make any hazardous maneuver such as:	X ______ (mark at end of certification)	2594

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
			hard over steering, full braking or approaching another vehicle, obstacle or part of the infrastructure too closely.		
3.2	**Scenario Execution Time and Maximum Speed**				
3.2.1	Measure the elapse time between when the lead vehicle in the scenario crosses the North End start line and when the last vehicle in the scenario crosses the South End finish line.	(T)	Record the time rounded off to the nearest tenth of a minute. Scenario run time shall not exceed 14 min.	______ min	2554
3.2.2	Record the number of obstacle locations in the scenario	(T)	The number of obstacle locations in the scenario shall not exceed three.	No. ______	2554
3.2.3	During the above scenario run, record the top speed of every vehicle.	(D)	The maximum speed observed shall not exceed 65 mph.	______ mph	2554
3.3	**Check-In** For every automated vehicle, demonstrate that the VRC Transponder causes the lane mounted changeable message sign to display the proper message as the vehicle passes the VRC reader.	(D)	The changeable message sign shall change from "TBD" to "Welcome to AHS"	X________	2398
3.4	**Switching Between Manual and Automated Control.** Demonstrate transition from manual-to-automated control and from automated-to-manual control, and evaluate ride sensation for smoothness and stability	(D)	All vehicle shall transition, on a single attempt, between manual and automated control smoothly with no uncomfortable or unsafe weaving or jerking.	X________	2544

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
3.5	**Acceleration.** Accelerate from minimum manual-to automated transition speed up to 65 mph, and evaluate ride sensation for smoothness and stability.	(D)	All vehicles shall accelerate to 65 mph (or their scenario top speed ≥ 45 mph and ≤ 65 mph) with no uncomfortable or unsafe weaving or jerking.	X_______	2589
3.6	**Speed Variation.** While operating vehicle under automated control, vary vehicle speed and evaluate ride sensation for smoothness and stability.	(D)	All vehicle speed changes shall be performed smoothly with no uncomfortable or unsafe weaving or jerking.	X_______	2590
3.7	**Maneuvering.**				
3.7.1	While operating vehicle under automated control, evaluate ride sensation for smoothness and stability during normal (for your scenario) maneuvers such as lane following, lane changing, passing, starting, stopping and pulling up behind a slower vehicle.	(D)	All vehicle shall perform all maneuvers smoothly with no uncomfortable or unsafe weaving or jerking	X_______	2593, 2594
3.7.2	While operating vehicle under automated control, verify that vehicles stay within their lane except when performing a scenario scripted lane change.	(D)	Under automated lateral control, no vehicle shall cross the lane boundary except during a scenario scripted lane change.	X_______	2545
3.7.3	While operating vehicle under automated control, verify that the vehicle does not approach any other vehicle any closer than scripted in the scenario.	(D)	Vehicle shall not approach any other vehicle any closer than scripted in the scenario.	X_______	2651

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
3.7.4	While operating vehicle under automated control, verify that the vehicle maintains a safe distance from any infrastructure object.	(D)	Vehicle shall not come within 3 feet of any infrastructure object while executing the scripted scenario.	X_______	2652
3.8	**Emergency Assumption of Manual Control.**				
3.8.1	Lateral Control - repeat this procedure once for each type of vehicle with automated lateral control.				
3.8.1.1	While operating the vehicle under automated lateral and longitudinal control, insert the faults listed below and execute emergency driver assumption of manual control for each of the following conditions: 1) failure of lateral control sensor(s) 2) failure of the steering actuator or controller 3) failure of the vehicle computer	(D) (D)	The vehicle shall detect each fault and switch into manual lateral <u>and</u> longitudinal control. When a lateral control element fails, the driver shall be able to easily assume manual control of the vehicle without exposing anyone to harm or danger.	X _______ X _______	2653 2654, 2597, 2526
3.8.1.2	Show that the vehicle driver was notified that a fault occurred and vehicle control has been switched from automated to manual.	(D)	The driver shall be provided with a visual <u>and</u> audible alert when ever a lateral control element fails and/or the driver assumes manual control.	X _______	2624, 2625
3.8.2	Longitudinal Control - repeat this procedure once for each type of vehicle with automated longitudinal control.				

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
3.8.2.1	While operating the vehicle under automated lateral and longitudinal control, insert the faults listed below and execute emergency driver assumption of manual control for each of the following conditions: 1) failure of longitudinal control sensor(s) 2) failure of the brake actuator or controller 3) failure of the throttle actuator or controller 4) failure of the vehicle-to-vehicle communications (if applicable). 5) failure of the vehicle computer	(D)	The vehicle shall detect each fault and switch into manual lateral <u>and</u> longitudinal control.	X ________	2653
		(D)	When a longitudinal control element fails, the driver shall be able to easily assume manual control of the vehicle without exposing anyone to harm or danger.	X ________	2655, 2597, 2526
3.8.2.2	Show that the vehicle driver was notified that a fault occurred and vehicle control has been switched from automated to manual.	(D)	The driver shall be provided with a visual <u>and</u> audible alert when ever a longitudinal control element fails and/or the driver assumes manual control.	X ________	2624, 2625
3.8.3	If possible, re-start the scenario after a vehicle executes an emergency driver assumption of manual control.	(D)	All vehicles shall be capable of clearing the lanes under either automated or manual control, but execution of the scenario as scripted may be discontinued.	X ________	2598

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
3.9	**Steering Safety Control**				
3.9.1	Verify by static test that all automated vehicles with lateral control have a means to limit the steering range as follows: a. lift front wheels off the ground b. insert a $\pm 0.5^0$ peak sinusoidal steering command with a period of 15 sec. c. compare the commanded vs. actual road wheel steering angle (if instrumentation is at the hand wheel, provide the steering gear ratio between hand and road wheel).	(T)	The actual ground wheel steering angle shall follow the commanded ground wheel steering angle. Attach computer printouts from which results were determined.	X ________	2538
3.9.2	Change the amplitude of the peak steering command so that it is a little higher then $\pm 2.0^0$.	(T)	The actual ground wheel steering angle shall not exceed $\|2^0\|$. Record the peak ground wheel steering angle and attach computer printouts from which results were determined.	______ deg	2538
3.9.3	Change the amplitude of the peak steering command so that it is $\pm 3.0^0$.	(T)	The actual ground wheel steering angle shall not exceed $\|2^0\|$. Record the peak ground wheel steering angle and attach computer printouts from which results were determined.	______ deg	2538
3.9.4	When the steering angle command exceeds the	(D)	When the steering angle limit has	X ________	2656,

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
	steering angle limit, demonstrate that the vehicle switches into manual lateral and longitudinal control and the driver is given and audio and visual alert.		been exceeded, the vehicle shall switch into manual lateral and longitudinal control and the driver shall be given an audio and visual alert.		2624
3.10	**Deceleration Safety Control**				
3.10.1	Verify by static test that all automated vehicles with automated brake control have a means to limit the braking command range as follows: a. insert a 1.0 m/s^2 (0.10 g) brake command. b. compare the requested vs. actual brake command (if instrumentation is in brake pressure, provide the brake pressure-to-vehicle deceleration conversation data or graph).	(T)	The actual braking requested shall follow the commanded. Attach computer printouts from which results were determined.	X ________	2579, 2580
3.10.2	Change the braking command so that it is a little higher then 5.0 m/s^2 (0.51 g)	(T)	The actual braking requested shall not exceed 5.0 m/s^2 (0.51g). Record the actual braking requested and attach computer printouts from which results were determined.	______ m/s^2	2579, 2580

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
3.10.3	Change the braking command so that it is 6.0 m/s^2 (0.62 g)	(T)	The actual braking requested shall not exceed 5.0 m/s^2 (0.51g). Record the actual braking command and attach computer printouts from which results were determined.	______ m/s^2	2579, 2580
3.10.4	When the braking command exceeds the braking limit, demonstrate that the vehicle switches into manual lateral and longitudinal control and the driver is given and audio and visual alert.	(D)	When the braking limit has been exceeded, the vehicle shall switch into manual lateral and longitudinal control and the driver shall be given an audio and visual alert.	X ________	2657, 2624
3.11	**Kill Switch**				
3.11.1	Inspect all automated vehicles to verify that they have a "kill switch" within easy reach of the driver.	(I)	A "kill switch" is in easy reach of the driver.	X________	2530
3.11.2	For all automated vehicles, demonstrate that the activation of the "kill switch" will safely return the vehicle to manual control and provide the driver with an indication that the vehicle is under manual control.	(D)	Activation of the "kill switch" disengages all automated controls, and provides the driver with full manual control, and an indication that control has been switched from automated to manual.	X________	2524, 2530, 2624, 2625
		(D)	Feel of steering wheel and brakes shall not differ from drivers normal expectation.	X________	2597

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
4	**SCENARIO ROBUSTNESS**				
4.1	**Safety Questions** Before starting the scenario runs, answer the following questions. Answers will be used by the Demonstration Safety Officer to help decide if the Demonstration should be stopped.				
4.1.1	Have you experienced any problems with temperature during your previous testing on I-15 or other test locations?	(A)	Answer yes or no and explain if yes.	YES______ NO______	2622
4.1.2	Have you experienced any problems with shadows or other effects from the particular angle of the sun during your previous testing on I-15 or other test locations?	(A)	Answer yes or no and explain if yes.	YES______ NO______	2621
4.1.3	What is the maximum wind speed, from any angle, (both steady and gusts) that it is safe to operate your vehicles?	(A)	Record answer. a) Steady b) Gusts	______mph ______mph	2622
4.1.4	What is the maximum rain rate your vehicle can operate in?	(A)	Record answer.	____mm/hr	2622
4.1.5	What is the maximum amount of fog (in feet of visibility) your vehicle can operate in?	(A)	Record answer.	_______ ft	2622
4.1.6	Can your vehicles operate at night?	(A)	Answer yes or no.	YES______ NO______	2621

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
4.2	**Scenario Description** Submit the current version of your scenario description along with quantitative values for vehicle speeds versus distance, vehicle-to-vehicle gaps and detection ranges of obstacles to be avoided. Attach scenario description to this Certification Procedure.	(A)	Scenario shall contain the appropriate elements and exhibit the functionality described in the following Appendices for your particular scenario: (1) Platoon (2) Multi-Platform Free Agent (3) Maintenance (4) Evolutionary (5) Control Transition (6) Alternative Technology (7) Truck	X________	2658
4.3	**Scenario Runs** After completing the ten scenario runs in step 4.4, record an overall summary of the scenario performance in this step for items a through g. Scenario runs shall be conducted as follows: • Alternately make five full South-to-North runs and five full North-to- South runs. • Ensure that half the runs are performed before noon and the other half after noon. • Vary the number of people and their sitting positions among runs. • Record the results for each run.				
		(D)	a) All vehicles while under automated control shall stay in scenario scripted	X________	2586

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
			lane(s)		
		(D)	b) All vehicles while automated control shall exhibit minimal weaving	X_______	2586
		(D)	c) All vehicles while under automated control shall exhibit minimal surging.	X_______	2586
		(D)	d) All vehicles while under automated control shall provide passenger ride comfort similar to that of 1996 model year manually controlled vehicles.	X_______	2587
		(D)	e) All vehicles while under automated control shall, once automated operation has commenced (in accordance with the scenario script), not be manually or automatically interrupted during the entire run.	X_______	2555, 2623
		(D)	f) All vehicles while under automated control shall: complete the scenario as	X_______	2554, 2658

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
			described in step 4.2 above.		
		(D)	g) Scenario shall pass pre-established way-point markers within acceptable timing as marked on velocity profile.	X ______	2554, 2658
4.4	**Run Results**		Record for each run:		
4.4.1	Run 1		North to South or South to North	______	
			Time of day	______	2621
			Temperature	______	2622
			Wind Speed (note steady or gusts)	______	2622
			Rain	____mm/hr	2622
			Fog Visibility	______ft	2622
		(D)	Were there any deviations from the success criteria called out in step in 4.3, a through g. above? If yes , record the letter and explain in the comments section.	a. ______ b. ______ c. ______ d. ______ e. ______ f. ______ g. ______	2586, 2587, 2555, 2623, 2554, 2658

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
4.4.2	Run 2	(D)	North-to-South or South-to-North Time of day Temperature Wind Speed (note steady or gusts) Rain Fog Visibility Were there any deviations from the success criteria called out in step in 4.3, a through g. above? If yes , record the letter and explain in the comments section.	______ ______ ______ ______ ____mm/hr ______ft a. ____ b. ____ c. ____ d. ____ e. ____ f. ____ g. ____	 2621 2622 2622 2622 2622 2586, 2587, 2555, 2623, 2554, 2658
4.4.3	Run 3	(D)	North to South or South to North Time of day Temperature Wind Speed (note steady or gusts) Rain Fog Visibility Were there any deviations from the success criteria called out in step in 4.3, a through g. above? If yes , record the letter and explain in the comments section.	______ ______ ______ ______ ____mm/hr ______ft a. ____ b. ____ c. ____ d. ____ e. ____ f. ____	 2621 2622 2622 2622 2622 2586, 2587, 2555, 2623, 2554, 2658

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
4.4.4	Run 4	(D)	North to South or South to North Time of day Temperature Wind Speed (note steady or gusts) Rain Fog Visibility Were there any deviations from the success criteria called out in step in 4.3, a through g. above? If yes , record the letter and explain in the comments section.	______ ______ ______ ______ ____mm/hr ______ft a. ____ b. ____ c. ____ d. ____ e. ____ f. ____ g. ____	2621 2622 2622 2622 2622 2586, 2587, 2555, 2623, 2554, 2658
4.4.5	Run 5	(D)	North to South or South to North Time of day Temperature Wind Speed (note steady or gusts) Rain Fog Visibility Were any deviations from the success criteria called out in step in 4.3, a through g. above? If yes , record the letter and explain in the comments section.	______ ______ ______ ______ ____mm/hr ______ft a. ____ b. ____ c. ____ d. ____ e. ____ f. ____ g. ____	2621 2622 2622 2622 2622 2586, 2587, 2555, 2623, 2554, 2658

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
4.4.6	Run 6	(D) (D) (D) (D) (D) (D) (D)	North to South or South to North Time of day Temperature Wind Speed (note steady or gusts) Rain Fog Visibility Were there any deviations from the success criteria called out in step in 4.3, a through g. above? If yes , record the letter and explain in the comments section.	________ ________ ________ ________ ____mm/hr ________ft a. ______ b. ______ c. ______ d. ______ e. ______ f. ______ g. ______	 2621 2622 2622 2622 2622 2586, 2587, 2555, 2623, 2554, 2658
4.4.7	Run 7	(D)	North to South or South to North Time of day Temperature Wind Speed (note steady or gusts) Rain Fog Visibility Were there any deviations from the success criteria called out in step in 4.3, a through g. above? If yes , record the letter and explain in the comments section.	________ ________ ________ ________ ____mm/hr ________ft a. ______ b. ______ c. ______ d. ______ e. ______ f. ______	 2621 2622 2622 2622 2622 2586, 2587, 2555, 2623, 2554, 2658

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
4.4.8	Run 8	(D)	North to South or South to North Time of day Temperature Wind Speed (note steady or gusts) Rain Fog Visibility Were there any deviations from the success criteria in procedure 4.3 a thru g. above noted? If yes , record the letter and attach an explanation.	______ ______ ______ ______ ____mm/hr ______ft a. ____ b. ____ c. ____ d. ____ e. ____ f. ____ g. ____	2621 2622 2622 2622 2622 2586, 2587, 2555, 2623, 2554, 2658
4.4.9	Run 9	(D)	North to South or South to North Time of day Temperature Wind Speed (note steady or gusts) Rain Fog Visibility Were there any deviations from the success criteria called out in step in 4.3, a through g. above? If yes , record the letter and explain in the comments section.	______ ______ ______ ______ ____mm/hr ______ft a. ____ b. ____ c. ____ d. ____ e. ____ f. ____ g. ____	2621 2622 2622 2622 2622 2586, 2587, 2555, 2623, 2554, 2658

Step	Procedure	Method	Pass/Fail Criteria	Results	Rqmt #
4.4.10	Run 10	(D)	North to South or South to North Time of day Temperature Wind Speed (note steady or gusts) Rain Fog Visibility Were there any deviations from the success criteria called out in step in 4.3, a through g. above? If yes , record the letter and explain in the comments section.	______ ______ ______ ______ ____mm/hr ______ft a. ____ b. ____ c. ____ d. ____ e. ____ f. ____ g. ____	 2621 2622 2622 2622 2622 2586, 2587, 2555, 2623, 2554, 2658
4.5	**Electromagnetic Environment** During the performance of all certification procedures, demonstrate that all hardware and software is unaffected by the electromagnetic environment.	(D)	Vehicles shall not effect or be effected by any other demonstration vehicles or the infrastructure.	X ______	2529, 2543
4.6	**Safety Critical Maneuvers** After all 10 consecutive runs, return to step 3.1 and complete the results.				
4.7	**Comments and Recommendations** Fill out attached Comments and Safety Review Board Recommendation sheets and submit Certification Report to Safety Review Board.				

Record Comments Here

Record Recommendations to the Safety Board Here

APPENDIX D Safety Plan

National Automated Highway System Consortium Technical Feasibility Demonstration Safety Plan

for the

Automated Highway System
System Definition Phase
Cooperative Agreement Number:
DTFH61-94-X-00001
Amendment 1

April 7, 1997

Prepared by:

National Automated Highway System Consortium
3001 West Big Beaver Road, Suite 500
Troy, Michigan 48084

Approval:

for James H. Rillings, NAHSC Program Manager

7 April 97
Date

SAFETY PLAN

Draft Plan provided via Purchase Order RG6-437408
January 31, 1997
P.A. Reynolds
and
D.J. Funke
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March 31, 1997

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1. SCOPE AND INTRODUCTION

This Safety Plan covers the I-15 live vehicle demonstrations and the activities involving moving vehicle demonstration at the Exhibition Center test area or nearby public roads. It does not cover activities at the Exhibit Hall and security measures at any of the sites. It also does not cover transportation of test vehicles to or from the Demonstration. The Plan includes procedures for implementation including the vehicle/scenario certification procedure and is designed to be executed in the short time available to the target August '97 demonstration.

The Plan provides checklists of vehicle/scenario faults and hazards based on general Calspan experience with automated flight and ground vehicles and study of AHS Safety, Malfunction Management, Incident Management, Entry/Exit, Vehicle Operations, Roadway Operations, and other tasks as part of the AHS Precursor Studies. The Plan calls for identification and mitigation of faults and hazards specific to the demo vehicles and scenario designs for the Demonstration requiring that the checklists be adopted and expanded to suit.

The Plan recognizes that the vehicles are experimental and are largely complete as this document is finalized, making safety requirements specifying redundancy, independent safety monitoring sensors, special monitoring software, etc. impossible to provide within budget and time available. Therefore the emphasis is on failure mitigation by limiting authority and by manual takeover.

2. ORGANIZATION AND IMPLEMENTATION

Safety activities will be accomplished by a Safety Review Team (referred to as "the Team") and a Safety Board (referred to as "the Board. Figures 2-1 and 2-2 illustrate how the safety activities fit with the other demonstration activities and the division of the safety task into areas of responsibility.

The Team and Board are formed by the System Integration Lead with the approval and recommendations of the Demo Lead, NAHSC Technical Director and NAHSC Program Manager. The recommended size for the Team is six to eight, roughly one person for each area of responsibility shown on Figure 2-2.

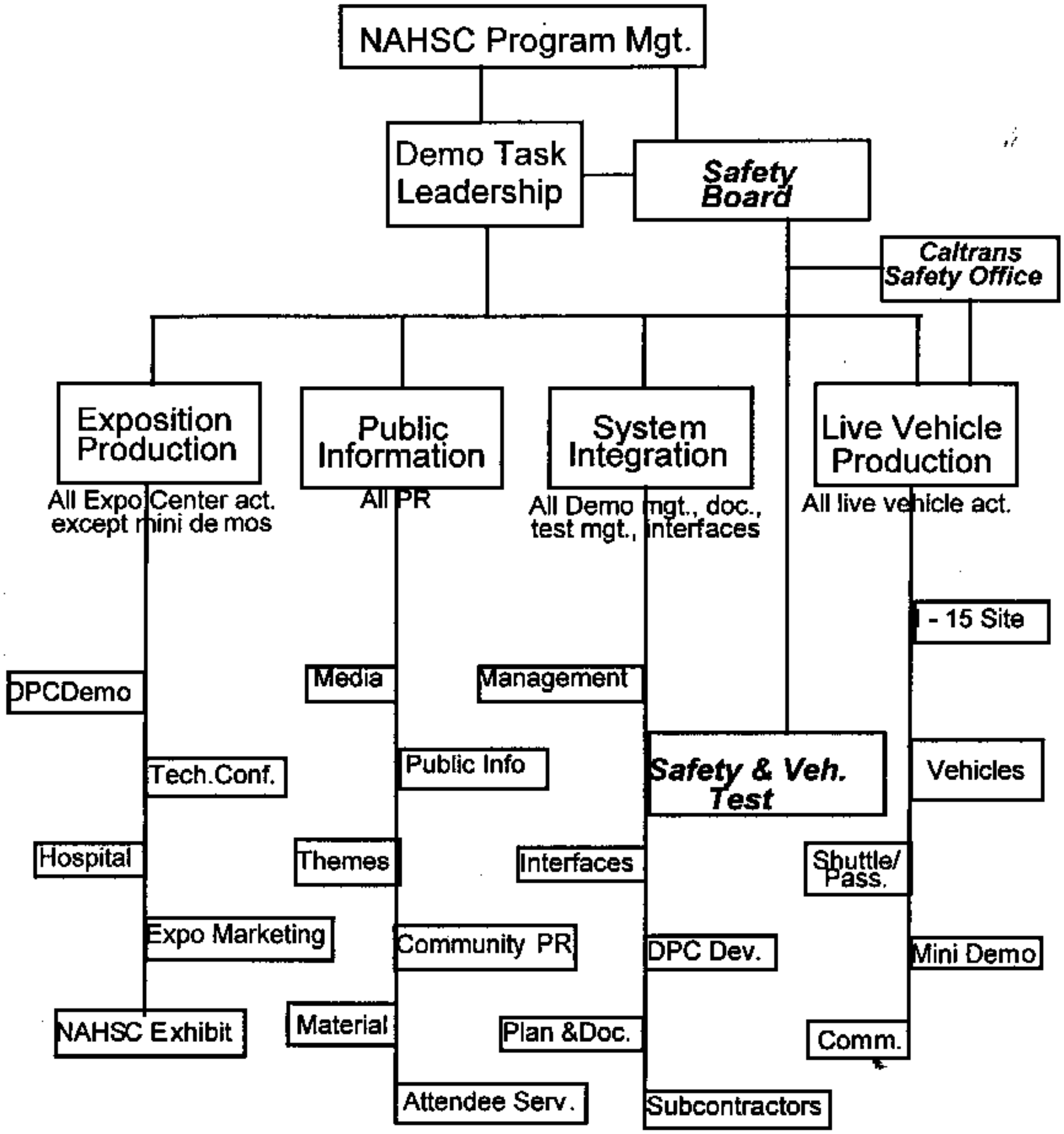


Figure 2-1 Demo Organization Safety Interface

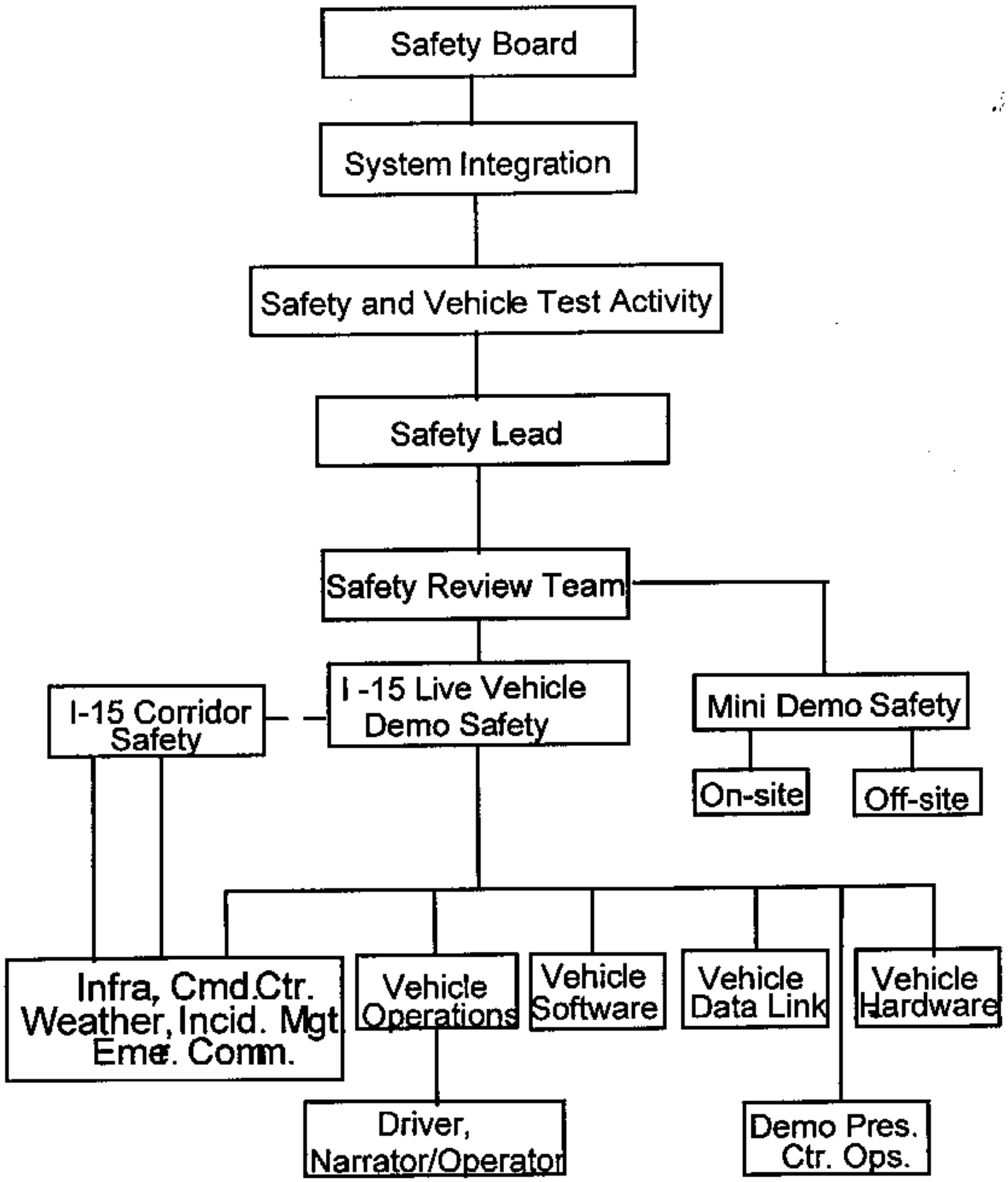


Figure 2-2 Demo Safety Organization

Members of the Team are drawn from System Integration and Live Vehicle Production or elsewhere in the Core membership. They qualify as "Domain Experts". Some have ground and/or flight vehicle automation in their backgrounds with experimental or prototype hardware experience. One member of the Team will serve as the Safety Team Chair.

Membership will include both regular and rotational members. This group will also serve a dual role as the Certification Test Team overseeing pre-certification and certification activity. Members include:

Name	Organization	Responsibilities
Ron Colgin	NAHSC P.O.	Safety/Certification Team Chair, Vehicle Integration Engineer
Joe Meyer	LMC	Safety/Certification Team Co-Chair, Safety Integration Engineer
Pat McKenzie	LMC	Demonstration Integration Engineer
Phil Coopman	CMU	Software Engineer
Andrew Segal	PATH	Software Engineer
Bill Stevens	NAHSC P.O.	Software Engineer
Bob Battersby	CALTRANS	I-15 Corridor Safety Engineer
George Clancy	GM	Vehicle Engineer for Platoon, Multi-Platform Free Agent and Maintenance Certification
Damon Delorenzis	Honda	Vehicle Engineer for Control Transition and Alternative Technology Certification
Michael Wolterman	Toyota	Vehicle Engineer for Evolutionary Certification
Michael Lesher	Eaton VORAD	Vehicle Engineer for Truck Certification
Bill Kennedy	LMC	Development Engineer for Truck and Alternative Technology Certification
Wei-Bin Zhang	PATH	Development Engineer Evolutionary and Multi-Platform Free Agent Certification
Todd Jochem	CMU	Development Engineer for Control Transition, Maintenance and Platoon Certification
Tommy Viner	NAHSC P.O.	Alternate Demonstration Integration Engineer
Pat Langley	LMC	Alternate Demonstration Integration Engineer

Responsible for the day-to-day contact with the Demo Team for all Safety related issues. This team will be responsible for finalizing and implementing the Demo '97 Safety Plan and associated certification procedures. It will finalize the Safety requirements and ensure their inclusion in vehicle certification procedures. The team will ensure proper staffing of safety related positions for Demo execution. This group will also develop recommended "pass / fail" criteria for each step in the certification process and provide that criteria to the Safety Board for their approval. This team will distribute the hazard questionnaires and facilitate the return of said material with appropriate vehicle developers. A subset of the Safety Review Team will be present at all pre-certification and certification runs executed by vehicle scenarios. Each subset group will report findings to the rest of the Safety Review Team and summaries will be provided to both the Safety Board and the Demo Team at large. The Safety Review Team Chair will coordinate and present appropriate briefings to the Safety Board at their monthly meetings.

The Safety Review Team will hold teleconferences regularly beginning in April 1997 and meet face-to-face once a month (may want to hold just prior to each Demo Team meeting to try to cut down on travel expenses). All regular members of the Review Team should participate in the weekly Safety Review Team teleconferences with rotational members "taking turns". All regular members of the review team will participate in as many pre-certification and certification runs as possible. As the team Chair, Ron will be responsible for coordinating the participation of the rotational members in pre-certification and certification activities. Rotational members may wish to delegate their participation in a given certification event to another member of their team should they not be available. Replacement would be coordinated well in advance with Ron. (NOTE: No rotational member will be allowed to participate as a part of the review team for their own scenario.)

After certification, the Team collects further information during Dry Runs and Dress Rehearsals in the form of Configuration Control and failure report documentation.

The Demonstration Safety Board is the principle adjudication body regarding Safety issues for Demo '97. Their primary responsibility will be to ensure that all reasonable efforts have been made to ensure the safety of participants and attendees at all Demo '97 events (dry runs, dress rehearsals, the demo itself). They will accomplish this by meeting on a regular basis (exact dates TBD) to review safety materials (safety questionnaires, hazard mitigation forms, safety requirements, pre-certification test results, and certification test results) and to receive safety briefings related to those materials. In cases of significant safety concern, selected members of the Safety Board may choose to exercise a "hands on" approach to working the issue. The Safety Board will report it's findings to the PMC and make the final decisions on live vehicle participation with the advice and counsel of the PMC. If the PMC disagrees with a Safety Board recommendation, it could appeal to the PSB.

The Board members should have served on other safety boards on programs involving early testing of experimental, person-rated ground or flight vehicles. Preferably these persons will have automotive experience. At least one Board member should come from outside the Consortium membership. Membership criteria and selection will be finalized by the Safety Board Chair, John West. Tentative membership includes:

John West (PMOC Chair)	- Safety Board Chair
Jim Rillings (NAHSC Program Manger)	- Safety Board Co-Chair
Bill Stevens (Technical Director)	- Member
Terry Quinlan (NAHSC Demo Task Lead)	- Member
Ron Colgin (Safety Review Team Chair)	- Member
Mike Atkinson (GM Proving Grounds)	- Member
Riley Garrett (Transportation Research Center)	- Member
Others as determined by the Board Chair	

The Board will meet approximately once a month during the period from March through June 1997. At those meetings, decisions regarding safety issues (such as "can the Houston Metro buses carry passengers without having seat belts?") will be made for subsequent presentation to the PMC. Decisions regarding live vehicle scenarios will also be made by the Board (scenario passed pre-certification, scenario failed pre-certification ... must redo, scenario passed certification, scenario is cleared for Demo '97 participation, etc.). The Board will probably need to meet twice in July (just prior to dress rehearsals and a few days after the last dress rehearsal). The Board may also decide it needs to be "on call" in early August and throughout the Demo in the event an unforeseen safety issue arises.

3. REQUIREMENTS

3.1 NATIONAL REQUIREMENTS

The NAHSC Collaborative Agreement does not specifically call out Governmental or industry safety requirements as applicable. However, the Safety Review Team should use these requirements as a guide where practical.

3.2 STATE AND LOCAL REQUIREMENTS

The Caltrans I-15 Testing Safety Procedures (Ref. 5) are required.

If a vehicle is to be operated on public roads (other than the I-15 HOV test track), it will be required to have valid registration. All individual live demonstration vehicles including live mini-demo vehicles must be covered by liability insurance provided by the vehicle owners.

There are no known local safety requirements.

3.3 DEFINITIONS (Refs. 6 and 7)

Fault - Physical defect, imperfection or flaw in hardware or software (can be latent).

Error - Unintended or incorrect physical or logical state of a subsystem element; the result of a fault.

Failure - Incorrect performance of subsystem element(s); the result of an error.

Hazard - an existing or potential condition that can result in a mishap.

Not all faults produce errors and not all errors produce failures. A failure can create a hazard if it happens at the wrong time or place. A hard-over failure is one that causes the subsystem output to move to its maximum possible value at maximum possible rate.

In the fault/hazard analysis required by this plan, our interest centers on those faults/hazards that could result in critical or catastrophic mishaps if not mitigated.

Catastrophic - loss of life or severe injury

Critical - moderate injury and/or property damage

Marginal - minor injury, failure to achieve Demo goal(s).

Negligible - no significant impact on Demo goal(s).

3.4 GENERAL CONSIDERATIONS

3.4.1 Demonstration Characteristics

Since I-15 activity involves fully automated vehicles at freeway speeds and closer than normal spacing, the activity must be undertaken with more than the normal caution. Orchestrating multiple-vehicle scenarios, sometimes simultaneously, involves coordination of many separate people and activities from many different organizations. Timing and control are important to a smooth, fast-paced and entertaining presentation and to a safe demonstration. Table 3-1 is a list of other demonstration planning documents that are relevant to the Safety Plan. The Safety Review Team will be familiar with the provision of these plans, particularly as indicated in the "Relevance" column.

Table 3-1
OTHER DEMONSTRATION PLANS WITH SAFETY RELEVANCE

Paragraph in Demonstration Planning Document	Relevance
Entire report	Defines content of all plans.
6.6 Development	Should mention Fault/Hazard Process in preparation.
6.9 Communications	Baseline for defining procedures for loss of communication.
6.12 Operations	Baseline for defining procedures in the event of operational failures
6.10 Live Demo Procedures	Defines contingency operational procedures and go/no-go criterion.
6.2 Traffic Mitigation	Minimizes probability of incident in manual lanes.
6.1 Risk Mitigation	Overlaps with Fault/Hazard process in dealing with technical risks.
6.4 Test/Validation	Describes details of pre-certification , certification dry-run and dress rehearsal tests.
6.5 EMC/EMI Control	Describes analysis and tests specifically designed to prove EMC and EMI immunity in the actual I-15 environment.

Table 3-1 (Cont.)

OTHER DEMONSTRATION PLANS WITH SAFETY RELEVANCE

Paragraph in Demonstration Planning Document	Relevance
6.17 Maintenance and Repair	Includes required Configuration Control of hardware and software.
6.13 Security	Includes precautions against deliberate disruptive or damaging activity at the I-15 site
6.15 Contingency	Cover contingencies not mentioned in other plans.

In accomplishing these plans the System Integration and Vehicle Production activities have close contact with the eight vehicle/scenario participants, three of which are led by Core Consortium members and five led by Associate members. (One Core member has joined together with one Associate member to stage a combined scenario). Much of the vehicle fault/hazard process will be accomplished by the organizations with Safety Review Team responsibility. The participants will provide the Safety Review Team with their top-level vehicle designs and enough analysis and test information to satisfy safety concerns as documented in the Fault/Hazard Mitigation forms and in this document.

The Safety Review Team and the Safety Board will be aware that many of the vehicle automated subsystems are proof-of-feasibility, non-redundant elements with low hours of unit and integrated testing. Software verification and validation testing may not be as complete as that of a pre-production prototype and fault tolerance may not be fully demonstrated. Demonstration safety is to be provided by trained test drivers with many hours of experience in the demo vehicles, executing scenarios with detailed scripts, capable of safely dealing with worst-case, hard-over failures of the major control subsystems. The effect of these failures will be minimized by limiting the authority of the automated mode compared with the manual mode of each critical subsystem - throttle, steering and braking.

The Safety Review Team also needs to be aware that safety as perceived by the passengers will also be very important. The scenario should not require maneuvers, timing or driver actions which are more urgent than a non-stressful freeway ride. The vehicle performance should be as smooth and comfortable as possible. Rough or erratic and possibly non-repeatable performance would be reasons for insufficient perceived safety even though real safety criteria are satisfied.

3.4.2 Demonstration Reliability

This section provides a numerical framework for estimating the reliability of the demonstration preparation activity on I-15 and the probability of running four days of demonstration without critical sub-system failures. Hazard analysis questionnaires prepared by vehicle developers will be followed up by high level fault tree analysis for each of the potential hazards which fall into the "critical" or "catastrophic" range. Actual application of this analysis by the Safety Review Team would treat the specific vehicles and their equipment and will specifically address questions like, "What is the probability of conducting all I-15 runs without a steering failure?" Assuming that the experimental nature of these vehicles will result in "some" failures, the next significant question to consider is, "Assuming you do have a steering actuation failure, how is the operator made aware of the failure and is he/she capable of safely taking over control of the vehicle?". Finally, from a "perceived safety" perspective, how many failures over the course of Demo week would the Consortium deem "acceptable" and how will the certification team test for this "robustness"?

In Table 3-2 are listed failure probability definitions to be used in the Fault/Hazard Mitigation Form and the implied mean time between failure (MTBF) of the subject component.

Table 3-2
FAILURE PROBABILITY DEFINITIONS

Definition of Failure Probabilities based on Demo Lifetime	*Single Vehicle MTBF (hours)*		*Probability of at least one failure in Lifetime*
	Lifetime of 200 hrs.	Lifetime of 1300 hrs.	
• Frequent - Likely to occur frequently	44	286	.99
• Probable - Will likely occur several times	87	565	.90
• Likely - Equal change of occurring as not occurring	289	1,879	.50
• Remote - Unlikely, but possible	1,898	12,337	.10
• Improbable - So unlikely that it may be assumed it will not happen	19,900	129,350	.01

The assumed lifetimes for this table are 200 and 1300 vehicle-hours on the basis of the planned I-15 activity. The lifetime defined for Safety Plan purposes is the total vehicle-hours with passengers which is the sum of planned dress rehearsal and actual demonstration vehicle-hours. At the present time this is estimated at 200 vehicle-hours.

Based on data on disabling vehicle failure (failures causing stoppage) frequency for the Toronto 401 and the San Francisco Bay Bridge, the mechanical/electrical failure rate for the vehicle populations in those localities is about 450 per million vehicle hours (Ref. 8).

To estimate projected AHS vehicle reliability we looked at failure data of similar components available primarily from Government sources and put components together to make systems. The basic data is summarized in Table 3-3, and an estimate for an entire demo vehicle with no redundancy, based on this data, is given in Table 3-4.

Table 3-3
AHS VEHICLE COMPONENTS RELIABILITY PROJECTIONS

	Failures per Million Hours
1. Longitudinal Sensing	14 to 135
2. Lateral Sensing	6 to 135
3. Computer Processing	7 to 22
4. Longitudinal Control	78 to 134
5. Lateral Control	58 to 72
6. Communications	40 to 94
7. Status and Operations	22 to 292
8. Malfunction Management	53 to 213
TOTAL	278 to 1,097

Table 3-4
PROJECTED GENERIC AUTOMATED VEHICLE SINGLE FAILURE RATE

Subsystem	Failures per Million Vehicle Hours (FPMH)
Basic Vehicle	411 to 490
Speed and Gap Control - Items 1, 3, 4	99 to 304
Lane Control - Items 2, 3, 5	71 to 229
Status and Operations - Item 7	22 to 292
Vehicle Data Link - Item 6	40 to 94

Total FPMH = 643 to 1409
MTBF = 1555 to 710 $(MTBF = \frac{10^6}{FPMH})$

Using the exponential probability distribution, the probability of experiencing at least one failure in time t, is $e^{-t/MTFB}$. If all vehicles in a given activity had the same failure rate using the above assumptions, then the probability of having at least one failure in 200 vehicle-hours is .12 to .25.

Assuming the numerical analysis presented above is flawed (after all, it is based on data which may or may not accurately reflect the components being used in Demonstration '97), we must utilize the fault tree analysis method combined with a rigorous certification process to get better "failure probability" numbers for each live vehicle scenario. Requirements need to be included in the Demonstration Specification which address "robustness" of major vehicle systems along with requirements which assure the safe transition to manual control should failures occur. The experimental systems may not be as reliable as in Table 3-4. They could end up being more reliable. Since the data we have to work with is limited, it is best to assume that the probability of a failure to critical subsystems is "Likely" (see Table 3-2). Therefore a major focus of the safety plan is to ensure that if a failure is experienced, the vehicle design and operational procedures will provide the required safety.

3.5 SAFETY REQUIREMENTS

Safety requirements which will be included in all vehicle certification procedures are documented in the NAHSC Technical Feasibility Demonstration Requirements Specification.

3.5.1 Fault/Hazard Mitigation Form

A form similar to the one shown as Table 3-5 shall be used to document the faults and hazards which are initially classified as catastrophic or critical. Lower-level fault/hazards can be documented if the resources are available.

Table 3-5
Fault/Hazard Mitigation Form

Title of Fault/Hazard : ______________________________

Description: ____
____
____
____
____

Submitted by : ______________________________

Demo Element
- ☐ DPC
- ☐ Infra., Cmd. Ctr., Weather Incident Mgt., Emer. Comm.
- ☐ Veh. Software
- ☐ Veh. Data Link
- ☐ Veh. Hardware
- ☐ Veh. Operations

Scenario
- ☐ Multiplatform Free Agent
- ☐ Platoon
- ☐ Maintenance
- ☐ Truck
- ☐ Control Transition
- ☐ Radar Reflective
- ☐ Evolutionary

Hazard Assessment	
Estimated Probability in 200 Veh. Hrs. (Dress Rehearsals, and Demo)	☐ A. Frequent (>.99) ☐ B. Probable (.90 to .99) ☐ C. Likely (.1 to .9) ☐ D. Remote (.01 to .10) ☐ E. Improbable (<.01)
Seriousness of Consequences	☐ I. Catastrophic ☐ II. Critical ☐ III. Marginal ☐ IV. Negligible
Mitigation	Description
Assessment after Mitigation	☐ A. Frequent ☐ B. Probable ☐ C. Likely ☐ D. Remote ☐ E. Improbable
Remarks	
Status	☐ Open ☐ Closed
Reviewed by	

3.5.2 Hazard List

A hazard list will be produced as a first step in defining safety precautions. Hazards will be identified and listed for:

- The operations involved in each scenario
- The operations involved in coordinating among scenarios
- All possible environmental conditions
- The operations for supporting the demo in general
- Procedures for manual takeover following failures

The hazard list will consider timing errors, communication errors, communication failures, vehicle failures, and so forth. Several examples are given on the next page:

Hazard	Mitigation Approach
Scenario-Specific Hazards *Multiplatform Free Agent Scenario (CMU):* - Front vehicle avoids obstacle too late for second vehicle to acquire and avoid (obstacle hit, or severe maneuver attempted by driver causes skid, etc.) - Emergency vehicle in wrong lane, lane change maneuver creates accident - Lane change at wrong time creating accident with other vehicle - Lateral control is erratic when buses are side by side.	- Set following distance to avoid problem - Verify during vehicle/scenario certification - Obstacle is lightweight, not dangerous threat - Operational procedure to avoid lane confusion - Vehicle certification, operational procedure, scenario monitoring
Platoon (PATH): - Inter-vehicle data-link lost. - Driver intervenes in vehicle braking beyond 0.3 gs	- Vehicle certification - Operational procedures - Operational procedures, driver training
Maintenance (Caltrans; IDV, DRV): - IDV instrumentation indicates unscripted faulty magnet - DRV fails to locate designated debris	- Vehicle maintenance - DRV driver surveys larger section of lane
Heavy Commercial Vehicle (Eaton/Vorad): - Sensor fails to acquire stopped vehicle target	- Minimize time when buses are side by side
Control Transition (Honda): - Change in lateral control sensor disengages lateral control	- Procedure specifies manual braking to start at given roadside marker - Procedure to re-engage lateral control after control error is corrected
Radar Reflective Technology (OSU): - Passing vehicle starts to return to right lane before proper gap has been established	- Driver intervenes and prevents lane change until safe
Evolutionary (Toyota): - Passing vehicle timing is in error and blocks right lane automated vehicle from avoiding obstacle.	- Procedure allows margin for error. Requires achieving desired speed at a pavement marker and gap
Inter-Scenario Hazards - Failure or speed variance in one scenario creates unsafe headway - Failure of inter-demo coordination	- Operational procedure, staff training - Operational procedure, staff training
Environmental Hazards: - Communication interference - Weather (rain, fog, wind gusts) - Accident spill-over (from public lanes) - Unintended obstacle - Low sun angle, glare	- Vehicle cert./verification, operational procedure - Vehicle cert./verification, operational procedure - Jersey barriers, operational procedure - Jersey barriers, demo monitoring, operational procedure
General Demonstration Operational Hazards: - Camera or monitor failure prevents demo monitoring - Distraction impact on manual lanes	- Operational procedure - Operational procedure (e.g., minimize use of flashing lights)
Failure Mode Mitigation Hazards: - Failure mode causes hand-off to driver under unsafe conditions - Obstacle is hit into manual lanes	- Operational procedures, vehicle certification - Jersey barriers

3.5.3 Hazard Analysis

Each hazard identified on the hazard list will be analyzed using the Fault/Hazard Mitigation Form (Table 3-5). The analysis will define the hazard in terms of: description, causal factors, and possible mishaps, probability of occurrence, and seriousness of consequences. It will also be used to define mitigation strategies and requirements for hazard tracking and verification. The Safety Board will review all hazard analyses to ensure that adequate safeguards are planned.

3.5.4 Requirements for Gaps Between Vehicles

The minimum gaps between vehicles will be stated in the scenario scripts. Operationally, these are controlled by the software while under automated longitudinal control and by the driver while under manual control. Safe gap depends on detection time, vehicle decelerations, and speed. Detection time depends on how the failure is detected and on how the trailing vehicle knows about the failure. Hazard analysis by the individual vehicle development teams will lead to spacing requirements that are unique to the given scenario. These requirements are to be verified, for the most part, utilizing the "analysis" test method whereby the vehicle developers will submit documentation which describes why the spacing selected is "safe". An example of one method for doing spacing analysis is included as Appendix B of this document. Analysis provided by vehicle developers will be reviewed by thc Safety Review Team and if deemed acceptable, will go forward to the Safety Board for final approval. This analysis will be combined with a rigorous certification process to verify the satisfaction of the "spacing" requirement.

3.5.5 Operational Safety Procedures

Based on the above analyses, Operational test procedures will be defined for integration within the appropriate test planning documents (e.g., the 1997 Demo Plan, etc.). These procedures will focus specifically on safety matters and will include: (1) tests and/or checks to be conducted at the beginning of each demo day to ensure that all safety critical equipment and functions are working properly; (2) procedures to be implemented within the demo control process to ensure that potential hazards are avoided; (3) procedures to be implemented under anticipated and unanticipated failure and/or hazard conditions (e.g., weather conditions); (4) communications protocols to communicate safety-critical information among demo participants; and (5) emergency procedures for implementation in safety critical situations.

The major required safety procedures are identified below:

- A procedure for verifying at the beginning of each demo day that all safety critical vehicle components (e.g., lateral and longitudinal control components, control logic, communication equipment) are working properly.

- A procedure for ensuring that all safety conditions are met before each scenario is allowed to enter onto the I-15 course, and before automated driving is permitted. This procedure will ensure that: all vehicles in the scenario are ready and operating properly; all communication channels are available and working properly; the scenario to be run is the proper scenario in the plan sequence; that obstacles are absent from the route or properly placed for the scenario starting; and the vehicle occupants are ready to go. If obstacles are to be placed or removed during the scenario (after it is underway), the procedures will ensure that the obstacle placer is in position to properly place or remove the obstacle, is aware of the proper obstacle placement/condition for the scenario and is not exposed to automated traffic.

- A procedure for ensuring that the Command Center is made aware of all major state changes for each scenario, and for tracking these states. State changes will include: scenario ready to start; scenario starting; major scenario events starting/ending; vehicles reaching passenger loading/unloading point.

All operational safety procedures will be defined in the Operations Plan and the Live Demo Procedures Plan and implemented to ensure safety of all dress rehearsals and demo runs.

They will also be applied during dry runs. During the dry runs the safety procedures will serve to ensure safety, but will also be verified and fine-tuned to ensure they are efficient and effective for providing safeguards against mishaps.

Because Demonstration '97 will involve new technology implemented with experimental equipment, careful definition and implementation of safety procedures will serve a critical role for ensuring safety.

3.5.6 Driver Qualifications and Training Plans

Based on the hazard analyses and operational test procedures, training plans will be made for ensuring that demo staff are adequately prepared for safe demo conduct and for implementing all defined safety procedures. This will include training for all drivers, vehicle communicators, Command Center operators, operators at the North and South Yards, and all support staff (e.g., obstacle placers, incident response team, etc.)

Drivers will need experience in safe, high-speed maneuvering of vehicle in close quarters. They will have demonstrated skill in rapidly exercising good judgment in handling contingencies similar to some of those arising in race car driving. They also will have previous experience in integrated testing of experimental vehicles. Previous testing experience is probably more important since extreme racing-type maneuvering should not be required under any circumstances, but executing the proper procedure following a failure could very well be necessary. The logical candidates would be the drivers involved in the vehicle's development with the most time in the vehicle at highway speeds. Driver backups will be needed.

The major training objectives are identified below:

- All demo staff must understand relative responsibilities for implementing emergency safety procedures and the conditions under which they should be used. These procedures will be defined based on the operational hazard analysis to be accomplished during the implementation of this safety plan.
- Demo staff must be able to implement all emergency procedures including associated communication actions.
- Vehicle drivers must be familiar with and skilled in the operation of the vehicle(s) they will be "driving" including the operation and monitoring of all automated vehicle control systems and in the implementation of emergency procedures (e.g.,

re-taking manual control). They should also have sufficient hands-on experience operating the vehicle(s) so that they are able to readily recognize uncharacteristic vehicle performance that could lead to failure conditions.

- Vehicle drivers must be practiced in re-taking vehicle control following a hard-over steering failure and a hard-over throttle failure.
- Command Center operators must understand and be able to implement procedures for monitoring scenario progress and be able to recognize failure and/or hazardous situations (e.g., correlate voice reports and video monitors to ensure safe spacing between scenarios, verify correct obstacle status/location).
- The vehicle communicators must understand and use proper protocol to convey messages that are brief and unmistakable.
- Obstacle placers must be fully familiar with all aspects of the scenarios in which they will be participating and particularly obstacle placement/removal and associated communication requirements. This will include participating in sufficient dry runs prior to actual live-demo operation to ensure error-free operation.

The Vehicle Production Safety Officer must understand all procedures and protocols for communication and coordination among scenario participants throughout all scenarios, and be able to communicate with the Command Center as necessary to convey safety concerns and to obtain needed safety and scenario status information. This person must be sufficiently familiar with scenario and daily plans to be able to recognize error conditions and potentially hazardous conditions.

The training will be accomplished by the organizations participating in the demo in conjunction with the System Integration activity. It will consist of written material, briefings, remote site vehicle testing, demo site dry runs and dress rehearsals.

3.5.7 Incident Management

Caltrans will provide incident management plans to include requirements for fire fighting, emergency medical response, and vehicle/debris removal. These plans will define conditions under which events in the manual lanes will affect activity in the HOV lanes.

3.6 VEHICLE CERTIFICATION PROCEDURE

Vehicle certification will depend, at this stage, on existing design information and analysis and testing that has already been done or can be done in the months of February and March by the vehicle suppliers. The required certification procedures, produced by the Certification / Safety Review Team and reviewed with all vehicle developers should include the following:

1. Review vehicle top-level design and detailed design as necessary to understand how critical control systems can fail.
2. Review documentation such as hazard analyses, high level fault tree analysis, hazard mitigation actions, and test results to determine likelihood of critical failure.
3. Observe (or review results of) the required hard-over tests.
4. Run certification tests to include the following:
    - manual control
    - check-in tests
    - engagement
    - acceleration to scenario speed
    - lane change if applicable
    - obstacle detection and avoidance if applicable
    - maximum acceleration at scenario speed
    - maximum automated deceleration
    - automated acceleration to scenario speed
    - exposure to repeatable EMI from roadside and overpass
    - EMC with vehicle communication
    - normal disengagement at scenario speed

- re-engagement at scenario speed
- disengagement by manual braking action

5. Examine vehicle configuration control procedures for hardware and software.
6. Safety Review Team submits a summary of findings to the Safety Board.
7. The Safety Board provides approval to dry run.
8. Conduct individual and vehicle-following runs on the I-15 Demo lanes.
9. Conduct dry runs of demonstration scenarios.
10. Safety Board approval (in consultation with the PMC) to demonstrate the vehicle in scenario as tested.

3.7 MINI-DEMONSTRATIONS

Providers are required to provide safety information as specified in Table 3-6. General safety requirements stated below.

Table 3-6
MINI-DEMONSTRATION SAFETY APPLICATION*

<u>On-site information required (for vehicles that will not be demonstrated on public roads)</u>

1. Description of vehicle, systems to be demonstrated, scenario to be demonstrated, requirement for personnel inside the protective perimeter.
2. Brief description of failure modes and procedures following failure.
3. System maturity, development history, and testing history.

<u>Off-site information required (for vehicles that will be demonstrated on public roads)</u>

1. Same as on-site plus testing history on public roads in the vehicle demonstrated.

* Required if system manipulates vehicle controls.

3.7.1 On-Site Demonstration

A barrier-protected area will be provided at Miramar College for dynamic vehicle demonstrations. This area will be contained within an existing five-acre paved parking lot. Vehicles and operations will meet the following requirements:

1. Spectators will be kept outside the barrier when vehicles are operated. (They will be easily able to view the action).
2. Vehicle speeds must be appropriate for a parking lot.
3. Demonstrations will be sequential rather than simultaneous and will involve only single vehicles or two vehicles with one operated manually by test personnel.
4. There must be at least one way for the driver and one independent way for test personnel to quickly cause transition to the manual mode.

3.7.2 Off-site Demonstrations

On-road demonstrations are also permitted for vehicles that have met common highway-operational prototype safety criteria and have been tested successfully in public road operation. Passengers for these demonstrations will be loaded and unloaded at the Exposition Center. On-road demonstration vehicles must be properly licensed and equipped to operate on California roads. These demonstrations will be preferably conducted on non-residential roads. If automated systems which directly control vehicle motion are not involved in the particular demonstration, the feature may be demonstrated off-site, as long as it has a valid license, without meeting further safety requirements. Demonstrations that involve automated vehicle control, must have successfully demonstrated safe operation on public roads. An example of an acceptable off-site vehicle control system demonstration is an Intelligent Cruise Control system that has many hundreds of hours of public road testing with pre-production hardware that has been thoroughly tested for failure characteristics.

4.0 DOCUMENTATION

The following documentation is planned:

1. Fault/Hazard Mitigation Forms - single sheets as in Table 3-5 describing mitigation of the major faults and hazards for each vehicle and scenario. These are to be prepared by the Safety Review Team, the vehicle/scenario participants, and all other interested parties.

2. Safety Assessment Report - a summary of the hazard analysis results and the vehicle certification documentation prepared by the Safety Review Team for the Safety Board.

3. Vehicle/Scenario Certification Applications - a collection of all documents furnished by the vehicle providers as evidence that the vehicle and the scenario are safe to demonstrate on I-15. This package will include the results of all certification runs.

4. Mini-Demo Application - to include information as in Table 3-6 to apply for either parking lot or on-road demonstration.

5. Software Change Notices - logs of software changes and re-testing to be maintained by each participant from the time of vehicle certification.

6. Maintenance and Repair Logs - logs of hardware removals and replacements, inspections and repairs to be maintained by each participant after vehicle certification.

7. Dry-Run and Dress Rehearsal Failure Log - log of failures while operating on I-15 from the time of vehicle/scenario certification to the start of demonstrations.

5. SCHEDULE

Figure 5.1 shows the schedule for the Safety Plan implementation. Figure 5.2 shows how each scheduled task flows from one to another. The task flow has been laid out to provide sufficient time for adequate thoroughness, aggressive enough to permit completion within the tight demo schedule. The tasks build from initial analyses and draft plans to definition of final procedures and implementation of defined safety precautions. Safety reviews are scheduled at key points to facilitate review of safety plans and coordination with other parallel demo planning efforts.

	Start	End	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Draft Safety Plan	11/25/96	1/24/97								
Final Safety Plan	1/15/97	2/15/97								
Oper. Hazard Analysis										
Hazard List	2/15/97	3/17/97								
Hazard Analysis	3/17/97	4/24/97								
Operational Safety Procedures & Training	4/1/97	5/25/97								
Demo Vehicle Safety Certification										
Preparation	2/15/97	4/1/97								
Certification	4/1/97	7/19/97								
Demo Dry Runs	5/1/97	7/19/97								
Safety Assessment Report										
Draft	3/15/97	3/30/97								
Final	4/1/97	4/30/97								
Dress Rehearsals	7/20/97	8/4/97								
Live Demo	8/7/97	8/10/97								
Safety Reviews										
Draft Safety Plan Wrapup		1/15/97								
Prelim. Safety Review		4/2/97								
Critical Safety Review		7/19/97								

Figure 5-1 SAFETY PLAN IMPLEMENTATION SCHEDULE

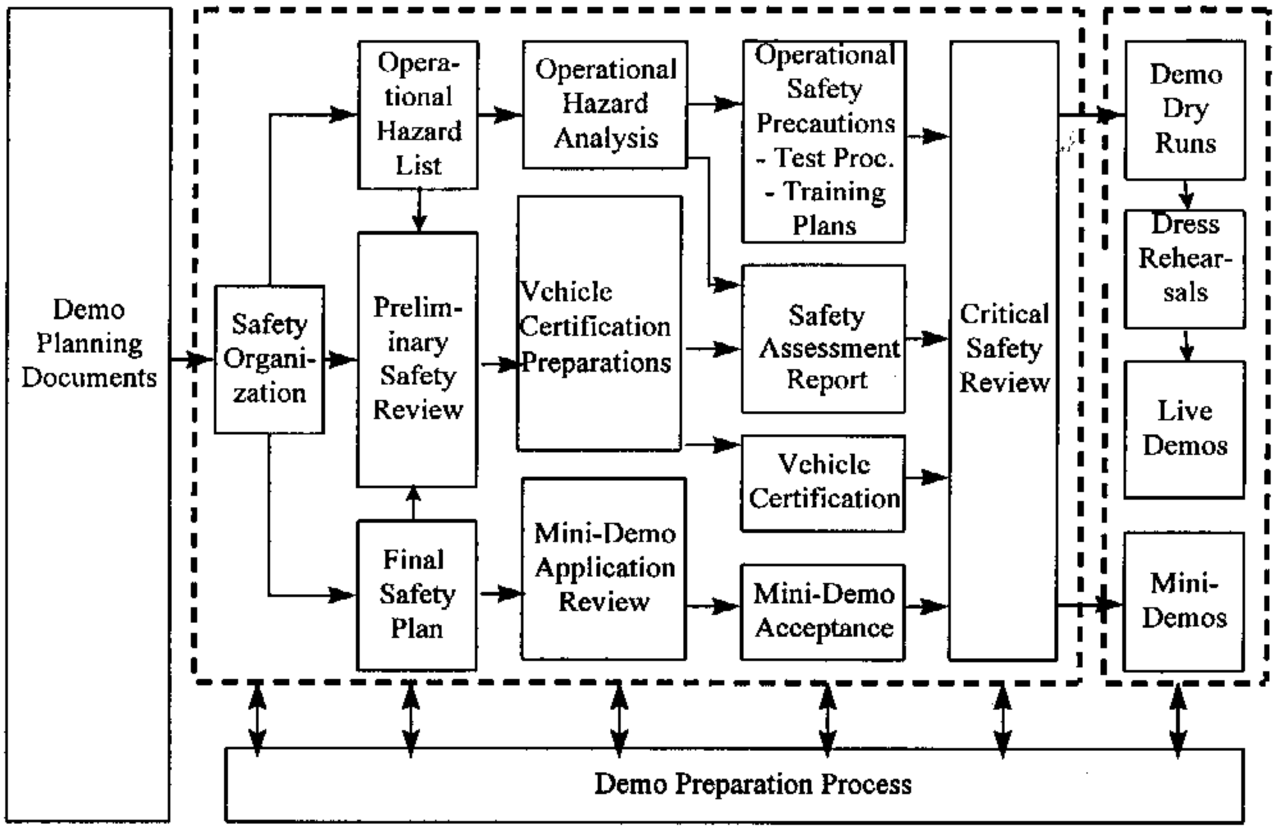


Figure 5-2 SAFETY TASK FLOW

6. ISSUES AND RECOMMENDATIONS

6.1 NO-COLLISION GAPS

Will all single failures be fully mitigated i.e. no collision is predicted? According to available data, safe full manual braking such as would be necessary in the event of an unplanned obstacle requires a gap of 25 to 30 meters at 60 mph.

This safety plan recommends this minimum spacing for all but the platoon scenario which is designed to demonstrate the feasibility of smaller gaps. Here the "unplanned obstacle" criterion can be relaxed but full automated deceleration or acceleration should result in no-collision.

6.2 PASSENGER BRIEFINGS AND WAIVERS

It is imperative that all passengers understand the risks of riding in experimental vehicles and be required to sign an informed consent document. It can be done as a routine part of registration and the briefing prior to each run.

6.3 PASSENGER RESTRAINTS

All vehicles in Demonstration '97 must be equipped with appropriate safety gear as mandated by law. This means passenger vehicles and trucks must have seat belts and shoulder harnesses. Automated transit vehicles will not be required to "force fit" seat belts in vehicles not designed to incorporate them but will implement appropriate measures to ensure the safety of their passengers.

6.4 EMI FROM MANUAL LANES

This Plan recommends that potential interference from EMI be tested. The safety organization should then determine and apply appropriate safety measures as needed. These cases should include the airborne radar from nearby Miramar NAS, high-powered truck CB broadcast and commercial radar/IR scramblers.

6.5 SOFTWARE LOADING

The recommendation is that all volatile and/or non-volatile memory be checked with a checksum. If possible, other components such as A/D's, D/A's should be checked with a simple built-in test (BIT).

6.6 MODE TRANSITION

Since manual mode reversion is a major safety measure for this activity, the recommendation is that driver-activated transition be software-independent and that computer-activated transition software be specially protected against unintended changes. Such software should be tested frequently using BIT. Transition to manual control should be accompanied by an audio tone as well as an independent light to ensure that the driver will take control immediately. It should also be very improbable that the automated mode become engaged without driver action.

7.0 REFERENCES

1. NTSA Order 700-1, November 4, 1981, "Protection of the Rights and Welfare of Human Subjects in NHTSA-Sponsored Experiments.
2. 45 CFR Subtitle A (10-1-93 Edition) Department of Health and Human Services; "Part 46 - Protection of Human Subjects".
3. 49 CFR Subtitle B (10-1-93 Edition), Chapter V NHTSA, "Part 571 Federal Motor Vehicle Safety Standards"
4. SAE Standards Vol. 3, Sections 28-34, 36.
5. "Caltrans Procedures and Guidelines for Research of the I-15 Reversible HOV Lanes," copy transmitted to the authors, January 1997.
6. Delco System Operations, "Precursor Systems Analyses of Automated Highway Systems, Activity Area L, Vehicle Operational Analysis," November 1994, page 42.
7. Military Standard; "System Safety Program Requirements," MIL-STD-882B March 1984.
8. Calspan SRL Corporation, Precursor Systems Analyses of Automated Highway Systems, Activity E, Malfunction Management and Analysis;" November 1994.
9. Calspan SRL Corporation, "Precursor Systems Analyses of Automated Highway Systems, Activity Area J, Entry/Exit Implementation," November 1994.

Appendix A
VEHICLE FAULT AND HAZARD CHECKLIST

1. Passenger Compartment
   - mounting of passenger-compartment equipment has strength inadequate to withstand collision inertia loads
   - automation equipment can be easily hit or disturbed by passengers
   - equipment inside the passenger compartment is unmounted or unrestrained

2. New or Modified Controllers, Switchology, Lights, Indicators
   - becomes inoperable due to internal failure, external foreign objects or dirt
   - feel or tactile cue controller malfunctions
   - controller interferes with access to critical controls
   - driver unable to reach system-disengage device easily and quickly
   - driver unable to see lights, displays, lighted buttons or indicators due to sunlight, temporary line of sight blockage, etc.
   - controls, lights, etc. difficult to properly interpret or can be used improperly

3. Primary Automated Control Systems - Throttle, Brakes, Steering, Transmission, Other

   In the following components:

   a) all single failures mitigated by:
      - automatic detection and action
      - driver detection and action
      - automatic detection and driver action
      - detection by maintenance action and failure shown to cause no significant hazard for the time it remains undetected.

   b) all EMC/EMI hazards mitigated

      Subsystem List

      1) Sensors
         - linear position, rate, acceleration
         - angular position, rate, acceleration
         - position relative to lanes
         - position relative to other vehicles
         - other sensors affecting control laws
      2) sensor analog signal processors
      3) sensor A/D conversion

4) data link from other vehicles
5) data or discrete signals from the infrastructure
6) digital processing hardware, software, algorithms, etc.
7) actuator command D/A conversion
8) actuator command analog data processors
9) actuator subsystems
10) actuator monitoring
11) mode switching units
12) mode switching commands
13) mode switching monitoring

4. <u>Mode Switching</u>

System must avoid failures associated with mode switching such as:

- not able to transition from automated to manual
- manual mode engaged but automated mode not disengaged
- mode switching causes hazardous transients
  - normal manual engagements and disengagements
  - automatic disengagements with and without preceding driver input or override

5. <u>Cooling</u>

- computer or other heat-sensitive subsystems cooling inadequate
- cooling provisions fail

6. <u>Hydraulic Subsystem</u>

- leak in automation equipment causes loss of basic vehicle function
- pressure shock fatigue causes leak or rupture
- increased hydraulic load causes source malfunction
- source malfunction causes both automated and basic vehicle failures simultaneously

7. <u>Electrical Subsystems</u>

- failure of any non-standard power source causes multiple simultaneous automation system faults.
- failure of any non-standard power source interferes with manual control or transition from automated to manual control
- power source failure causes hazard to vehicle occupants
- high voltage not adequately protected

- short in power distribution causes smoke or fire hazard

8. Warnings, Alarms, or Procedures
    - no single failure should prevent critical visual or audio annunciations unless that failure is otherwise immediately obvious to the driver.
    - no single event or failure shall prevent the driver from executing the primary and the backup takeover procedure, short of driver incapacitation.

9. Software
    - top-down design not accomplished or not revealed (may restrict last minute software modifications)
    - unit testing not adequately documented
    - system testing not adequately documented
    - software failures (data link problems, infinite loop, improper branching, frame overrun, division by zero, etc.) not mitigated by techniques such as:
        - watchdog timer
        - stale data check
        - check sums
        - parity checks
        - value reasonableness checks
        - output value limits
        - output rate limits
        - error correcting codes
    - version control inadequate

10. Wiring and Circuitry
    - chafing hazard
    - wires exposed to flexing or external damage
    - power grounding biasing signal
    - circuit cards vibrate
    - wires not properly attached to connectors
    - high humidity causes circuit card malfunction
    - high local temperatures cause circuit problems
    - short causes loss of signal

11. Data Link
    - Frame time or data latency too long for gap proposed
    - Data transmitted inadequate for gap proposed
    - Handshaking protocol inadequate
    - Drop-out protocol causes automation disengagement
    - Link controller versus passive role as link terminal
    - Vehicle position in string and addressing protocol

Added Questions for Vehicle Developers

1) Passenger Compartment

   no additional items

2) New or Modified Controllers, Switchology, Lights, Indicators
   - What happens to feel of steering wheel, brakes, and throttle after system engagement and what produces the change? After disengagement?
   - Can driver see and/or feel control action? Can driver overpower system?
   - Can driver superimpose his/her inputs on the system inputs without system disengagement?
   - How is manual disengagement caused?
   - Where should driver place hands when system is engaged?

3) Primary Automated Control System
   - Have any system components been produced in quantity and have known reliability?
   - What data words and discretes are on the vehicle data link at what frame rate?
   - What happens on the data link on manual takeover or disengagement?
   - Can data link errors cause hard-overs?
   - What is data link range? Can dropouts cause hard-overs?

4) Mode Switching
   - Does mode switching require software? How is that software integrity assured?
   - Do mode switching analog component failures always result in return to the normal manual control?

5) Cooling
   - Cooling from an external source required when vehicle is at the dock in ambient temperature above some limiting value?
   - At what ambient temperature is vehicle air conditioning inadequate to cool both occupants and computers?

7) Hydraulic Subsystem

   no additional items

8) Warnings, Alarms and Procedure

   no additional items

9) Software

   - Have end-to-end time delays been tested?
   - What is a top-level time line for real time execution during system engagement? Is the data link synchronized with the control law processor? Are A/D's and D/A's synchronized with that processor?
   - How is the frame rate and can it be changed?
   - Can control laws be changed while the system is engaged? While vehicle is under manual operation?
   - Can test input files be executed inadvertently?

10) Wiring and Circuitry

   no additional items

11) Data Link

   - Can the data link faults cause braking hard-overs?
   - Do all vehicles at close head-ways receive and process data from all other vehicles simultaneously or within one processor frame?

Appendix B

POTENTIAL FORMULAS FOR DETERMINING COLLISIONS OF VEHICLES IN TRAIL

Actual time histories of the initiation of a braking or a throttle hard-over must be examined, along with the typical data link behavior, to enter simple collision analysis. Knowing equivalent constant and equal decelerations D with time lag τ, the minimum gap to avoid any collisions or to avoid a second collision at a given speed V can be estimated. Equal-deceleration cases are important since this control action mimics the automated behavior in a non-failure condition. Unequal decelerations are analyzed in Ref. 9. The formula for no-collision gap is given below.

Table B-1 indicates the formulas relating collision relative velocity and time of collision to gap, deceleration, time delay and speed for vehicles in trail. These formulas apply to situations where all vehicles have the same deceleration and where all trailing vehicles start decelerating at the same time but τ seconds after the first vehicle involved starts decelerating.

For the situation where vehicles have unequal decelerations, the gap to avoid collision is

$$s = \left(\left(D_1 - D_2\right)V^2 / 2D_1D_2\right) + V\tau$$

where s = gap between vehicles

D_1 = equivalent constant deceleration of the vehicle ahead

D_2 = equivalent constant deceleration of the vehicle behind

V = initial common speed of vehicles

τ = time delay between the leading and following vehicle deceleration

Table B-1
SINGLE COLLISION CRITERIA
FOR EQUAL DECELERATION OF
TWO OR MORE VEHICLES WITH $V \geq D\tau$

Case	Range of Gap	Time of Collision	ΔV	First Collision	Gap to Avoid Between Veh. 3 and Veh. 2
Collision before Veh. 2 starts to decelerate	$0 < s \leq D\tau^2/2$	$t_c = (2S/D)^{1/2}$	$(2Ds)^{1/2}$	Inelastic	$s > D\tau^2(2k+1-(4k+1)^{1/2})/4k^2$ where $k = 5D\tau/8V$
				Elastic	Cannot avoid for $V > D\tau$ For $V = D\tau$ can avoid with $s = D\tau^2/2$
Collision after Veh. 2 starts to decelerate but before Veh. 1 stops	$\frac{D\tau^2}{2} < s \leq \tau V - D\frac{\tau^2}{2}$	$\tau_c = (s/D\tau) + \tau/2$	$D\tau$	Inelastic	$s > (V\tau/3) + D\tau^2/12$
				Elastic	$s > V\tau/2$
Collision after Veh. 1 stops	$\tau V - \frac{D\tau^2}{2} < s \leq \tau V$	$\tau_c = (V/D + \tau) - (2(V\tau - s))/D)^{1/2}$	$(2D(\tau V - s))^{1/2}$	Inelastic	No second collision
				Elastic	No second collision

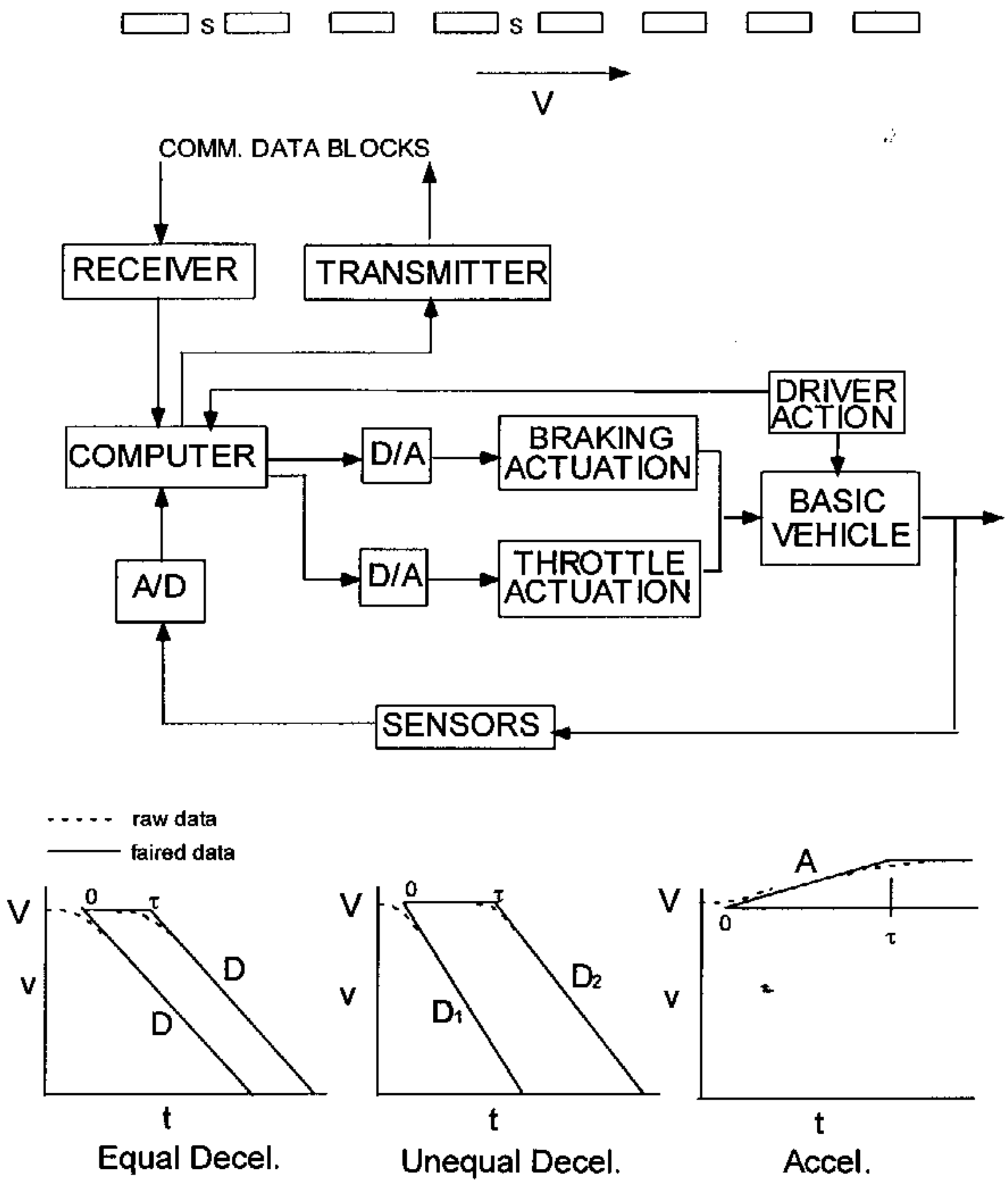


Figure B-1 GENERAL BLOCK DIAGRAM AND TIME HISTORIES FOR CLOSE HEADWAY SAFETY ANALYSIS

APPENDIX E Demo '97 Media Coverage Summary Sample

VMS
VIDEO MONITORING SERVICES OF AMERICA, L.P.
1000 National Press Building
Washington, DC 20045
(202) 393-7110
(202) 393-6467

New York (212) 736-2010
Detroit (810) 352-3220
Denver (303) 777-4000
Los Angeles (213) 857-0111
Boston (617) 266-2121
Hartford (860) 236-6552
Chicago (312) 663-1131
Dallas (214) 644-9636
San Diego (619) 544-1850
Philadelphia (215) 659-6330
Houston (713) 780-1636
San Francisco (415) 543-3391
Miami (305) 678-3581

(Radio + Cable incl.)

Broadcast Schedule

DEMO '97: AUTOMATED HIGHWAY COVERAGE
7/22 To 8/20

1)	World News Now ABC Network Programming	7/23/97	3:00-5:00 AM
2)	All News Channel All News Channel Cable Programming	8/6/97	5:30-6:00 PM
3)	CBC Morning News CBC Network Programming	8/8/97	8:00-9:00 AM
4)	Late Show with David Letterman CBS Network Programming	7/23/97	11:35-12:35 AM
5)	Up To The Minute CBS Network Programming	7/24/97	2:00-4:00 AM
6)	CBS This Morning CBS Network Programming	7/24/97	8:00-9:00 AM
7)	CBS Morning News CBS Network Programming	8/7/97	5:30-6:00 AM
8)	CBS This Morning CBS Network Programming	8/7/97	8:00-9:00 AM
9)	CBS Evening News CBS Network Programming	8/7/97	6:30-7:00 PM
10)	Up To The Minute CBS Network Programming	8/8/97	2:00-4:00 AM
11)	CBS Morning News CBS Network Programming	8/8/97	5:30-6:00 AM
12)	CBS This Morning CBS Network Programming	8/8/97	7:00-8:00 AM
13)	Power Lunch CNBC Cable Programming	7/23/97	12:30-2:00 PM
14)	Early Edition CNN Cable Programming	7/23/97	7:00-8:00 AM
15)	News/Future Watch CNN Cable Programming	8/9/97	4:30-5:00 AM
16)	Fox News Now/The Schneider Report Fox News Channel Cable Programming	7/25/97	7:00-8:00 PM
17)	Fox News Now/Fox On Health Fox News Channel Cable Programming	7/26/97	12:00-2:00 PM
18)	Fox News Now/Fox On Money Fox News Channel Cable Programming	7/26/97	4:00-6:00 PM
19)	Headline News CNN Headline News Cable Programming	7/23/97	7:00-7:30 AM
20)	Headline News CNN Headline News Cable Programming	7/23/97	2:00-2:30 PM
21)	Headline News CNN Headline News Cable Programming	7/23/97	7:30-8:00 PM
22)	News MSNBC Cable Programming	7/22/97	2:00-3:00 PM
23)	The Site Weekend MSNBC Cable Programming	8/9/97	7:00-8:00 PM
24)	Nightside NBC Network Programming	7/22/97	3:00-5:00 AM
25)	Nightside NBC Network Programming	7/23/97	3:00-5:00 AM
26)	NBC News at Sunrise NBC Network Programming	7/23/97	5:30-6:00 AM
27)	Nightside NBC Network Programming	8/7/97	3:00-5:00 AM
28)	The Newshour with Jim Lehrer PBS Network Programming	8/8/97	7:00-8:00 PM
	All Things Considered NPR Network	8/6/97	4:00-6:00 PM
30)	The Osgood File WBBM-AM (CBS) Freq. 780 Syndicated	7/23/97	7:40-7:45 AM
31)	Paul Harvey WMAL-AM (ABC) Freq. 630 Syndicated	7/28/97	11:45-12:00 PM
32)	Channel Two News At Eleven WCBS-TV (CBS) CH 2 New York	7/23/97	11:00-11:35 PM
33)	Channel Two News At Noon WCBS-TV (CBS) CH 2 New York	7/24/97	12:00-12:30 PM
34)	NewsChannel 4 New York WNBC-TV (NBC) CH 4 New York	7/22/97	11:00-11:35 PM
35)	Today In New York WNBC-TV (NBC) CH 4 New York	07/23/97	5:28-7:00 AM
36)	Eyewitness News KABC-TV (ABC) CH 7 Los Angeles	8/7/97	6:25 AM
37)	Newsline KCET-TV (PBS) CH 28 Los Angeles	7/22/97	7:28-7:30 PM
38)	Channel 4 News KNBC-TV (NBC) CH 4 Los Angeles	7/23/97	6:00-6:30 PM
39)	Channel 4 News KNBC-TV (NBC) CH 4 Los Angeles	8/7/97	5:00-6:00 PM
40)	Orange County News OCN CABLE Los Angeles	7/23/97	4:00-5:00 PM
41)	Minyard & Tilden Show KABC-AM (ABC) Freq. 790 Los Angeles	7/24/97	5:00-7:00 AM
42)	Minyard & Tilden Show KABC-AM (ABC) Freq. 790 Los Angeles	8/6/97	7:00-9:00 AM
43)	KFWB News 98 KFWB-AM (Ind) CH 980 Los Angeles	8/6/97	6:00-7:00 AM
44)	KNX 1070 NewsRadio KNX-AM (CBS) CH 1070 Los Angeles	7/23/97	6:00-7:00 AM
45)	WLS-AM News WLS-AM (ABC) CH 890 Chicago	7/23/97	6:00-6:10 AM
46)	The Channel 2 News At 4:30 WBBM-TV (CBS) CH 2 Chicago	08/07/97	4:30-5:30 PM
47)	The Channel 2 News At Ten WBBM-TV (CBS) CH 2 Chicago	8/7/97	10:00-10:30 PM
48)	Channel 2 News This Morning WBBM-TV (CBS) CH 2 Chicago	8/8/97	5:00-6:00 AM
49)	Channel 2 News Morning Show WBBM-TV (CBS) CH 2 Chicago	8/8/97	6:00-7:00 AM
50)	Fox Thing in the Morning WFLD-TV (Fox) CH 32 Chicago	7/23/97	7:00-8:00 AM
51)	7 News WLS-TV (ABC) CH 7 Chicago	08/07/97	6:00-7:00 AM
52)	5 News at 6:00 WMAQ-TV (NBC) CH 5 Chicago	7/27/97	6:00-7:00 AM
53)	News 3 This Morning KYW-TV (CBS) CH 3 Philadelphia	7/23/97	6:00-7:00 AM
54)	News 10 WCAU-TV (NBC) CH 10 Philadelphia	7/22/97	5:00-6:00 PM
55)	News 10 WCAU-TV (NBC) CH 10 Philadelphia	7/23/97	6:00-7:00 AM
56)	News 10 WCAU-TV (NBC) CH 10 Philadelphia	7/23/97	11:00-12:00 PM
57)	Bay TV Mornings BAY-TV Cable CH 35 San Francisco	7/23/97	7:00-8:00 AM
58)	Channel 7 News KGO-TV (ABC) CH 7 San Francisco	7/23/97	5:30-7:00 AM
59)	KNTV News Nightside KNTV-TV (ABC) CH 11 San Jose	8/6/97	11:00-11:30 PM
60)	Eyewitness News Nightcast KPIX-TV (CBS) CH 5 San Francisco	7/23/97	10:00-11:00 PM
61)	Eyewitness News This Morning KPIX-TV (CBS) CH 5 San Francisco	7/24/97	7:00-9:00 AM
62)	7 News WHDH-TV (NBC) CH 7 Boston	7/22/97	11:00-11:30 PM

63)	7 News Morning Edition WHDH-TV (NBC) CH 7 Boston	7/23/97	6:00-7:00 AM
64)	7 News WHDH-TV (NBC) CH 7 Boston	7/23/97	12:00-1:00 PM
65)	News WTOP-AM (CBS) CH 1500 Washington	7/23/97	6:00-7:00 AM
66)	News 7 at 6:00 PM WJLA-TV (ABC) CH 7 Washington	7/23/97	6:00-6:30 PM
67)	News 7 at 11:00 PM WJLA-TV (ABC) CH 7 Washington	7/23/97	11:00-11:35 PM
68)	Good Morning Washington WJLA-TV (ABC) CH 7 Washington	7/24/97	5:30-6:00 AM
69)	News 4 Today WRC-TV (NBC) CH 4 Washington	7/23/97	6:30-7:00 AM
70)	Fox Morning News WTTG-TV (Fox) CH 5 Washington	7/25/97	5:30-6:30 AM
71)	Eyewitness News At 4 WUSA-TV (CBS) CH 9 Washington	7/23/97	4:00-5:00 PM
72)	11 News This Morning KTVT-TV (CBS) CH 11 Dallas	7/24/97	6:00-8:00 AM
73)	11 News At Ten KTVT-TV (CBS) CH 11 Dallas	08/07/97	10:00-10:30 PM
74)	11 News This Morning KTVT-TV (CBS) CH 11 Dallas	8/8/97	6:00-8:00 AM
75)	Texas News 5 at Five KXAS-TV (NBC) CH 5 Dallas	07/22/97	5:00-5:30 PM
76)	Texas News 5 at Ten KXAS-TV (NBC) CH 5 Dallas	7/22/97	10:00-10:30 PM
77)	Texas News 5 The Morning Report KXAS-TV (NBC) CH 5 Dallas	7/23/97	5:00-7:00 AM
78)	Texas News 5 at Noon KXAS-TV (NBC) CH 5 Dallas	7/23/97	12:00-1:00 PM
79)	KVIL News Cut-ins KVIL-AM (Ind) CH 103 Dallas	7/23/97	7:00-9:00 AM
80)	Automotive Report WJR-AM (ABC) Freq. 760 Detroit	8/8/97	5:55 AM
81)	Newscenter WJR-AM (ABC) CH 760 Detroit	8/8/97	6:00-6:30 PM
82)	Automotive Report WJR-AM (ABC) Freq. 760 Detroit	8/18/97	5:55 AM
83)	Newscenter WJR-AM (ABC) CH 760 Detroit	8/18/97	6:00-6:30 PM
84)	Newsbeat Today WDIV-TV (NBC) CH 4 Detroit	7/23/97	6:30-7:00 AM
85)	Eyewitness News PrimeTime WAGA-TV (Fox) CH 5 Atlanta	7/24/97	10:00-11:00 PM
86)	Good Day 6:00 AM WAGA-TV (Fox) CH 5 Atlanta	7/25/97	6:00-7:00 AM
87)	11 News at Six KHOU-TV (CBS) CH 11 Houston	7/23/97	6:00-6:30 PM
88)	11 News at Ten KHOU-TV (CBS) CH 11 Houston	7/28/97	10:00-10:35 PM
89)	News 2 Houston First at Five KPRC-TV (NBC) CH 2 Houston	7/23/97	5:00-6:00 AM
90)	News 2 Houston Daybreak KPRC-TV (NBC) CH 2 Houston	7/23/97	6:00-7:00 AM
91)	Eyewitness News at 11:30 AM KTRK-TV (ABC) CH 13 Houston	8/7/97	11:30-12:00 PM
92)	Channel 3 News At Noon WKYC-TV (NBC) CH 3 Cleveland	7/23/97	12:00-1:00 PM
93)	KARE 11 News KARE-TV (NBC) CH 11 Minneapolis/St. Paul	7/22/97	5:00-5:30 PM
94)	KARE 11 News KARE-TV (NBC) CH 11 Minneapolis/St. Paul	7/22/97	10:00-10:40 PM
95)	KARE 11 First Edition KARE-TV (NBC) CH 11 Minneapolis/St. Paul	7/23/97	5:00-6:00 AM
96)	KARE 11 Sunrise KARE-TV (NBC) CH 11 Minneapolis/St. Paul	7/23/97	6:00-7:00 AM
97)	The News At Noon WCCO-TV (CBS) CH 4 Minneapolis/St. Paul	8/7/97	12:00-12:30 PM
98)	KING Five News At Five KING-TV (NBC) CH 5 Seattle	7/22/97	5:00-6:00
99)	CBS This Morning KIRO-TV (CBS) CH 7 Seattle	7/23/97	7:00-9:00 AM
100)	KIRO News At Eleven KIRO-TV (CBS) CH 7 Seattle	7/23/97	11:00-11:30 PM
101)	KOMO News Four KOMO-TV (ABC) CH 4 Seattle	7/22/97	11:00-11:30 PM
102)	WB News at Ten WDZL-TV (WB) CH 39 Miami	7/22/97	10:00-10:30 PM
103)	Channel 6 News WTVJ-TV (NBC) CH 6 Miami	7/22/97	11:00-11:30 PM
104)	Today In South Florida WTVJ-TV (NBC) CH 6 Miami	7/23/97	5:30-6:00 AM
105)	Today In South Florida WTVJ-TV (NBC) CH 6 Miami	7/23/97	6:30-7:00 AM
106)	News At Midday WTVJ-TV (NBC) CH 6 Miami	7/23/97	11:00-12:00 PM
107)	Newschannel 8 At 11 WFLA-TV (NBC) CH 8 Tampa/St. Pete.	7/22/97	11:00-11:30 PM
108)	Newschannel 8 Sunrise WFLA-TV (NBC) CH 8 Tampa/St. Pete.	7/23/97	5:30-6:00 AM
109)	Newschannel 8 Morning Edition WFLA-TV (NBC) CH 8 Tampa/St. Pete.	7/23/97	6:00-7:00 AM
110)	Channel 11 News Nightbeat WPXI-TV (NBC) CH 11 Pittsburgh	7/22/97	11:00-11:35 PM
111)	Action News 4 WTAE-TV (ABC) CH 4 Pittsburgh	7/23/97	5:30-6:00 AM
112)	Action News 4 WTAE-TV (ABC) CH 4 Pittsburgh	7/23/97	6:30-7:00 AM
113)	Action News 4 WTAE-TV (ABC) CH 4 Pittsburgh	7/23/97	5:00-6:00 PM
114)	Action News 4 WTAE-TV (ABC) CH 4 Pittsburgh	7/26/97	9:00-10:00 AM
115)	Action News 4 WTAE-TV (ABC) CH 4 Pittsburgh	7/26/97	11:00-12:00 P
116)	Action News 4 WTAE-TV (ABC) CH 4 Pittsburgh	8/7/97	5:30-6:00 AM
117)	Action News 4 WTAE-TV (ABC) CH 4 Pittsburgh	8/7/97	6:30-7:00 AM
118)	Your News This Morning KMOV-TV (CBS) CH 4 St. Louis	7/23/97	6:00-7:00 AM
119)	Your News This Morning KMOV-TV (CBS) CH 4 St. Louis	7/24/97	6:00-7:00 AM
120)	Newschannel 5 Today In St. Louis At Five-7 KSDK-TV (NBC) CH 5 St. Louis	7/23/97	5:30-7:00 AM
121)	Newschannel 5 At Noon KSDK-TV (NBC) CH 5 St. Louis	7/23/97	12:00-1:00 PM
122)	2 News At Six KTVI-TV (Fox) CH 2 St. Louis	7/23/97	6:00-6:30 PM
123)	Channel Three Reports KCRA-TV (NBC) CH 3 Sacramento	7/22/97	11:00-11:35 PM
124)	Channel Three Reports KCRA-TV (NBC) CH 3 Sacramento	7/23/97	6:00-7:00 AM
125)	The Primetime News KQCA-TV (UPN) CH 58 Sacramento	7/22/97	10:00-8:30 PM
126)	Fox Forty News KTXL-TV (Fox) CH 40 Sacramento	8/10/97	10:00-11:00 PM

127) News Ten at Noon	KXTV-TV (ABC) CH 10 Sacramento	08/05/97	12:00-1:00 PM
128) Twelve News Six O'Clock	KPNX-TV (NBC) CH 12 Phoenix	7/22/97	6:00-6:30 PM
129) Twelve News Tonight	KPNX-TV (NBC) CH 12 Phoenix	7/22/97	10:00-10:30 PM
130) Twelve News Sunrise	KPNX-TV (NBC) CH 12 Phoenix	7/23/97	5:30-6:00 AM
131) Twelve News Today	KPNX-TV (NBC) CH 12 Phoenix	8/6/97	6:00-7:00 AM
132) News Four Today	KCNC-TV (CBS) CH 4 Denver	8/8/97	6:00-8:35 AM
133) Real Life Real News At Ten	KMGH-TV (ABC) CH 7 Denver	8/6/97	10:00-10:35 PM
134) Real Life Real News This Morning	KMGH-TV (ABC) CH 7 Denver	8/7/97	5:00-7:00 AM
135) Nine News	KUSA-TV (NBC) CH 9 Denver	7/22/97	6:00-6:30 PM
136) Nine News	KUSA-TV (NBC) CH 9 Denver	7/22/97	10:00-10:35 PM
137) Nine News Daybreak	KUSA-TV (NBC) CH 9 Denver	7/23/97	5:30-6:00 AM
138) Rise And Shine	WJZ-TV (CBS) CH 13 Baltimore	7/24/97	5:30-6:00 AM
139) Eyewitness News	WJZ-TV (CBS) CH 13 Baltimore	7/24/97	12:00-12:30 PM
140) 2 News Nightbeat	WESH-TV (NBC) CH 2 Orlando	7/22/97	11:00-11:30 PM
141) NewsChannel 2 Sunrise	WESH-TV (NBC) CH 2 Orlando	7/23/97	6:00-7:00 AM
142) 2 News At Noon	WESH-TV (NBC) CH 2 Orlando	7/23/97	12:00-12:30 PM
143) The 10:00 News.	WKCF-TV (Ind) CH 18 Orlando	8/7/97	10:00-10:30 PM
144) 1080 News	WTIC-AM (CBS) Freq. 1080 Hartford	7/23/97	8:00-8:59 AM
145) Eyewitness News This Morning	WFSB-TV (CBS) CH 3 Hartford	7/24/97	5:30-6:00 AM
146) Eyewitness News	WFSB-TV (CBS) CH 3 Hartford	8/7/97	5:30-6:00 PM
147) Connecticut News Live at 10	WTXX-TV (Ind) CH 20 Hartford	07/22/97	10:00-10:30 PM
148) Connecticut News	WVIT-TV (NBC) CH 30 Hartford	07/22/97	11:00-11:35 PM
149) Connecticut News	WVIT-TV (NBC) Ch 30 Hartford	7/26/97	9:00-9:30 AM
150) News 8 at Four	KFMB-TV (CBS) CH 8 San Diego	7/23/97	4:00-5:00 PM
151) News 8 at Five	KFMB-TV (CBS) CH 8 San Diego	7/23/97	5:00-6:00 PM
152) News 8 at Six-Thirty	KFMB-TV (CBS) CH 8 San Diego	7/23/97	6:30-7:00 PM
153) News 8 Weekend	KFMB-TV (CBS) CH 8 San Diego	7/26/97	5:00-6:00 PM PT
154) News 8 at 6:00 am	KFMB-TV (CBS) CH 8 San Diego	8/6/97	6:00-7:00 AM PT
155) News 8 at 5:30 AM	KFMB-TV (CBS) CH 8 San Diego	8/7/97	5:30-6:00 AM
156) News 8 at Noon	KFMB-TV (CBS) CH 8 San Diego	8/7/97	12:00-12:30 PM
157) News 8 at Four	KFMB-TV (CBS) CH 8 San Diego	8/7/97	4:00-5:00 PM
158) News 8 at Five	KFMB-TV (CBS) CH 8 San Diego	8/7/97	5:00-6:00 PM
159) News 8 at Six-Thirty	KFMB-TV (CBS) CH 8 San Diego	8/7/97	6:30-7:00 PM
160) News 8 at 5:30 AM	KFMB-TV (CBS) CH 8 San Diego	8/8/97	5:30-6:00 AM
161) News 8 at 6:00 AM	KFMB-TV (CBS) CH 8 San Diego	8/8/97	6:00-7:00 AM
162) News 8 Weekend	KFMB-TV (CBS) CH 8 San Diego	8/9/97	5:00-6:00 PM PT
163) News 8 Weekend Edition	KFMB-TV (CBS) CH 8 San Diego	8/10/97	5:00-6:00 PM
164) News 8 Weekend Edition	KFMB-TV (CBS) CH 8 San Diego	08/10/97	6:30-7:00 PM
165) News 8 Weekend Edition	KFMB-TV (CBS) CH 8 San Diego	08/10/97	11:00-11:30 PM
166) News 8 at 6:00 AM	KFMB-TV (CBS) CH 8 San Diego	8/11/97	6:00-7:00 AM
167) 10 News at 6:30	KGTV-TV (ABC) CH 10 San Diego	8/6/97	6:30-7:00 PM
168) KGTV 15 News at Nine	KGTV-CABLE (ABC) CH 15 San Diego	8/6/97	9:00-9:30 PM
169) Good Morning San Diego	KGTV-TV (ABC) CH 10 San Diego	8/7/97	5:30-6:00 AM
170) 10 News Midday Edition	KGTV-TV (ABC) CH 10 San Diego	8/7/97	11:00-12:00 PM
171) 10 News Weekend Edition	KGTV-TV (ABC) CH 10 San Diego	8/9/97	5:00-6:00 PM PT
172) KGTV-15 News at Nine	KGTV-TV (ABC) CH. 15 San Diego	8/9/97	9:00-9:30 PM PT
173) 10 News Weekend Edition	KGTV-TV (ABC) CH 10 San Diego	08/09/97	11:00-11:35 PM
174) 10 News Weekend Edition	KGTV-TV (ABC) CH 10 San Diego	8/10/97	5:00-6:00 PM PT
175) KGTV 15 News at 9	KGTV-CABLE (ABC) CH 15 San Diego	08/10/97	9:00-10:00 PM
176) 10 News Weekend Edition	KGTV-TV (ABC) CH 10 San Diego	08/10/97	11:00-11:35 PM
177) Good Morning San Diego	KGTV-TV (ABC) CH 10 San Diego	8/11/97	6:00-7:00 AM
178) 10 News Midday Edition	KGTV-TV (ABC) CH 10 San Diego	8/11/97	11:00-12:00 PM
179) NBC 7/39 News at 6	KNSD-TV (NBC) CH 39 San Diego	7/22/97	6:00-6:30 PM
180) NBC 7/39 News at 6	KNSD-TV (NBC) CH 39 San Diego	8/7/97	6:00-6:30 PM
181) NBC 7/39 News This Weekend	KNSD-TV (NBC) CH 39 San Diego	8/10/97	8:00-9:00 AM
182) NBC 7/39 News Weekend Edition	KNSD-TV (NBC) CH 39 San Diego	08/10/97	4:00-5:30 PM
183) NBC 7/39 Today	KNSD-TV (NBC) CH 39 San Diego	8/11/97	5:30-7:00 AM
184) KUSI News at Ten	KUSI-TV (UPN) CH 51 San Diego	7/22/97	10:00-11:05 PM
185) KUSI Morning News	KUSI-TV (UPN) CH 51 San Diego	7/23/97	5:25-9:00 AM PT
186) KUSI Morning News	KUSI-TV (UPN) CH 51 San Diego	7/31/97	5:25-9:00 AM PT
187) KUSI News at Ten	KUSI-TV (UPN) CH 51 San Diego	8/4/97	10:00-11:05 PM
188) KUSI Morning News	KUSI-TV (UPN) CH 51 San Diego	8/5/97	5:25-9:00 AM PT
189) KUSI Morning News	KUSI-TV (UPN) CH 51 San Diego	8/6/97	5:25-9:00 AM PT
190) KUSI News at Ten	KUSI-TV (UPN) CH 51 San Diego	8/6/97	10:00-11:05 PM

191) KUSI Morning News KUSI-TV (UPN) CH 51 San Diego	8/7/97	5:25-9:00 AM PT
192) KUSI Morning News KUSI-TV (UPN) CH 51 San Diego	8/8/97	5:25-9:00 AM PT
193) KUSI News at Ten KUSI-TV (UPN) CH 51 San Diego	08/10/97	10:00-11:05 PM
194) KUSI Morning News KUSI-TV (UPN) CH 51 San Diego	8/11/97	5:25-9:00 AM PT
195) KFMB Morning News Hour KFMB-AM (CBS) Freq. 760 San Diego	7/23/97	5:00-6:00 AM PT
196) San Diego's First News RKOGO-AM Freq. 600 San Diego	8/6/97	5:00AM-6:00AM
197) San Diego's First News RKOGO-AM Freq. 600 San Diego	8/8/97	5:00AM-6:00AM
198) News KPBS-FM (NPR) Freq. 89.5 San Diego	8/7/97	6:30-6:37 AM PT
199) WRTV 6 News At 5:30 WRTV-TV (ABC) CH 6 Indianapolis	7/23/97	5:30-6:00 PM
200) NewsChannel 13 Sunrise WTHR-TV (NBC) CH 13 Indianapolis	7/23/97	5:00-7:00 AM
201) News 5 This Weekend KCTV-TV (CBS) CH 5 Kansas City	8/10/97	8:30-11:30 AM
202) 41 News This Morning KSHB-TV (NBC) CH 41 Kansas City	7/23/97	5:30-7:00 AM
203) Channel 12 News Tonight WKRC-TV (CBS) CH 12 Cincinnati	7/23/97	11:00-11:35 PM
204) KMOL News 4 KMOL-TV (NBC) CH 4 San Antonio	7/22/97	10:00-10:30 PM
205) News 3 First Edition WWMT-TV (CBS) CH 3 Grand Rapids/Kalamazo	7/23/97	5:00-6:00 AM
206) News 3 at 5:30 WWMT-TV (CBS) CH 3 Grand Rapids/Kalamazo	7/24/97	5:30-6:00 PM
207) News Channel 10 The Night Team WJAR-TV (NBC) CH 10 Providence	7/22/97	11:00-11:35 PM
208) News 8 at 11:00 WGAL-TV (NBC) CH 8 Harrisburg/Lancaster	7/22/97	11:00-11:35 PM
209) WHTM Newscenter WHTM-TV (ABC) CH 27 Harrisburg	8/7/97	6:00-7:00 AM
210) Eyewitness News At 5:30 WPEC-TV (CBS) CH 12 West Palm Beach	8/7/97	5:30-6:00 PM
211) News Channel 5 News Nightbeat WPTV-TV (NBC) CH 5 West Palm Beach	7/22/97	11:00-11:30 PM
212) Sunrise on 5 WPTV-TV (NBC) CH 5 West Palm Beach	7/23/97	5:30-6:00 AM
213) Today on 5 WPTV-TV (NBC) CH 5 West Palm Beach	7/23/97	6:00-7:00 AM
214) K EYE Opener News KEYE-TV (CBS) CH 42 Austin	7/25/97	5:30-6:00 AM
215) KVUE 24 News Daybreak KVUE-TV (ABC) CH 24 Austin	8/7/97	5:30-7:00 AM
216) KVUE 24 News KVUE-TV (ABC) CH 24 Austin	8/7/97	6:00-6:30 PM
217) News 36 Nightcast KXAN-TV (NBC) CH 36 Austin	7/22/97	10:00-10:30 PM
218) News 36 Firstcast KXAN-TV (NBC) CH 36 Austin	7/23/97	5:00-7:00 AM
219) 20 News Nightside WICS-TV (NBC) CH 20 Springfield IL	07/22/97	10:00-10:35 PM
220) 20 News Sunrise WICS-TV (NBC) CH 20 Springfield IL	07/23/97	6:00-7:00 AM
221) Eyewitness News at 6 KLAS-TV (CBS) CH 8 Las Vegas	7/25/97	6:00-7:00 PM
222) News 13 Inside Las Vegas KTNV-TV (ABC) CH 13 Las Vegas	7/23/97	6:00-7:00 PM
223) 22 News WWLP-TV (NBC) CH 22 Springfield	7/22/97	11:00-1[illegible] PM
224) Live at Six KERO-TV (ABC) CH 23 Bakersfield	7/23/97	6:00-6:30 PM
225) News at Six KGET-TV (NBC) CH 17 Bakersfield	7/22/97	6:00-6:30 PM
226) News at Six KGET-TV (NBC) CH 17 Bakersfield	8/7/97	6:00-6:30 PM

North American Network, Inc.
Bethesda - New York

STATIONS ACCEPTING STRATACOMM

CALLS	DMA	RANK	FORMAT	AQH	EST	CITY	ST
WXRK-FM	NEW YORK	001	CR	85,200		New York	NY
WQEW-AM	NEW YORK	001	ST	57,300		New York	NY
WPSC-FM	NEW YORK	001	NA	6,600	*	Wayne	NJ
WGHT-AM	NEW YORK	001	GO	2,800	*	Pompton Lakes	NJ
WKNY-AM	NEW YORK	001	SC	1,000	*	Kingston	NY
KFI -AM	LOS ANGELES	002	NT	81,500		Los Angeles	CA
KRTH-FM	LOS ANGELES	002	GO	59,600		Los Angeles	CA
WKQX-FM	CHICAGO	003	MA	47,500		Chicago	IL
WAIT-AM	CHICAGO	003	ST	39,200		Crystal Lake	IL
WONZ-AM	PHILADELPHIA	004	NT	2,600	*	Linwood	NJ
WMSX-AM	BOSTON	006	NT	4,400	*	Brockton	MA
WUNZ-FM	BOSTON	006	NA	2,000	*	Hyannis	MA
WOMC-FM	DETROIT	009	GO	23,200		Ferndale	MI
WGRT-FM	DETROIT	009	AC	4,000	*	Port Huron	MI
WKEV-AM	PITTSBURGH	017	C	27,600	*	Washington	PA
WMBA-AM	PITTSBURGH	017	NT	27,600	*	Ambridge	PA
WQTW-AM	PITTSBURGH	017	NT	27,600	*	Latrobe	PA
WHJB-AM	PITTSBURGH	017	NT	8,400	*	Greensburg	PA
WAMO-AM	PITTSBURGH	017	GO	2,000		Pittsburgh	PA
WGBN-AM	PITTSBURGH	017	RE	1,500		New Kensingtn	PA
WSSZ-FM	PITTSBURGH	017	CR	1,500		Greensburg	PA
WIL -FM	ST. LOUIS	018	C	31,000		Saint Louis	MO
KEZK-FM	ST. LOUIS	018	SC	23,500		Saint Louis	MO
WKKX-FM	ST. LOUIS	018	C	13,000		Saint Louis	MO
KSD -FM	ST. LOUIS	018	CR	11,300		Saint Louis	MO
WRTH-AM	ST. LOUIS	018	ST	7,000		Saint Louis	MO
KFNS-AM	ST. LOUIS	018	NT	4,100		Saint Louis	MO
KIRL-AM	ST. LOUIS	018	RE	1,400		Saint Charles	MO
KCLC-FM	ST. LOUIS	018	AC	1,000	*	St. Charles	MO
KFAV-FM	ST. LOUIS	018	C	1,000	*	Warrenton	MO
KSLQ-AM	ST. LOUIS	018	AC	1,000	*	Washington	MO
KSLQ-FM	ST. LOUIS	018	AC	1,000	*	Washington	MO
KTUI-FM	ST. LOUIS	018	C	1,000	*	Sullivan	MO
KWRE-AM	ST. LOUIS	018	C	1,000	*	Warrenton	MO
KZMN-FM	ST. LOUIS	018	C	1,000	*	Troy	MO
WINU-AM	ST. LOUIS	018	AC	1,000	*	Highland	IL
WTMD-FM	BALTIMORE	022	AC	3,800	*	Towson	MD
WTTR-AM	BALTIMORE	022	AC	3,800	*	Westminster	MD
WMMB-AM	ORLANDO-DAYTONA BEACH-MELBRN	023	ST	5,600		Melbourne	FL
WOGK-FM	ORLANDO-DAYTONA BEACH-MELBRN	023	C	5,000		Ocala	FL
WQGD-FM	ORLANDO-DAYTONA BEACH-MELBRN	023	GO	1,900		Melbourne	FL

STATIONS ACCEPTING STRAT=COMM

CALLS	DMA	RANK	FORMAT	AQH	EST	CITY	ST
WTLN-AM	ORLANDO-DAYTONA BEACH-MELBRN	023	RE	1,200	*	Altamonte Spg	FL
KPRZ-AM	SAN DIEGO	024	RE	2,400		San Diego	CA
WIHS-FM	HARTFORD-NEW HAVEN	025	RE	1,000	*	Middletown	CT
WAXT-FM	INDIANAPOLIS	026	C	7,700	*	Anderson	IN
WCSI-AM	INDIANAPOLIS	026	NT	7,700	*	Columbus	IN
WPZZ-FM	INDIANAPOLIS	026	RE	1,500		Indianapolis	IN
WKKG-FM	INDIANAPOLIS	026	C	1,100	*	Columbus	IN
WWKI-FM	INDIANAPOLIS	026	C	1,100	*	Kokomo	IN
WLUM-FM	MILWAUKEE	028	NA	11,000		Milwaukee	WI
WMYX-FM	MILWAUKEE	028	AC	6,500		Hales Corners	WI
WAMG-FM	MILWAUKEE	028	SC	6,100		Hales Corners	WI
WGLB-AM	MILWAUKEE	028	SC	2,400	*	Port Washington	WI
WGLB-FM	MILWAUKEE	028	SC	2,400	*	Port Washington	WI
WEZY-FM	MILWAUKEE	028	EZ	1,900		Racine	WI
WAUK-AM	MILWAUKEE	028	NT	1,400		Waukesha	WI
WFMX-FM	CHARLOTTE	029	C	23,800	*	Statesville	NC
WIST-AM	CHARLOTTE	029	AC	23,800	*	Statesville	NC
WACB-AM	CHARLOTTE	029	C	9,600	*	Taylorsville	NC
WCIS-AM	CHARLOTTE	029	RE	9,600	*	Morganton	NC
WIKC-AM	CHARLOTTE	029	C	9,600	*	Newton	NC
WCCJ-FM	CHARLOTTE	029	NA	2,800		Charlotte	NC
WBAV-AM	CHARLOTTE	029	RE	1,500		Charlotte	NC
WOGR-AM	CHARLOTTE	029	RE	1,400	*	Charlotte	NC
WSAT-AM	CHARLOTTE	029	GO	1,400	*	Salisbury	NC
WMMA-FM	CINCINNATI	030	GO	1,600	*	Lebanon	OH
KEXS-AM	KANSAS CITY	031	RE	3,000	*	Excelsior Springs	MO
KLJC-FM	KANSAS CITY	031	RE	2,000	*	Kansas City	MO
WGTM-AM	RALEIGH-DURHAM	032	RE	14,200	*	Wilson	NC
WIDU-AM	RALEIGH-DURHAM	032	RE	2,100		Fayetteville	NC
WAUG-AM	RALEIGH-DURHAM	032	FS	1,100		Raleigh	NC
WZNG-AM	NASHVILLE	033		1,600	*	Shelbyville	TN
WIZO-AM	NASHVILLE	033	GO	1,000	*	Franklin	TN
WCOL-FM	COLUMBUS, OH	034	C	15,000		Columbus	OH
WBEX-AM	COLUMBUS, OH	034	NT	9,400	*	Chillicothe	OH
WORD-AM	GREENVILLE-SPRTNBRG-ASHVL-AND	035	NT	2,300		Greenville	SC
WHBK-AM	GREENVILLE-SPRTNBRG-ASHVL-AND	035	RE	1,000	*	Marshall	NC
WLFJ-FM	GREENVILLE-SPRTNBRG-ASHVL-AND	035	RE	1,000	*	Greenville	SC
WMUU-AM	GREENVILLE-SPRTNBRG-ASHVL-AND	035	RE	1,000	*	Greenville	SC
WWKB-AM	BUFFALO	037	NT	2,600		Buffalo	NY
WSPQ-AM	BUFFALO	037	CO	1,200	*	Springville	NY

STATIONS ACCEPTING STRATOCOMM

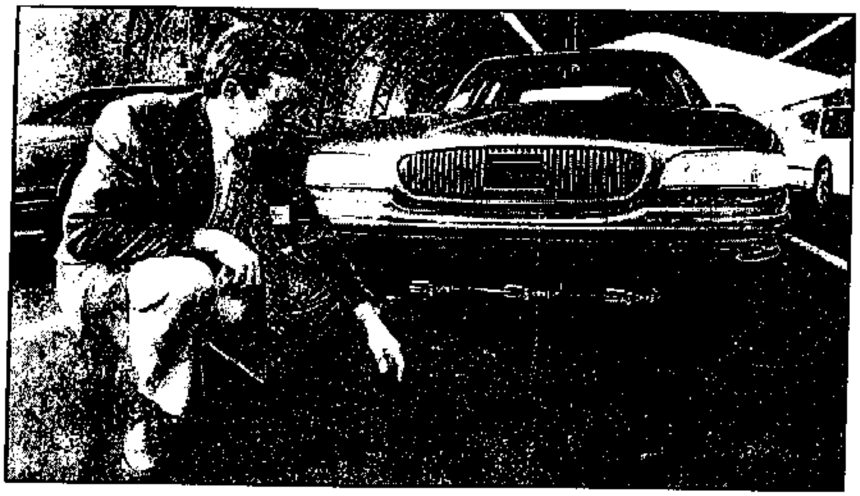
CALLS	DMA	RANK	FORMAT	AQH	SGT	CITY	ST
KRSP-FM	SALT LAKE CITY	038	CR	10,500		Salt Lake City	UT

Potential Gross Impressions: 841,000

NETWORKS ACCEPTING STRATOCOMM

NETWORK	REGION	Affil	Potential Reach	Est
ABC Contemporary/Ent. Networ	National	760	1,480,200	
Lifestyle Network	Minnesota	70	111.276	*
Louisiana Network	Louisiana	80	144,100	
Metro Networks--Boston	Boston	1	10,400	
Metro Networks--Buffalo	Buffalo	3	29,700	
Metro Networks--Charlotte	Charlotte	5	8.800	*
Metro Networks--Chicago	Chicago	7	87,800	*
Metro Networks--Louisville	Louisville	5	8,500	*
Metro Networks--Memphis	Memphis	5	24,600	
Metro Networks--Nashville	Nashville	3	1,000	*
Minnesota News Network	Minnesota	70	118.020	*
North Dakota Network	North Dakota	25	12,400	
South Dakota Network	South Dakota	14	15.300	

POTENTIAL GROSS IMPRESSIONS: 2,032,296



SMART CAR: California transit official Steven Shladover shows magnetic sensors on the front of a Buick LeSabre on Tuesday. The sensors read magnets in the road and allow the car to be controlled by onboard computer.

The Associated Press

Let the highway do the driving

FRONT PAGE

TECHNOLOGY: The nation's first automated pavement debuts in San Diego. Forget steering, brakes.

By DANA CALVO/The Associated Press

SAN DIEGO — The nation's first stretch of highway that enables computers to drive specially equipped cars debuted Tuesday and was proudly declared by its creators to be "really dull."

Once the computer takes over, drivers can take their hands off the steering wheel, their feet off the pedals and their eyes off the road.

"It's really exciting for about the first 15 seconds, then it gets really dull," said Jim Rillings of the National Automated Highway System Consortium. "It's like driving with a chauffeur. You just sit back and let your mind wander."

Vehicles equipped with video cameras, magnets and radar navigated down the nation's first 7.6 miles of automated highway on Interstate 15, providing a glimpse of futuristic travel that could reduce car accidents and air pollution.

There is no price tag for the project, but its supporters insist it will save millions of federal dollars because it relies on existing infrastructure and eliminates the need to build more freeway lanes.

The National Automated Highway System Consortium is composed of private and public agencies and universities. Among the participants

Please see HIGHWAY, Page 4

ROAD TO THEMSELVES: Two specially equipped Honda Accords let the high-tech lanes do the steering and accelerating Tuesday.

ORANGE COUNTY REGISTER
SANTA ANA, CA
DAILY 353,779
WEDNESDAY
JUL 23 1997

HANDS-FREE CRUISING AT 55: Hung Pham of Honda USA proves Tuesday that the modified road and cars can keep things under control even at 55 mph.

HIGHWAY

FROM 1

working to develop the technology are General Motors, Lockheed Martin and Carnegie Mellon University.

Its genesis was a 1991 federal law that empowered the U.S. Department of Transportation to develop "fully automated, intelligent vehicle-highway systems."

Tiny magnets embedded in the asphalt on either side of traffic lanes at four-foot intervals enables the magnetized vehicle to constantly propel itself within the lane's boundaries.

The dozen cars and buses in the demonstration project are equipped with one-inch video cameras on their rearview mirrors or windshields that follow visual aids along the road. That could be cement barriers or even deep tracks in a snowy road, researchers said.

The cameras can function at night with headlights illuminating the barriers. A small television screen inside the car shows diagrams of the vehicle in relation to boundaries and other cars, as it maintains a safe distance.

It would cost less than $10,000 to equip one mile of freeway with the new technology, compared to anywhere from $1 million to $100 million to build one mile of new highway, said Dick Bishop, a spokesman for the U.S. Department of Transportation.

The consortium estimates that the automated highway system would triple the efficiency of each existing lane.

But the question remains: Will car-dependent Americans be willing to hand over control of their cars to a computer?

Research conducted with focus groups revealed that older drivers were more receptive to the idea, while younger drivers appeared to crave the hands-on driving experience.

Associated Press Story by Dana Calvo			
Publication	Origin	Date	Circulation
New York Times (National Edition)	New York, NY	July 23, 1997	1,149,700
Chicago Tribune	Chicago, IL	July 23, 1997	691,283
Dallas Morning News	Dallas, TX	July 23, 1997	536,153
Miami Herald	Miami, FL	July 25, 1997	419,187
Star Tribune	Minneapolis, MN	July 23, 1997	412,482
Arizona Republic	Phoenix, AZ	July 23, 1997	365,979
Orange County Register	Santa Ana, CA	July 23, 1997	353,779
St. Peterburg Times	St. Petersburg, FL	July 23, 1997	351,977
St. Louis Post-Dispatch	St. Louis, MO	July 23, 1997	338,793
Denver Post	Denver, CO	July 24, 1997	316,027
Buffalo News	Buffalo, NY	July 23, 1997	306,905
Atlanta Constitution	Atlanta, GA	July 23, 1997	303,185
San Jose Mercury News	San Jose, CA	July 23, 1997	284,206
Orlando Sentinel	Orlando, FL	July 23, 1997	281,104
Sacramento Bee	Sacramento, CA	July 23, 1997	275,000
Times-Picayune	New Orleans, LA	July 23, 1997	265,820
Pittsburgh Post-Gazette	Pittsburgh, PA	July 23, 1997	249,301
New York Times	New York, NY	July 23, 1997	248,860
Santa Fe New Mexican	Santa Fe, NM	July 23, 1997	245,000
Courier-Journal	Louisville, KY	July 23, 1997	244,000
Seattle Times	Seattle, WA	July 23, 1997	231,446
Indianapolis Star	Indianapolis, IN	July 23, 1997	231,150
Daily Oklahoman	Oklahoma City, OK	July 23, 1997	219,158
Richmond Times-Dispatch	Richmond, VA	July 23, 1997	211,598
Cincinnati Enquirer	Cincinnati, OH	July 23, 1997	203,107
Seattle Post-Intelligencer	Seattle, WA	July 23, 1997	203,000
Florida Times-Union	Jacksonville, FL	July 23, 1997	197,706
Providence Journal-Bulletin	Providence, RI	July 23, 1997	188,217
Philadelphia Daily News	Philadelphia, PA	July 23, 1997	180,000
Tulsa World	Tulsa, OK	July 23, 1997	180,000
Arizona Daily Star	Tucson, AZ	July 23, 1997	179,652
Tennessean	Nashville, TN	July 23, 1997	148,000
Blade	Toledo, OH	July 23, 1997	147,312
Sunday Press-Telegram	Long Beach, CA	July 27, 1997	141,633
Morning Call	Allentown, PA	July 23, 1997	134,438
State	Columbia, SC	July 23, 1997	132,000
San Francisco Examiner	San Francisco, CA	July 23, 1997	128,736
News Tribune	Tacoma, WA	July 23, 1997	126,000
San Gabriel Valley Tribune	Covina, CA	July 23, 1997	122,500
Post and Courier	Charleston, SC	July 23, 1997	116,000
Sarasota Herald-Tribune	Sarasota, FL	July 23, 1997	114,450
Clarion-Ledger	Jackson, MS	July 23, 1997	109,395
Gazette	Colorado Springs, CO	July 23, 1997	105,955
News-Journal	Daytona Beach, FL	July 23, 1997	104,606
Daily Press	Newport News, VA	July 23, 1997	103,000
North County Times (Carlsbad/La Costa Edition)	Escondido, CA	July 23, 1997	102,311
North County Times (Escondido Edition)	Escondido, CA	July 23, 1997	102,311
News	Greenville, SC	July 24, 1997	100,000
Winston-Salem Journal	Winston-Salem, NC	July 23, 1997	95,000
Press Democrat	Santa Rosa, CA	July 23, 1997	94,365

Associated Press Story by Dana Calvo			
Publication	Origin	Date	Circulation
Sun	San Bernardino, CA	July 23, 1997	93,000
Union Leader	Manchester, NH	July 23, 1997	89,000
Post-Standard	Syracuse, NY	July 24, 1997	87,900
Courier-Post	Cherry Hill, NJ	July 23, 1997	87,547
News-Press	Fort Myers, FL	July 23, 1997	86,104
Inland Valley Daily Bulletin	Ontario, Canada	July 23, 1997	83,685
Modesto Bee	Modesto, CA	July 23, 1997	81,304
Daily Breeze	Torrance, CA	July 23, 1997	80,800
Oakland Tribune	Oakland, CA	July 23, 1997	79,759
Press	Atlantic City, NJ	July 23, 1997	79,377
Ledger	Lakeland, FL	July 23, 1997	79,050
Journal Star	Peoria, IL	July 23, 1997	75,500
Register-Guard	Eugene, OR	July 23, 1997	75,140
Oakland Press	Pontiac, MI	July 24, 1997	75,000
Press & Sun-Bulletin	Binghamton, NY	July 23, 1997	73,444
Bakersfield Californian	Bakersfield, CA	July 23, 1997	72,500
Bucks County Courier	Levittown, PA	July 23, 1997	70,017
Lansing State Journal	Lansing, MI	July 23, 1997	70,000
Reno Gazette-Journal	Reno, NV	July 23, 1997	66,460
Beaumont Enterprise	Beaumont, TX	July 23, 1997	66,191
Times	Hammond, IN	July 23, 1997	65,500
Topeka Capital-Journal	Topeka, KS	July 23, 1997	65,380
Montgomery Advertiser	Montgomery, AL	July 23, 1997	65,000
Patriot-News	Harrisburg, PA	July 23, 1997	64,750
Evansville Courier	Evansville, IN	July 23, 1997	64,500
Repository	Canton, OH	July 23, 1997	62,000
Washington Sunday Times	Washington, DC	July 27, 1997	61,856
Herald-Journal	Spartanburg, SC	July 23, 1997	61,166
Tallahassee Democrat	Tallahassee, FL	July 23, 1997	57,151
News-Herald	Willoughby, OH	July 23, 1997	57,000
Branson Tri-Lakes Daily News	Branson, MO	July 23, 1997	56,000
Ledger-Enquirer	Columbus, GA	July 23, 1997	56,000
Gainsville Sun	Gainesville, FL	July 23, 1997	55,972
Saginaw News	Saginaw, MI	July 23, 1997	55,157
Billings Gazette	Billings, MT	July 23, 1997	55,127
Burlington Free Press	Burlington, VT	July 23, 1997	55,000
Wilmington Morning Star (Local-Region-State Edi	Wilmington, NC	July 23, 1997	55,000
Quad-City Times	Davenport, AR	July 23, 1997	54,868
Daily Southtown	Chicago, IL	July 23, 1997	53,965
Herald	Everett, WA	July 23, 1997	52,254
Argus-Leader	Sioux Falls, SD	July 23, 1997	52,000
Sun News	Myrtle Beach, SC	July 23, 1997	52,000
Pueblo Chieftain	Pueblo, CO	July 23, 1997	51,205
Express-Times	Easton, PA	July 23, 1997	51,000
Otago Daily Times	Dunedin, New Zealand	August 6, 1997	51,000
Mesa Tribune	Mesa, AZ	July 23, 1997	50,745
Observer-Dispatch	Utica, NY	July 23, 1997	50,724
Pantagraph	Bloomington, IL	July 23, 1997	50,600
Herald-Dispatch	Huntington, WV	July 27, 1997	49,123
Santa Barbara News-Press	Santa Barbara, CA	July 23, 1997	49,000

Associated Press Story by Dana Calvo			
Publication	Origin	Date	Circulation
Sun Herald	Biloxi, MS	July 23, 1997	48,250
Tribune-Democrat	Johnstown, PA	July 23, 1997	48,014
St. Joseph News-Press	St. Joseph, MO	July 23, 1997	48,000
Times Leader	Wilkes-Barre, PA	July 24, 1997	47,920
El Paso Times	El Paso, TX	July 23, 1997	47,000
Middlesex News	Framingham, MA	August 3, 1997	45,174
Bristol Herald Courier	Bristol, VA	July 23, 1997	45,000
Pasadena Star-News	Pasadena, CA	July 23, 1997	45,000
San Motoe County Times	San Mateo, CA	July 23, 1997	45,000
Free Lance-Star	Fredericksburg, VA	July 23, 1997	44,868
Intelligence Journal	Lancaster, PA	July 23, 1997	44,364
Abilene Reporter-News	Abilene, TX	July 23, 1997	44,000
Daily Review	Hayward, CA	July 23, 1997	43,740
Bradenton Herald	Bradenton, FL	July 23, 1997	43,194
Victoria Advocate	Victoria, TX	July 23, 1997	42,285
Chattanooga Times	Chattanooga, TN	July 23, 1997	42,000
Daily Record	York, PA	July 23, 1997	42,000
Lima News	Lima, OH	July 23, 1997	42,000
Yakima Herald-Republic	Yakima, WA	July 23, 1997	42,000
Times-Record	Fort Smith, AR	July 23, 1997	41,900
Marin Independent Journal	Novato, CA	July 23, 1997	41,839
Sun-Journal	Lewiston, ME	July 23, 1997	41,749
Herald & Review	Decatur, IL	July 23, 1997	41,679
Alexandria Daily Town Talk	Alexandria, LA	July 23, 1997	41,000
Lincoln Journal-Star	Lincoln, NE	July 23, 1997	40,416
News-Star	Monroe, LA	July 23, 1997	39,278
Sun	Bremerton, WA	July 23, 1997	39,103
Record Searchlight	Redding, CA	July 23, 1997	38,821
Times Record News	Wichita Falls, TX	July 23, 1997	38,800
Grand Forks Herald	Grand Forks, ND	July 23, 1997	38,797
Journal and Courier	Lafayette, IN	July 23, 1997	38,567
Journal and Courier	Lafayette, IN	July 26, 1997	38,567
Dothan Eagle	Dothan, AL	July 27, 1997	38,000
News & Advance	Lynchburg, VA	July 23, 1997	38,000
Jackson Citizen Patriot	Jackson, MI	July 23, 1997	37,911
Lake Charles American Press	Lake Charles, LA	July 23, 1997	37,000
Great Falls Tribune	Great Falls, MT	July 23, 1997	36,000
Herald	Monterey, CA	July 23, 1997	36,000
Joplin Globe	Joplin, MO	July 23, 1997	36,000
Olympian	Olympia, WA	July 28, 1997	36,000
Tri-Valley Herald (San Ramon Valley Edition)	Danville, CA	July 23, 1997	36,000
Tri-Valley Herald (Livermore/Dublin/Pleasanton)	Pleasanton, CA	July 23, 1997	35,446
Daily Camera	Boulder, CO	July 23, 1997	35,000
San Luis Obispo County Telegram-Tribune	San Luis Obispo, CA	July 23, 1997	35,000
Rapid City Journal	Rapid City, SD	July 23, 1997	34,219
Erie Morning News	Erie, PA	July 23, 1997	34,000
Longview News-Journal	Longview, TX	July 23, 1997	34,000
Messenger-Inquirer	Owensboro, KY	July 27, 1997	33,731
Harold Palladium	St. Joseph, MI	July 23, 1997	33,149
Albany Herald	Albany, GA	July 23, 1997	33,000

Associated Press Story by Dana Calvo			
Publication	Origin	Date	Circulation
Harold Bulletin	Anderson, IN	July 23, 1997	33,000
Argus	Fremont, CA	July 23, 1997	32,879
Missoulian	Missoula, MT	July 23, 1997	32,711
Daily Herald	Provo, UT	July 24, 1997	32,005
Eastside Journal	Bellevue, WA	July 23, 1997	32,000
South County Journal	Kent, WA	July 23, 1997	32,000
Johnson City Press	Johnson City, TN	July 23, 1997	31,619
Eagle	Butler, PA	July 23, 1997	31,300
Times Herald	Norristown, PA	July 23, 1997	30,000
Chico Enterprise-Record	Chico, CA	July 23, 1997	29,996
Kenosha News	Kenosha, WI	July 23, 1997	29,300
Fort Collins Coloradoan	Fort Collins, CO	July 23, 1997	29,000
Battle Creek Enquirer	Battle Creek, MI	July 23, 1997	28,918
Kokomo Tribune	Kokomo, IN	July 25, 1997	28,000
Marietta Daily Journal	Marietta, GA	July 23, 1997	28,000
Santa Cruz County Sentinel	Santa Cruz, CA	July 23, 1997	27,691
Outlook	Santa Monica, CA	July 23, 1997	27,572
Mail Tribune	Medford, OR	July 23, 1997	27,395
Lewiston Morning Ribune	Lewiston, ID	July 23, 1997	25,933
Danville Register & Bee	Danville, VA	July 23, 1997	25,000
Intelligencer	Wheeling, WV	July 23, 1997	25,000
Ledger Dispatch	Antioch, CA	July 23, 1997	24,865
Grand Island Independent	Grand Island, NE	July 23, 1997	24,604
Standard-Speaker	Hazelton, PA	July 23, 1997	24,000
Carroll County Times	Westminster, MD	July 23, 1997	23,500
Leaf-Chronicle	Clarksville, TN	July 23, 1997	23,000
Rutland daily Herald	Rutland, VT	July 23, 1997	22,431
Times-Standard	Eureka, CA	July 23, 1997	22,248
Killeen Daily Herald	Killeen, TX	July 23, 1997	22,000
Republic	Columbus, IN	July 23, 1997	21,778
Appeal-Democrat	Marysville, CA	July 23, 1997	21,500
Hickory Daily Record	Hickory, NC	July 23, 1997	21,280
Sun Herald (Charlotte Edition)	Charlotte Harbor, FL	July 23, 1997	21,174
Santa Maria Times	Santa Maria, CA	July 23, 1997	21,084
Daily Republic	Fairfield, CA	July 23, 1997	21,000
Southeast Missourian	Cape Girardeau, MO	July 23, 1997	20,625
Bristol Press	Bristol, CT	July 23, 1997	20,484
Reporter	Vacaville, CA	July 25, 1997	20,250
Holland Sentinel	Holland, MI	July 23, 1997	20,000
Muskogee Daily Phoenix	Muskogee, OK	July 23, 1997	19,600
Daily Courier	Kelowna, British Columbi	July 25, 1997	19,000
Whittier Daily News	Whittier, CA	July 23, 1997	18,880
Whittier Daily News	Whittier, CA	July 23, 1997	18,800
Daily Reflector	Greenville, NC	July 23, 1997	18,660
Lawrence Daily Journal-World	Lawrence, KS	July 23, 1997	18,501
Brazosport Facts	Clute, TX	July 23, 1997	18,100
Daily Californian	El Cajon, CA	July 23, 1997	18,000
Daily Telegraph	Napier, New Zealand	July 25, 1997	18,000
Lodi News-Sentinel	Lodi, CA	July 23, 1997	18,000
Journal	Martinsburg, WV	July 23, 1997	17,931

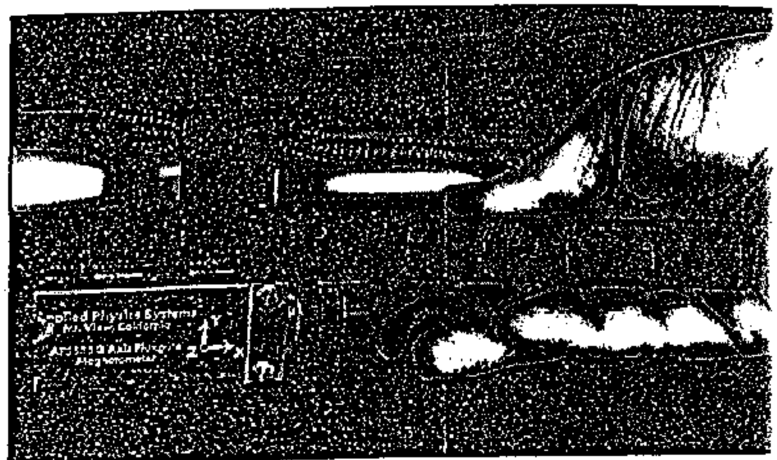
Associated Press Story by Dana Calvo			
Publication	Origin	Date	Circulation
Kentucky Enquirer	Cincinnati, OH	July 23, 1997	17,830
Daily News Journal	Morfreesboro, TN	August 2, 1997	17,500
West Central Tribune	Willmar, MN	July 24, 1997	16,927
Centralia Morning Sentinel	Centralia, IL	July 23, 1997	16,000
Montana Standard	Butte, MT	July 23, 1997	16,000
Jacksonville Journal-Courier	Jacksonville, IL	July 23, 1997	15,500
Northwest Arkansas Times	Fayetteville, AR	July 23, 1997	15,121
Delta Democrat Times	Greenville, MS	July 23, 1997	15,000
Daily Citizen-News	Dalton, GA	July 23, 1997	14,900
Daily World	Opelousas, LA	July 27, 1997	14,600
Sentinel-Tribune	Bowling Green, OH	July 23, 1997	14,500
Free Press	Kinston, NC	July 25, 1997	14,198
Auburn Journal	Auburn, CA	July 23, 1997	14,070
Athens Daily News	Athens, GA	July 23, 1997	14,000
Hanford Sentinel	Hanford, CA	July 23, 1997	14,000
Winona Daily News	Winona, MN	July 23, 1997	14,000
Conroe Courier	Conroe, TX	July 23, 1997	13,777
Bozeman Daily Chronicle	Bozeman, MT	July 23, 1997	13,100
Daily Herald (Arlington Heights)	Arlington Heights, IL	July 23, 1997	12,512
Standard-Observer	Irwin, PA	July 28, 1997	12,500
Register-Pajaronian	Watsonville, CA	July 23, 1997	12,250
Mesabi Daily News	Virginia, MN	July 23, 1997	12,245
Courier-Express	DuBois, PA	July 23, 1997	12,200
Daily Herald (Hoffman Estates/Schaumburg)	Arlington Heights, IL	July 23, 1997	11,953
Advertiser-Tribune	Tiffin, OH	July 23, 1997	11,500
Thomasville Times-Enterprise	Thomasville, GA	July 23, 1997	11,365
Journal Review	Crawfordsville, IN	July 23, 1997	11,320
News Chief	Winter Haven, FL	July 23, 1997	11,226
Daily Democrat	Woodland, CA	July 24, 1997	11,014
Messenger	Madisonville, KY	July 23, 1997	10,900
Davis Enterprise	Davis, CA	July 23, 1997	10,835
Beaufort Gazette	Beaufort, SC	July 23, 1997	10,700
Lake City Reporter	Lake City, FL	July 23, 1997	10,600
Daily Herald (Gurnee/Grayslake)	Arlington Heights, IL	July 23, 1997	10,500
Gazette	Bedford, PA	July 23, 1997	10,500
Leader-Call	Laurel, MS	July 23, 1997	10,000
Plainsman	Huron, SC	July 23, 1997	10,000
Selma Times-Journal	Selma, AL	July 23, 1997	10,000
Lompoc Record	Lompoc, CA	July 24, 1997	9,067
Daily Independent	Ridgecrest, CA	July 23, 1997	9,000
San Diego Daily Transcript	San Diego, CA	July 28, 1997	9,000
Daily Herald (Elgin-South Elgin)	Arlington Heights, IL	July 23, 1997	8,635
Mercury-Register	Oroville, CA	July 23, 1997	8,600
Southern Standard	Minniville, TX	July 23, 1997	8,400
Daily Herald (Mount Prospect/Prospect Hts.)	Arlington Heights, IL	July 23, 1997	8,188
Corsicana Daily Sun	Corsicana, TX	July 23, 1997	8,000
Fielding Herald	Fielding, New Zealand	August 5, 1997	8,000
Laramie Daily Boomerang	Laramie, WY	July 23, 1997	8,000
Pasadena Citizen	Pasadena, TX	July 23, 1997	8,000
Statesboro Herald	Statesboro, GA	July 23, 1997	8,000

Associated Press Story by Dana Calvo			
Publication	Origin	Date	Circulation
Summit Daily News	Fresco, CO	July 23, 1997	8,000
Clarksburg Exponent	Clarksburg, WV	July 23, 1997	7,789
Clayton News/Daily	Jonesboro, GA	July 23, 1997	7,700
Elko Daily Free Press	Elko, NV	July 25, 1997	7,600
Daily Herald (Palatine/Inverness)	Arlington Heights, IL	July 23, 1997	7,446
Evening Telegram	Herkimer, NY	July 31, 1997	7,200
Alameda Times-Star	Alameda, CA	July 23, 1997	7,158
Daily Union	Junction City, KS	July 23, 1997	7,110
Daily News	Rhinelander, WI	July 23, 1997	7,000
Sun Herald (North Port Edition)	North Port, FL	July 23, 1997	7,000
Seattle Daily Journal of Commerce	Seattle, WA	July 23, 1997	6,800
Daily Citizen	Searcy, AR	July 23, 1997	6,500
Paragould Daily Press	Paragould, AR	July 23, 1997	6,500
Athol Daily News	Athol, MA	July 23, 1997	6,000
Cape Coral Daily Breeze	Cape Coral, FL	July 23, 1997	6,000
Siskiyou Daily News	Yreka, CA	July 23, 1997	6,000
Rangitikei Mail	Auckland, New Zealand	July 30, 1997	5,500
Sunday Courier-News	Bridgewater, NJ	August 3, 1997	5,500
Morning News	Blackfoot, ID	July 23, 1997	4,918
Daily Herald (Bartlett/Hanover Park/Streamwood)	Arlington Heights, IL	July 23, 1997	4,911
Ketchikan Daily News	Ketchikan, AK	July 23, 1997	4,900
Herald	Titusville, PA	July 23, 1997	4,800
Humboldt	Winnemucca, NV	July 23, 1997	4,800
Daily Herald (Des Plaines/Elk Grove)	Arlington Heights, IL	July 23, 1997	4,403
Daily Herald (Algonquin/Lake in the Hills)	Arlington Heights, IL	July 23, 1997	4,352
Sun Herald (De Soto Edition)	Arcadia, FL	July 23, 1997	3,900
Daily Herald (Buffalo Grove/Long Grove/Wheelin	Arlington Heights, IL	July 23, 1997	3,657
Deming Headlight	Deming, NM	July 23, 1997	3,650
Daily Herald (Rolling Meadows)	Arlington Heights, IL	July 23, 1997	3,620
Daily News	Mountain Home, AR	July 23, 1997	2,800
Daily Herald (Libertyville/Mundelein)	Arlington Heights, IL	July 23, 1997	2,716
Daily Herald (Barrington)	Arlington Heights, IL	July 23, 1997	2,111
Daily Herald (Lake Zurich/Wauconda)	Arlington Heights, IL	July 23, 1997	1,860
Daily Reporter	Milwaukee, WI	July 24, 1997	n/a
TOTAL AUDIENCE			19,348,237

TRANSPORTATION

World's first 'smart highwa-' may be just around corner

Los Angeles Times



SAN DIEGO — Dumb questions you might never think to ask a smart highway:

- Can one be cited for driving under the influence when one is under the influence but not actually driving?
- In a car programmed to auto-commute to work, will there be a pause button should personal plumbing suggest an earlier exit?
- When computers crash, will cars crash?
- Who gets sued if a driverless sport utility rear-ends a driverless minivan?
- And what of that helpless feeling when you, steeped in full and personal control of cars since Dad plopped you on his lap behind the wheel of the family Pontiac, suddenly are driving by wire — look Ma, no hands or feet! — and tailgating at 80 mph?

Here, at the media dry run for August's public dress rehearsal of the world's first Automated Highway System, such points were acknowledged as genuine concerns being studied by transportation experts who have started hard-wiring motorists to life in the smart lane.

They are even heavy into examining ways a pilotless car can avoid a tire carcass, dead mattress or a refrigerator dumped by the unintelligent on intelligent interstates. Or, if hackers can reprogram and clone cell phones, what havoc can they wreak on computers controlling the speed and separation of robot sedans?

"These are certainly things we are addressing under the headings of societal and institutional analyses," says James Rillings, a former National Aeronautics and Space Administration researcher whose engineering career has journeyed from space to surface streets as program manager of the National Automated Highway System Consortium.

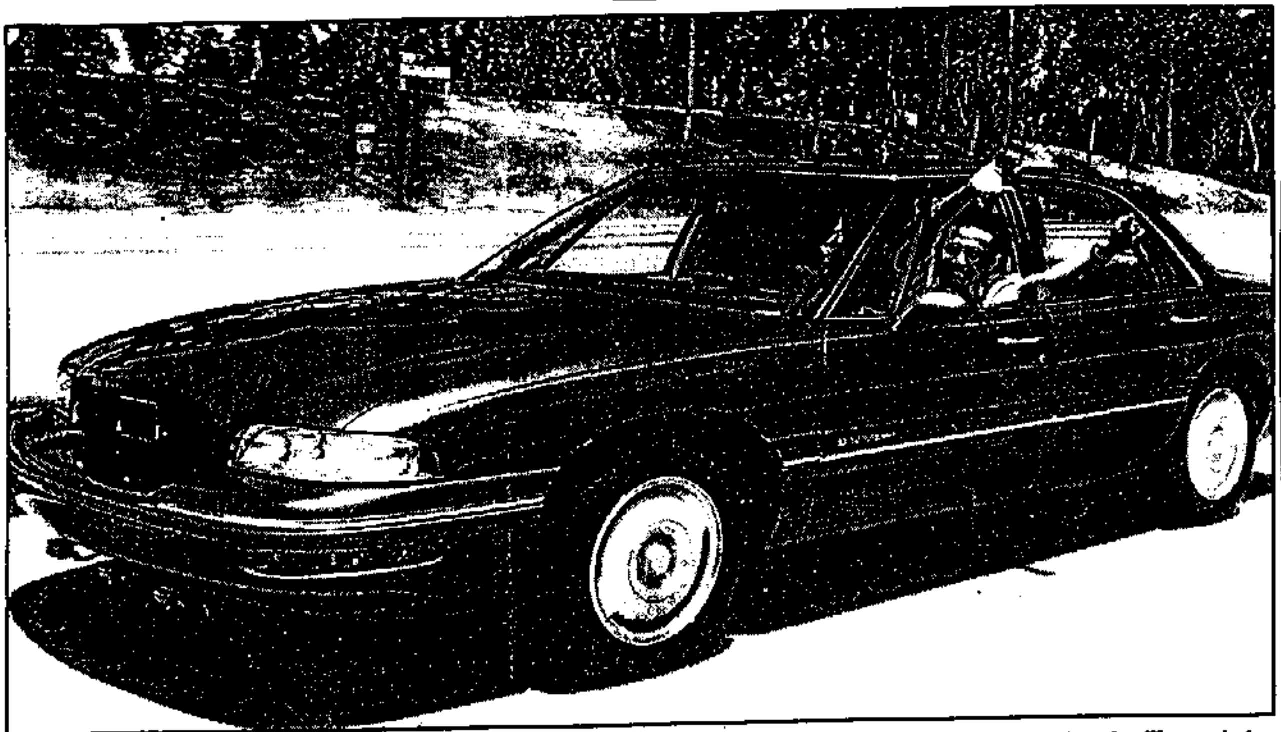
"The need is there," Rillings says. That's the need to unclog metropolitan highways, reduce traffic fatalities and ease fuel demands.

"The technology is coming," he adds. That's the technology of cruise controls that adjust a car's pace and position in relation to other hard objects; of navigation by the Global Positioning System that talks to satellites and pin-points your Hertz rental to within 35 feet of the motel you weren't able to find last time; of the collision avoidance system that warns Air Force One of closing traffic; and of super-IQ computers that recently out-pondered a worl ess master.

"And that," Rillings concludes "makes AHS just another step ir improving the condition of man-kind."

Judging from the recent demonstration — sponsored by the Buicl Division of General Motors, th U.S. Transportation Department California Transportation Department, University of California Berkeley and other representatives of more than 100 members o the Consortium — AHS is a masterpiece in progress.

Clearly with decades to go.



Los Angeles Times photos

AUTO-MATIC: *The Automated Highway System allows hands-free driving, as engineer Han-Shue Tan, above, demonstrates. The system utilizes magnet pegs, left, inserted in the pavement and sensors on the bumpers.*

Since November, using a 7.6-mile stretch of a carpool lane on Interstate Highway 15 slicing northeast from San Diego, the program's 10 Buick LeSabre guinea pigs have logged more than 5,000 miles of automated travel. Most of that distance has been in convoy, and mostly 12 feet apart at 65 mph — but with the easy potential, say test engineers, of 100 mph with only 6 feet of separation.

NAHSC researchers also say they are on top of lane changing, allowing for a curve, accelerating into traffic and maintaining freeway speeds with smoothness. In dry weather and on ice.

There is little about NAHSC's direction not to understand.

Part involves radar, a means of bouncing, recovering and measuring radio signals from solid objects, and that trick has been around since World War II. And the core of AHS methodology is no more complex than magnetism.

Six-inch magnetic pegs are buried in the center of the freeway lane, 4 feet apart. Magnetometers beneath front and rear bumpers of the car search for signals from the pegs and feed the information to on-board computers. They, in turn, order actuators to get on with the business of steering. It's really just a modified, full-size version of a radio-control dune buggy.

Radar behind the grille locates the car in front, relays that information back to another on-board computer, which controls vehicle separation by setting and adjusting acceleration and braking. Just like a glorified theme park ride.

Project scientists admit it's all a brave beginning, and maybe at the same point of development reached by aviation in the mid-40s when airplanes went from piston engines to jets.

But before AHS flies high, there are several key issues to address, says Steve Shladover, deputy director of California Partners for Advance Transit and Highways, a consortium partner.

Obstacle avoidance — that tire carcass or dead mattress — is an obstacle that cannot be avoided. What if a driver falls asleep when it's time to exit?

And how much redundancy must be built into systems and their components before they can be considered fail-safe? For although computers can land a Boeing 747 and put a man on the moon, they can't manage an automated, new-fashioned motorcade when a car in the middle of a pack blows its old-fashioned transmission.

Story by Paul Dean of the Los Angeles Times			
Publication	Origin	Date	Circulation
Los Angeles Times	Los Angeles, CA	July 1, 1997	1,058,498
Boston Sunday Globe	Boston, MA	July 13, 1997	793,672
Sunday Star-Ledger	Newark, NJ	July 13, 1997	710,650
Chicago Sun Times	Chicago, IL	July 7, 1997	501,115
Philadelphia Inquirer	Philadelphia, PA	July 10, 1997	486,318
Indianapolis Star	Indianapolis, IN	July 6, 1997	411,260
Columbus Dispatch	Columbus, OH	July 27, 1997	401,612
Arizona Republic	Phoenix, AZ	July 26, 1997	365,979
Milwaukee Journal Sentinel	Milwaukee, WI	July 6, 1997	348,000
Sun	Baltimore, MD	July 24, 1997	326,864
Charlotte Observer	Charlotte, NC	July 14, 1997	236,579
St. Paul Pioneer Press	St. Paul, MN	July 5, 1997	194,753
Salt Lake Tribune	Salt Lake City, UT	July 21, 1997	186,824
Record	Hackensack, NJ	July 5, 1997	172,000
Sunday Journal	Edmonton, Canada	July 13, 1997	146,208
Journal Gazette	Fort Wayne, IN	July 6, 1997	140,000
News Tribune	Tacoma, WA	July 3, 1997	126,000
Lexington Herald-Leader	Lexintgon, KY	July 3, 1997	119,317
Sunday Times (Central Contra Costa)	Walnut Creek, CA	July 6, 1997	107,221
Advocate	Baton Rouge, LA	July 3, 1997	99,960
Union Leader	Manchester, NH	July 16, 1997	89,000
Modesto Bee	Modesto, CA	July 8, 1997	81,304
Sunday Enterprise	Brockton, MA	July 6, 1997	65,000
Gainsville Sun	Gainesville, FL	July 28, 1997	55,972
Herald	Everett, WA	July 3, 1997	52,254
Yakima Herald-Republic	Yakima, WA	July 3, 1997	42,000
Sun	Bremerton, WA	July 4, 1997	39,103
Sun	Bremerton, WA	July 4, 1997	39,103
Sunday Times (Tri-Valley)	Pleasanton, CA	July 6, 1997	39,077
Sunday Times (West Contra Costa)	Richmond, CA	July 6, 1997	32,721
Bellingham Herald	Bellingham, WA	July 3, 1997	28,500
Santa Fe New Mexican	Santa Fe, NM	July 19, 1997	24,500
Lawrence Daily Journal-World	Lawrence, KS	July 3, 1997	18,501
Los Angeles Times (Washington Edition)	Los Angeles, CA	July 3, 1997	5,500
Sunday Times	Walnut Creek, CA	July 6, 1997	n/a
TOTAL AUDIENCE			4,481,430

HI-TECH HIGHWAY

Car of the future lets the microchip do the driving

By Dana Calvo
The Associated Press

SAN DIEGO — Drivers took the pedal off the metal and their hands off the wheel in a test that some say represents the future of commuting.

Computerized cars made their debut Tuesday on a 7.6-mile experimental stretch of Int. 15. They aren't quite the hovercrafts that George Jetson took to work, but they are a giant leap from your father's Oldsmobile.

Researchers say automated highways and special vehicles — equipped with video cameras, magnets and radar — could reduce accidents, traffic jams and air pollution.

But after a short ride, some drivers got bored.

"It's really exciting for about the first 15 seconds, then it gets really dull," said Jim Rillings of the National Automated Highway System Consortium. "It's like driving with a chauffeur. You just sit back and let your mind wander."

The test was purely a demonstration. The specially equipped cars necessary are not available to the public. The prototype highway should be running by 2002, but the location has not yet been selected.

Tiny magnets embedded in the asphalt enable the magnetized vehicles to constantly stay within the lane's boundaries.

The dozen cars and buses in the demonstration are equipped with small video cameras on their rearview mirrors or windshields that follow visual aids along the road.

The cameras can function at night with headlights illuminating the barriers. A small television screen inside the car shows diagrams of the vehicle in relation to boundaries and other cars, as it maintains a safe distance.

The National Automated Highway System Consortium comprises private and public agencies and universities. Among the participants working to develop the technology are General Motors Corp., Lockheed Martin and Carnegie Mellon University.

There is no price tag for the project, but its supporters insist it will save millions of federal dollars because it relies on existing infrastructure and eliminates the need for building more highway lanes.

Its genesis was a 1991 federal law that empowered the Department of Transportation to develop "fully automated, intelligent vehicle-highway systems."

It would cost less than $10,000 to equip one mile of highway with the new technology, compared with $1 million to $100 million to build one mile of new highway, said Dick Bishop, a spokesman for the Transportation Department.

AP PHOTO

Hung Pham of Honda USA *"drives" along Int. 15 during a demonstration of an automated highway system.*

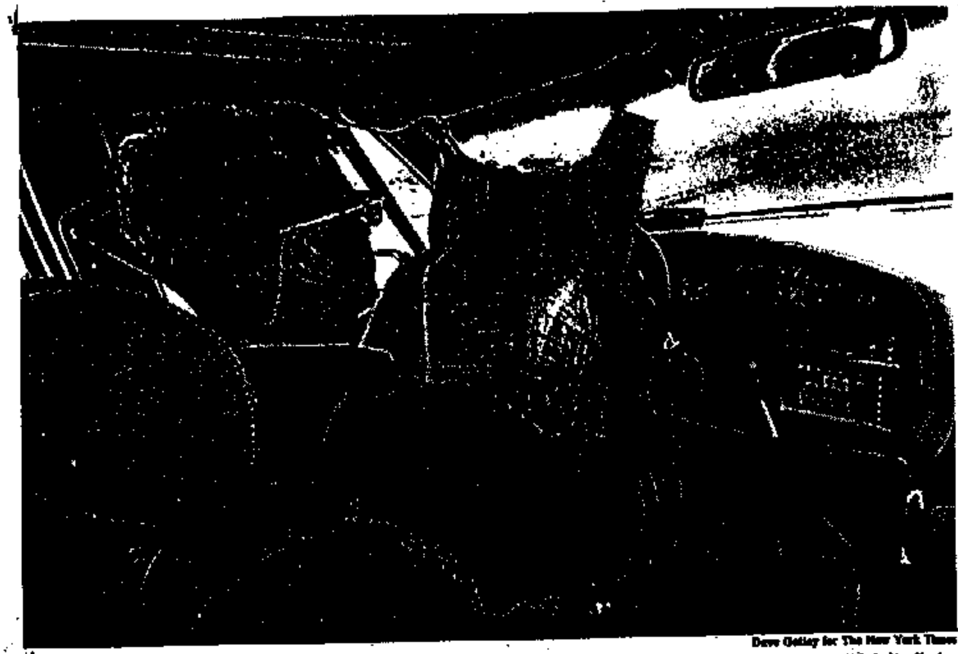
GRAND RAPIDS PRESS
GRAND RAPIDS, MI
DAILY 153,061
WEDNESDAY
JUL 23 1997

Story by Dana Calvo of the Associated Press			
Publication	Origin	Date	Circulation
Kansas City Star	Kansas City, MO	July 26, 1997	297,041
Omaha World-Herald	Omaha, NE	July 23, 1997	238,462
Grand Rapids Press	Grand Rapids, MI	July 23,1997	153,061
Flint Journal	Flint, MI	July 23, 1997	110,000
Indianapolis News	Indianapolis, IN	July 23 ,1997	100,000
New Era	Lancaster, PA	July 23 1997	99,198
Staten Island Advance	Staten Island, NY	July 23 1997	78,000
State Journal-Register	Springfield, IL	July 27, 1997	76,096
Syracuse Herald-Journal	Syracuse, NY	July 23, 1997	73,000
Kalamazoo Gazette	Kalamazoo, MI	July 23, 1997	65,000
Statesman Journal	Salem, OR	July 25, 1997	62,000
Republic-American	Waterbury, CT	July 24, 1997	61,000
Birmingham Post-Herald	Birmingham, AL	July 23 1997	60,592
Huntsville Times	Huntsville, AL	July 23, 1997	59,795
Record	Stockton, CA	July 23 1997	57,837
News Sentinel	Fort Wayne, IN	July 23, 1997	55,000
Ann Arbor News	Ann Arbor, MI	July 23, 1997	54,000
Bay City Times	Bay City, MI	July 27, 1997	51,154
Journal Inquirer	Manchester, CT	July 26, 1997	49,252
Capital	Annapolis, MD	July 23, 1997	48,000
Muskegon Chronicle	Muskegon, MI	July 23 1997	48,000
Macomb Daily	Mt. Clemens, MI	July 27, 1997	47,217
Charleston Daily Mail	Charleston, WV	July 24, 1997	46,000
Tribune Chronicle	Warren, OH	July 23, 1997	45,000
Post-Bulletin	Rochester, MN	July 23, 1997	42,000
Day	New London, CT	July 26, 1997	40,627
North County Times	Oceanside, CA	July 23, 1997	40,316
Dispatch	York, PA	July 23, 1997	40,000
Reporter	Fond Du Lac, WI	July 27, 1997	40,000
Northeast Mississippi Daily Journal	Tupelo, MS	July 26, 1997	38,204
Albuquerque Tribune	Albuquerque, NM	July 23, 1997	35,000
Morning News	Florence, SC	July 27, 1997	33,000
Daily Herald	Provo, UT	July 24, 1997	32,005
Leader-Telegram	Eau Claire, WI	July 23, 1997	32,000
Daily Evening Item	Lynn, Ma	July 23 1997	31,000
Decatur Daily	Decatur, AL	July 23, 1997	31,000
Foster's Daily Democrat	Dover, NH	July 24, 1997	30,136
Daily Journal	Kankakee, IL	July 24, 1997	30,000
St. Cloud Times	St. Cloud, MN	July 23 1997	28,780
Wenatchee World	Wenatchee, WA	July 23, 1997	28,376
Journal-News	Hamilton, OH	July 26, 1997	28,200
Evansville Press	Evansville, IN	July 23 1997	28,073
Janesville Gazette	Janesville, WI	July 23 1997	28,000
Traverse City Record-Eagle	Traverse City, MI	July 24, 1997	27,000
Call	Woonsocket, RI	August 3, 1997	26,000
Wausau Daily Herald	Wausau, WI	July 23 1997	25,700
Salisbury Post	Salisbury, NC	July 27, 1997	25,642
Daily Record	Wooster, OH	July 23 1997	25,200
Herald	Sharon, PA	July 23 1997	25,123
Daily News	Longview, WA	July 23, 1997	25,000

Story by Dana Calvo of the Associated Press			
Publication	Origin	Date	Circulation
Daily News	Lebanon, PA	July 24, 1997	25,000
Middletown Journal	Middletown, OH	July 23, 1997	24,000
Commercial-News	Danville, IL	July 27, 1997	23,700
Monroe Evening News	Monroe, MI	July 23, 1997	23,629
Maui News	Wailuku, HI	July 23 1997	23,000
Meridian Star	Meridian, MS	July 23, 1997	23,000
El Paso Herald Post	El Paso, TX	July 23, 1997	22,266
Daily Park City News	Bowling Green, KY	July 23 1997	22,013
Capital Times	Madison, WI	July 23 1997	22,000
Citizen Tribune	Morristown, TN	July 23, 1997	22,000
Public Opinion	Chambersburg, PA	July 23 1997	22,000
Freeman	Waukesha, WI	July 24, 1997	21,424
Evening Sun	Hanover, PA	July 23 1997	21,000
Rome News-Tribune	Rome, GA	July 23, 1997	21,000
Daily Times Call	Longmont, CO	July 27, 1997	20,367
Idaho State Journal	Pocatello, ID	July 23, 1997	19,500
Daily Sentinel	Rome, NY	July 23, 1997	19,200
Progress-Index	Petersburg, VA	July 23, 1997	19,200
Examiner	Independence, MO	July 23, 1997	19,021
Herald and News	Klamath Falls, OH	July 23, 1997	18,694
Indiana Gazette	Indiana, PA	July 23 1997	18,500
Union-Sun & Journal	Lockport, NY	July 23 1997	18,400
Cecil Whig	Elkton, MD	July 25, 1997	18,000
Sentinel	Carlisle, PA	July 23 1997	18,000
Statesville Record & Landmark	Statesville, NC	July 23, 1997	18,000
Clinton Herald	Clinton, IA	July 23 1997	17,800
Register-Mail	Galesburg, IL	July 24, 1997	17,733
Courier-Tribune	Aseboro, NC	July 23, 1997	17,500
Loveland Daily Reporter-Herald	Loveland, CO	July 23, 1997	17,500
Daily World	Aberdeen, WA	July 23, 1997	17,403
Times News	Leighton, PA	July 23 1997	17,004
Beloit Daily News	Beloit, WI	July 23 1997	17,000
Kane County Chronicle	Geneva, IL	July 24, 1997	17,000
Progress	Clearfield, PA	July 23 1997	17,000
Vicksburg Post	Vicksburg, MS	July 27, 1997	17,000
St. Augustine Record	St. Augustine, FL	July 23, 1997	16,800
Cleveland Daily Banner	Cleveland, TN	July 23 1997	16,571
Brunswick News	Brunswick, GA	July 23, 1997	16,284
Citizen	Auburn, NY	July 23 1997	16,143
La Grange Daily News	La Grange, GA	July 23, 1997	15,765
Daily Bunklin Democrat	Kennett, MO	July 23 1997	15,700
Independent	Gallup, NM	July 24, 1997	15,673
Norman Transcript	Norman, OK	July 23, 1997	15,632
Walla Walla Union-Bulletin	Walla Walla, WA	July 23, 1997	15,532
Independent	Massillon, OH	July 23 1997	15,216
Daily Messenger	Canadaigua, NY	July 23, 1997	15,180
Aiken Standard	Aiken, SC	July 23, 1997	15,000
Daily American Republic	Polar Bluff, MO	July 23 1997	15,000
Times-Mail	Bedford, IN	July 23, 1997	14,878
Clarksburg Telegram	Clarksburg, WV	July 24, 1997	14,786

Story by Dana Calvo of the Associated Press			
Publication	Origin	Date	Circulation
Herald Journal	Logan, UT	July 23 1997	14,665
Newport Daily News	Newport, RI	July 23 1997	14,650
Sanford Herald	Sanford, NC	July 23 1997	14,341
Hays Daily News	Hays, KS	July 23, 1997	14,000
Kansas City Kansan	Kansas City, KS	July 25, 1997	14,000
Times-Union	Warsaw, IN	July 26, 1997	14,000
Daily Mountain Eagle	Jasper, AL	July 23, 1997	13,700
Poway News Chieftan	Poway, CA	July 23, 1997	13,562
Enquirer-Journal	Monroe, NC	July 25, 1997	13,400
Courier Herald	Dublin, GA	July 25, 1997	13,200
Kearney Hub	Kearney, NE	July 23, 1997	13,024
Chronicle	Williamtic, CT	July 26, 1997	13,000
Waycross Journal-Herald	Waycross, GA	July 23, 1997	13,000
Daily Star	Hammond, LA	July 23, 1997	12,504
Daily Herald	Roanoake Rapids, NC	July 23, 1997	12,500
Daily Chronicle	De Kalb, IL	July 23, 1997	12,300
Enterprise-Journal	McComb, MS	July 30, 1997	12,200
Alliance Review	Alliance, OH	July 23 1997	12,000
Garden City Telegram	Garden City, KS	July 23, 1997	12,000
Kerrville Daily Times	Derrville, TX	July 27, 1997	12,000
News Press	Stillwater, OK	July 23, 1997	11,500
Troy Daily News	Troy, OH	July 23, 1997	11,500
Journal	Macon, MO	July 28, 1997	11,358
Bellefontaine Examiner	Bellefontaine, OH	July 23 1997	11,110
Daily Leader	Noblesville, IN	July 23, 1997	11,100
Telegraph	Dixon, IL	July 23, 1997	11,000
Log Cabin Democrat	Conway, AR	July 25, 1997	10,800
Orange Leader	Orange, TX	July 23 1997	10,710
News Virginian	Waynesboro, VA	July 23, 1997	10,581
Fremont Tribune	Fremont, NE	July 23, 1997	10,500
Eagle Times	Claremont, NH	July 23, 1997	10,000
Huron Daily Tribune	Bad Axe, MI	July 23, 1997	10,000
Madison Courier	Madison, IN	July 23, 1997	9,876
Muscatine Journal	Muscatine, IA	July 23, 1997	9,640
Daily Astorian	Astoria, OR	July 24, 1997	9,497
Casa Grande Dispatch	Casa Grande, AZ	July 23, 1997	9,000
Daily News	Greenville, MI	July 23 1997	9,000
Richmond County Daily Journal	Rockingham, NC	July 24, 1997	8,610
Daily Tribune	Hibbing, MN	July 23, 1997	8,500
Virginian Review	Covington, VA	July 23, 1997	8,300
Circleville Herald	Circleville, OH	July 23, 1997	8,100
Delaware Gazette	Delaware, OH	July 24, 1997	8,056
News-Sun	Kendallville, IN	July 23 1997	8,036
Ukiah Daily Journal	Ukiah, CA	August 2, 1997	8,027
Gardner News	Gardner, MA	July 24, 1997	8,000
Today in Peachtree City	Peachtree City, GA	July 24, 1997	8,000
Observer	La Grande, OR	July 23, 1997	7,678
Parsons Sun	Parsons, KS	July 23, 1997	7,445
Urbana Daily Citizen	Urbana, OH	July 25, 1997	7,300
Athens Daily Review	Athens, TX	July 23, 1997	7,200

Story by Dana Calvo of the Associated Press			
Publication	Origin	Date	Circulation
Malone Telegram	Malone, NY	July 23, 1997	7,200
Winchester Sun	Winchester, KY	July 23, 1997	7,200
Sulphur Springs News-Telegram	Sulphur Springs, TX	July 23, 1997	6,700
Greensburg Daily News	Greensburg, IN	July 23, 1997	6,600
Banner Graphic	Greencastle, IN	July 23 1997	6,500
McCurtain Daily Gazette	Idabel, OK	July 23, 1997	6,500
Miami Herald	Miami, FL	July 24, 1997	403555
Constitution-Tribune	Chillicothe, MO	July 23, 1997	5,400
Journal	Ogdensburg, NY	July 23, 1997	5,300
Daily Review	Morgan City, LA	July 23, 1997	5,250
Southbridge Evening News	Southbridge, MA	July 23, 1997	5,000
Sullivan Daily Times	Sullivan, IN	July 23 1997	5,000
Chanute Tribune	Chanute, KS	July 23 1997	4,700
Times-Gazette	Hillsboro, OH	July 26, 1997	4,600
Daily News	Havre, MT	July 23 1997	4,500
Fayete Daily News	Fayetteville, GA	July 24, 1997	4,500
Daily Chief-Union	Upper Sandusky, OH	July 23, 1997	4,400
Journal	Corry, PA	July 23, 1997	4,400
Daily News-Bulletin	Brookfield, MO	July 23 1997	4,000
Rushville Republican	Rushville, IN	July 23, 1997	3,950
Stuttgart Daily Leader	Stuttgart, AR	July 23, 1997	3,800
Banner Tribune	Franklin, LA	July 30, 1997	3,500
Daily Clay County Advocate Press	Flora, IL	July 23 1997	3,500
Daily Capital News	Jefferson City, MO	July 24, 1997	3,452
Alliance Times-Herald	Alliance, NE	July 23 1997	3,414
Mesia Daily News	Mexia, TX	July 23, 1997	3,200
Daily Herald	Tyrone, PA	July 28, 1997	3,047
Dalhart Daily Texan	Dalhart, TX	July 23 1997	2,700
Pecos Enterprise	Pecos, TX	July 23, 1997	2,500
Rensselaer Republican	Rensselaer, IN	July 24 1997	2,468
Estherville Daily News	Estherville, IA	July 24, 1997	2,220
Daily Mail	Hagerstown, MD	July 24, 1997	
TOTAL AUDIENCE			4864727



Dave Gatley for The New York Times

A test of an automated highway system allowed Tad Dockstader to read a newspaper while "driving" the course in San Diego. Perfecting such systems could reduce the number of traffic accidents, researchers say.

High-Tech Travel Gets a Road Test

By TODD S. PURDUM

SAN DIEGO, Aug. 6 — For nine minutes this morning, H. E. Edmonson, last year's runner-up for Houston Metro bus driver of the year, went barreling down a stretch of Interstate 15 here at 45 miles an hour, comfortably ensconced in 20,000 pounds of rolling steel and rubber. His bus sped up and changed lanes to pass, swerved to avoid an orange construction barrel, then slowed to a gentle stop.

No big deal, except for this: Mr. Edmonson's feet never touched the pedals, and his hands never brushed the wheel. He sat in the driver's seat but left all the work to a matchbook-size video camera mounted on the front windshield, radar sensors on the front and sides and a desktop-sized computer stored behind him — and so did the drivers in the other four vehicles on the road around him.

Ralph Kramden never had it so good.

But if the engineers and entrepreneurs gathered here this week for the biggest public test yet of a prototype automated highway system have their way, average drivers in a country that already loves to eat, read and chatter on cell phones behind the wheel will someday have hands-free, high-technology options at their fingertips. Some of those options — like cruise control that slows down and speeds up automatically in sync with the car ahead — are already available on select models in Japan and expected here in just a few years.

"It's great," said Mr. Edmonson, who has been driving buses in Houston for 25 years, although nothing like the red-white-and-blue wonder he drove today. The bus has a camera that can read visual clues, like lane markers or the swath of oil that builds up in the center of a busy roadway, yet lets him resume control at the tap of the brake or a touch of the steering wheel. "I love it," he said. "At first, it was a little scary, but after about five minutes, you get used to it."

Created by Congress as part of the Intermodal Surface Transportation Efficiency Act of 1991 to coordinate research in the field, the National Automated Highway System Consortium is a seven-year, $200 million public-private effort embracing researchers from General Motors, Carnegie-Mellon University and the California and United States Departments of Transportation. Its test, in the controlled-access car-pool lanes of a 7.6-mile stretch of highway here, was to show off the work so far to Congress and corporate executives and keep the research ball rolling.

"It's to get comfortable with the idea that this is not something as far out as you might think," said Jim Rillings, a G.M. research engineer who serves as the consortium's program manager.

Giving motorists more time to read, eat and chat.

Automated highways have been an engineering dream since at least the 1939 World's Fair in New York, where the G.M. Futurama pavilion was a huge hit.

In fact, virtually all the technology used in the tests here already exists, from the $150 video camera on Mr. Edmonson's bus, to common 25-cent refrigerator-style ceramic magnets embedded in the roadway to guide cars in another system under review. It costs an extra $15,000 to outfit the special bus, but engineers envision a day when automated driving systems could be a factory add-on in the range of $500, not much different from leather seats or a fancy stereo.

But the people working automated systems have a far grander goal than turning the family car into a mobile family room. The Government estimates that human error is a contributing factor in 90 percent of the 10.7 million annual automobile accidents and one-third of the 40,000 fatalities.

"If we can take even part of those crashes away, we can save a tremendous number of lives," Dr. Rillings said.

The system has its skeptics. Widespread testing among the general public — not scheduled till 2002 — would require any number of adjustments to existing insurance and liability laws and would doubtless spawn litigation. And while the public now trusts computers in transportation like jet planes and light-rail trams, passengers do not see the hands-free operation close up, and accepting it day-to-day will take some getting used to.

"Would the computer also be able to raise the finger of the driver so they could comment on the person ahead of them?" asked Charles Komanoff, a transportation consultant based in New York. "It seems so Buck Rogers and bizarre that it's hard for me to imagine anything like this would really happen."

Moreover, Mr. Komanoff cautioned, experience has shown that any roadway expansion or engineering advance tends to be offset quickly by increases in road use that swallow up the new capacity.

In fact, the engineers here say, they hope to overcome that by using technology to increase the capacity of existing roads without having to build more. The magnetic-based system developed by California Path, a joint project of the University of California at Berkeley, the California Department of Transportation and G.M. is intended to double or triple lane capacity by allowing cars to travel at high speeds in radio-linked, magnet-guided convoys — as little as 12 feet apart.

In this system, digital radio signals transmitted 50 times a second from the car at the head of the line and each one behind it can guide braking, steering and other functions, all in rapid sequence. The advantage of the magnetic system, its creators say, is that it can work in all weather and road conditions, and it would cost only about $10,000 per lane-mile to fit existing roads with magnets spaced every four feet, as opposed to $1 million to $100 million to build a new lane-mile of road.

HOW IT WORKS

The Automated Automobile

Automated cars, minivans and buses were test-driven on a freeway in San Diego yesterday by the National Automated Highway System Consortium. Here is a how such a car might operate after passing a checkpoint and entering an automated lane.

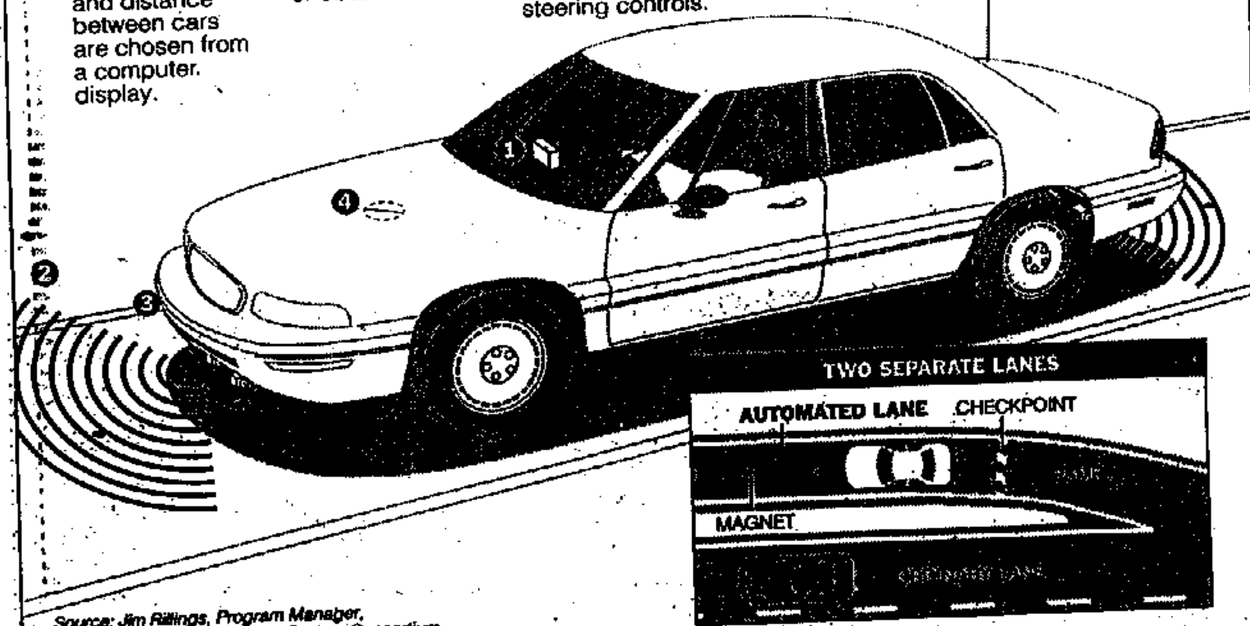
1 Driver sets the car on automatic ...
With a button on the steering wheel. Options for speed, exits and distance between cars are chosen from a computer display.

2 ... engaging front and back sensors.
The sensors scan both ahead and behind the vehicle for cars or obstacles.

3 Magnet detectors center the car in lane ...
The magnet detectors relate to magnets embedded in the road and relay that data to steering controls.

4 ... while throttle controls maintain speed.
Speed is maintained based on information from the front and rear sensors.

Upon reaching the exit the car alerts the driver to retake control. (If the driver doesn't respond, the car will pull over and call 911.)



Source: Jim Rillings, Program Manager, National Automated Highway System Consortium

in/The New York Times; Illustration by John Papasian

NEW YORK TIMES

NEW YORK, NY
DAILY 1,149,700

THURSDAY
AUG 7 1997

Story by Todd S. Purdum of The New York Times			
Publication	Origin	Date	Circulation
New York Times	New York, NY	August 7, 1997	1,149,700
Chicago Tribune	Chicago, IL	August 7, 1997	691,283
San Francisco Chronicle	San Francisco, CA	August 12, 1997	495,286
New York Times (National Edition)	New York, NY	August 7, 1997	248,860
News & Observer	Raleigh, NC	August 7, 1997	153,000
Wisconsin State Journal	Madison, WI	August 8, 1997	86,000
Anderson Independent-Mail	Anderson, SC	August 7, 1997	50,000
Chico Enterprise-Record	Chico, CA	August 9, 1997	29,996
TOTAL AUDIENCE			2,904,125

USA TODAY
Washington, DC
July 23, 1997

Automated highway is a 'no hands' success

Research meets the 7.6-mile road in San Diego

By Martin Kasindorf
USA TODAY

SAN DIEGO — Houston Metro bus driver Max Bonton wouldn't dream of taking his hands off the wheel on crosstown Post Oak Route 33. But on a 7.6-mile stretch of Interstate 15 here Tuesday, he left the driving to the world's smartest bus.

Hands held high and feet off the pedals, Bonton just smiled as the bus accelerated past one car, slowed to keep its distance from another car in front of it, then swerved to avoid a traffic cone.

"At first I was very, very leery of it after years of having control," said Bonton, 46. "After a while, I became comfortable with it."

Transportation researchers hope that in about 15 years, an electronic chauffeur will be just as comfortable to a driving public that is fed up with traffic jams.

Tuesday, the research met the road on a California express lane that was closed to midday traffic.

Meeting a deadline set by Congress in 1991, a consortium of government agencies, industry groups and academia demonstrated competing designs for a 21st-century "National Automated Highway System."

They worked without a glitch.

Among the ideas unveiled:

▶ Automated vehicles. An onboard package of cameras and sensors that would keep a car, truck or bus within lane markings and warn of drivers passing or tailgating.

Houston's transit authority, working with Carnegie-Mellon University, had two buses on the road with equally high-tech cars and vans. Houston residents may see the idea demonstrated locally in November.

▶ "No hands" technology for both the highway and vehicle. A hybrid system controlled by a computer in the trunk would use cameras and radar in rural areas. On urban freeways, the system from American Honda Motor Co. would switch to under-bumper sensors guided by $1 iron magnets that are imbedded in the road every four feet.

▶ An alternative to the magnetic "nails" was a system from Ohio State University that teamed radar with magnetic strips in the road.

Dick Bishop, Federal Highway Administration manager for the automated highway system program, called the demonstration a major "turning point."

He said it would cost less than $10,000 to equip one mile of freeway with the new technology, compared with $1 million to $100 million to build a mile of new highway.

On Aug. 7-10, ordinary drivers will get a chance to attend an exposition on the subject and take short parking lot rides here in San Diego. Politicians and corporate VIPs will get full-fledged rides in the test lane.

Backers of the automated systems want to "build national consensus and get people feeling comfortable with the technology," said Steven Shladover of the University of California, another consortium member.

"The biggest issue for us is what kind of a market there's going to be," said Damon Delorenzis, an engineer with Honda. "How do we build a product that people want to buy."

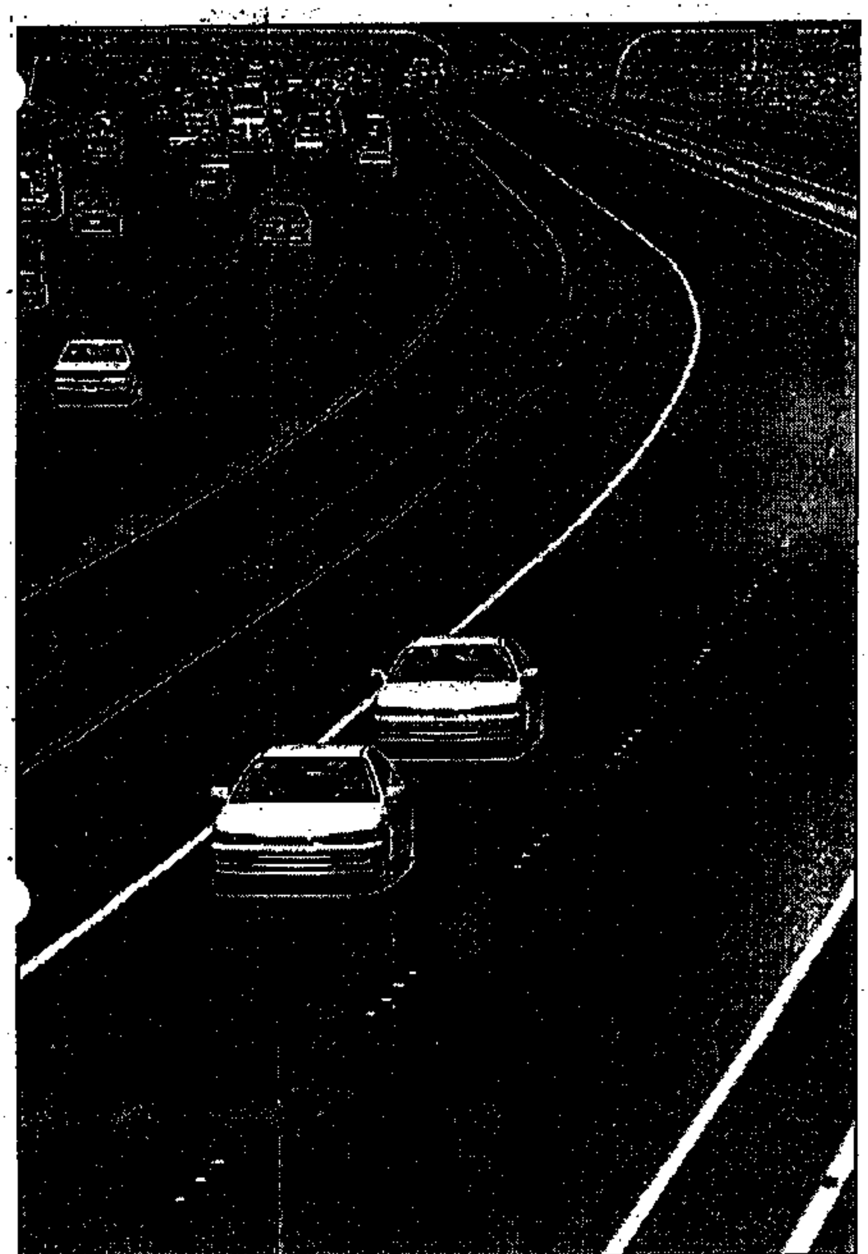
The 1991 Intermodal Surface Transportation Efficiency Act (ISTEA), also known as Iced Tea, mandated work on a prototype for future "fully automated, intelligent vehicle-highway systems."

Total research cost to taxpayers: $200 million.

The 10-member consortium, which includes General Motors, was the winner in a competition to design a prototype for the U.S. Department of Transportation.

The group won't decide which system to focus upon until 2000.

After that, it will be up to officials



By Denis Poroy, AP

Computer controlled: Two Honda Accords magnetic-sensor their way down I-15 in San Diego during a demonstration Tuesday of the automated highway system.

in Washington to decide whether to promote the system for installation by state highway departments — and for use by drivers who could end up paying hundreds of dollars for extra equipment on new cars.

"We can't keep building ourselves out of traffic congestion, so we have to think about new technologies to enhance our freeways," says Hamed Benouar of the California Department of Transportation.

Among the arguments for automated highways:

▶ Enhanced safety as the high-tech gear prevents collisions: 90% of road accidents result from human error, says consortium project manager Jim Rillings.

▶ Greater mobility with shorter or at least more predictable drive times.

▶ Environmental protection. Cars will be bunched together in "platoons" on highways, drafting on each other like racers to burn less fuel.

An eventual automated system may not be entirely Made in the USA.

A European consortium continues to work on collision-avoidance devices it tested in 1994. And Japan got the jump on the USA with tests of an automated roadway in 1995 and 1996.

Long before highways go electronic, planners say, drivers will benefit from "building block" components that already are becoming available to the driving public.

Mitsubishi, for example, already has an advanced cruise control on the market in Japan that automatically slows a car when it gets too close to the car ahead.

Story by Martin Kasindorf of USA Today			
Publication	Origin	Date	Circulation
USA Today	Washington, DC	July 23, 1997	2,100,022
Sacramento Bee	Sacramento, CA	July 25, 1997	275,000
USA Today (European Edition)	Zurich, Switzerland	July 24, 1997	61,066
TOTAL AUDIENCE			2,436,088

WALL STREET JOURNAL

Look Who's Getting a License to Drive

Automated Cars Operate Without Human Drivers

By VALERIE REITMAN
Staff Reporter of THE WALL STREET JOURNAL

The auto industry is moving closer to putting the car itself in the driver's seat.

The result: a car that looks like any other Pontiac Bonneville sedan but that can "drive" on an interstate highway pretty smoothly without the need for a human to press the gas or turn the steering wheel.

Dubbed the Navlab, the car is actually a robot with about $5,000 worth of technological add-ons and some sophisticated software designed by Carnegie-Mellon University scientists.

The Navlab will join a host of other automated cars and transit buses next month on a 7.6-mile drive on a San Diego freeway in a futuristic experiment that seems more fitting for Disneyland. A similar test took place for the media on Tuesday.

Auto makers, including General Motors Corp., Honda Motor Co. and Toyota Motor Corp., are part of a nine-member consortium along with suppliers, universities and mass-transit systems that received a $160 million federal grant in 1994 — partly matched with $40 million from members — to develop automated cars and technologies that could reduce accidents, air pollution and congestion on U.S. roads.

The entries include automated vehicles developed by Honda and Toyota as well as two Houston mass-transit passenger buses retrofitted by Carnegie Mellon and an automated 18-wheel truck developed by Eaton Vorad, a joint venture between Eaton Corp. and IVHS Technologies' Vorad Safety Systems unit. They will pass each other and maneuver around barrels and other obstacles during the experiment that will take over the high-occupancy vehicle lanes of Interstate 15.

To showcase another type of automated-driving technology, those interstate lanes have also been fitted with magnets and magnetic tape that will guide eight Buick LeSabres—modified by General Motors and the University of California. Those cars will be able to drive themselves just 12 feet apart by following the magnets.

But the Navlab and the other automated automobiles aren't anywhere near being ready for mass use. The experiment itself will be tightly controlled, and humans will be in the cars in case of problems. But the Aug. 7-11 demonstration is expected to help experts determine some of the better means for automating driving and highways in the future.

Navlab—the Carnegie-Mellon entry—"sees" the road with a tiny camera mounted behind the rear-view mirror. It feeds information into a standard personal computer in the trunk, which serves as the car's brain and controls its steering. The car brakes and accelerates via intelligence relayed from inconspicuous six-inch side- and front-mounted radars.

Navlab takes cues for staying in its lane by sensing differences in color and texture between the roadway and the roadside gravel, from ruts left by cars, as well as from oil spots that tend to form in the center of the lane from passing cars. Buttons on the steering wheel enable the driver to adjust the speed and program the gap between the cars ahead. Next to the driver, is a computer screen that shows the road ahead with multicolored X's showing the cars in front and behind.

But the car isn't quite perfect yet. For example, Navlab can't go in reverse. It brakes only for metal, not flesh. It can't see in the fog, see red lights or park itself. And since the car's sensors follow the lines on the highway and the cars in front, the Navlab wants to get off at every freeway exit. A driver actually has to prompt the car to pass — otherwise it just follows the car ahead at a distance set by the driver. Navlab's record without any driver intervention: a 122-mile interstate drive from Erie, Pa., to Pittsburgh.

Some people are betting on technologies like those used in Navlab, which runs without external guides in the roads, to be the way of the future. Others favor the alternative: installing magnets in the highway surface — at a cost of $10,000 a mile — that guide the vehicles, allowing them to travel in close proximity at a standard speed even in bad weather. By some estimates, such an externally guided system could triple the capacity of current highways and potentially reduce the need for new highways that cost as much as $100 million a mile, according to the demonstration's sponsor, the National Automated Highway Consortium.

However, plenty of experts, including the developers themselves, doubt that such systems will ever be safe enough for mass use. Chrysler Corp. opted not to participate in the consortium because its own attempts at automation turned comic. Given the number of things that have gone wrong, Chrysler concludes that such systems are "not an intelligent use of technological resources," says Chrysler's vice president of research and development, Bernard Robertson.

Chrysler attempted to adapt the automation technology that guides carts around its factories to cars, which it tested at its own proving ground. Humans could withstand only a few hours of driving Chrysler's test vehicles on the tough road surface, so the idea was to make a roboticized car that could drive for hundreds of hours at a shot to test endurance. The system they designed used robots in the car to send signals to operate the brake and throttle.

But every day at 3 p.m. the cars automatically turned left. (Chrysler later found that a small slit in a sensor was blinding the vehicle when the sun hit a particular point.) Furthermore, the robots would keep driving even when the rear tires fell off because they couldn't sense the damage. "We've had vehicles doing laps with 10 redundant safety systems that climbed a 25-foot beam, fell into a parking lot and crashed into a parked car," says Chrysler spokesman Scott Fosgard.

Mr. Robertson and many others agree that even if vehicles can never be completely driverless, there are some individual features on the vehicles in the demonstration that may well become standard on passenger cars within the next few years.

Story by Valerie Reitman			
Publication	Origin	Date	Circulation
Wall Street Journal (Southwest Edition)	Beaumont, TX	July 25, 1997	171,689
Wall Street Journal (Midwest Edition)	Bowling Green, OH	July 25, 1997	489,998
Wall Street Journal (Eastern Edition)	New York, NY	July 25, 1997	775,153
Wall Street Journal (Western Edition)	Riverside, CA	July 25, 1997	386,367
TOTAL AUDIENCE			1,823,207

BUSINESS WEEK
NEW YORK, NY
WEEKLY 1,000,000

AUG 4 1997

Technology & You

BY LARRY ARMSTRONG

SO THIS IS AUTOPIA

The writer barrels down an automated highway on a car that drives itself

It seems like forever that I've been reading about the imminent debut of smart cars and automated highways. They were a big hit at the 1939 New York World's Fair, I'm told, at General Motors' Futurama pavilion. I even drove a prototype Cadillac with radar braking some 25 years ago. So when a couple of opportunities came up recently to try out cars that steer, accelerate, and brake by themselves, this skeptic took the bait.

The idea behind automated highways is that by taking control of the vehicle out of the hands of the driver, the capacity of existing roads could be doubled or tripled. That's because most of today's congestion is caused by crashes, and 90% of all car accidents are caused by human error.

UNDER CONTROL. The most likely scenario for the automated highway is that you drive your car to specially instrumented lanes of a highway and "check in," much like entering a toll road. Then, the system takes control of the car until you exit, when it steers it to a transition area where you can resume manual driving.

After experimenting with two test systems, my skepticism quickly faded. I was impressed to find that much of the technology exists today and, in fact, some of it is already in today's cars. I think we will ultimately have commercially available smart cars and automated highways. But I expect they'll face limited use over the next 30 years.

For the first test, I went to I-15 in San Diego, where the National Automated Highway System Consortium will run a Congress-mandated demonstration of smart-car technology in early August. The consortium has embedded magnets every four feet along the center of two reversible car-pool lanes that run for nearly eight miles. And it has decked out a fleet of 10 Buick LeSabres with magnetometers under the bumper to sense the magnets and automatically keep the cars in the center of the lane. The magnets have another role as well: Because they can be set with alternating polarities, they can send a series of ones and zeroes to the car, a binary code that can signal exits or the radius of an approaching curve.

Each car also has a radar sensor mounted on the front to assess the distance to the vehicle ahead. There's lots of other gear, too: Motors have to be added to steer and brake, for example, and there are two Pentium 166 computers in the trunk to control everything.

It's a pretty eerie feeling to be barreling down the highway at 65 mph in a convoy. Especially when no one's driving. We were running in a "platoon" of three cars spaced about 20 feet apart. Twelve feet is typical, and better for fuel economy—a savings of about 30%—because the closer spacing cuts down on wind resistance. They can run cars six feet apart, but that's too nerve-racking for the passengers, said an engineer who rode in our car.

On our first run, we had a lucky break. Our radar failed, so we got to see how the system handles breakdowns. The cars talk to one another digitally through a radio link and, in this case, the lead car took control of ours and increased the spacing between us and the other vehicles. With a major catastrophe, such as a blowout, the sys tem would instantaneously hi the brakes on all of the fol lowing cars so the worst tha could be expected is a serie of fender benders.

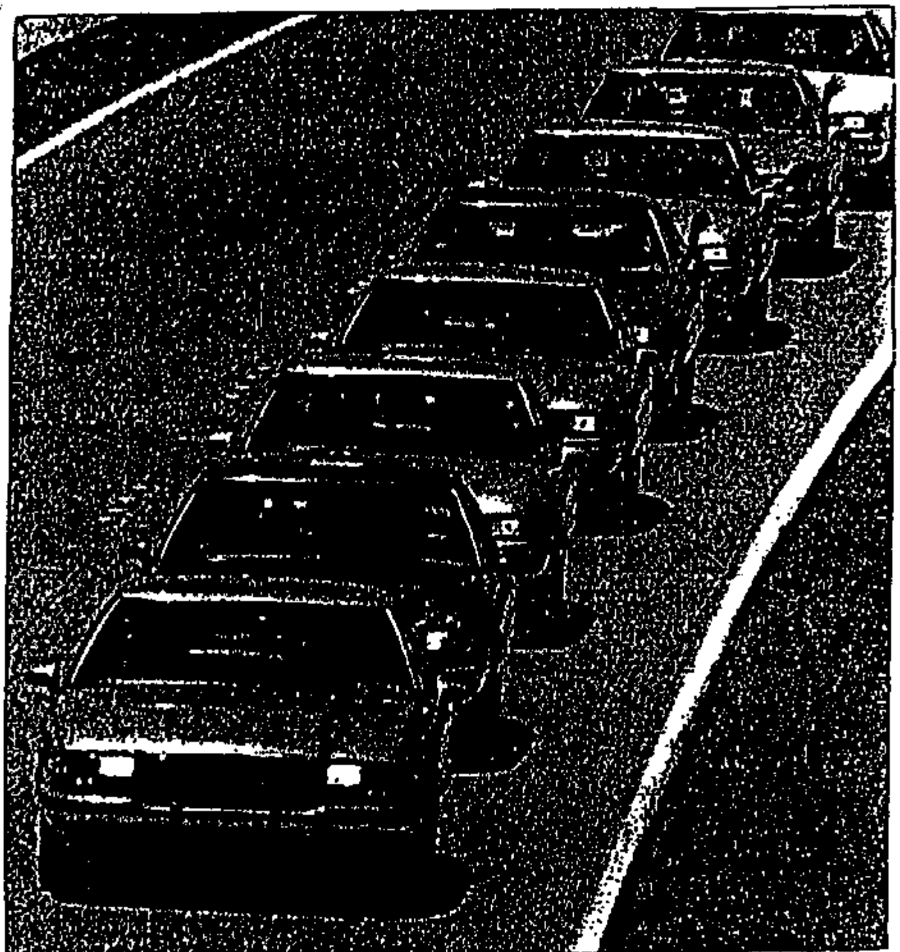
I got to see even mor pieces of the system at a sec ond preview, this one at Hon da Motor's proving ground, 7.5-mile oval in the Mojav Desert. The carmaker ha outfitted two Accords fo hands-free platooning, bu with a difference—it doesn' need the instrumented road way. The cars have a camer trained on the road ahead and the computer keeps th car in the center of the lan by watching the white line between the lanes. One car drove had what's called adap tive cruise control. Instead o keeping the car at a constant speed, it uses a for ward-looking radar t adapt the speed t traffic conditions.

CRUISING. I got on th track, and Honda sen out two other driver just to make it inter esting. I got up to 8 mph and set the cruis control. As I ap proached a slower moving car in front o me, my car slowe down and locked ont its speed. When changed lanes, the ca accelerated back up t 85 mph, passing th other driver. Mitsubish Motors already offer this as an option in th Japanese market.

Although pieces of th technology are starting t show up as options, the con sortium estimates that it's 1 years from tests of complete ly automated highways wit the general public and 2 years away from widesprea use. I'm still not convince that I'll ever be able to set car on autopilot and take nap or watch television o my commute. But the tech nology is creating "co-pilots that now help to make dri ving easier.

Story by Larry Armstrong of Business Week			
Publication	Origin	Date	Circulation
Business Week	New York, NY	August 4, 1997	1,000,000
Business Week (Industrial/Technology Edition)	New York, NY	August 4, 1997	308,831
Business Week (International Edition)	New York, NY	August 4, 1997	103,700
TOTAL AUDIENCE			1,412,531

The Washington Post
SATURDAY, AUGUST 9, 1997
1,163,338 circulation



PHOTOS BY DAVID [illegible]—REUTERS

A line of Buick LeSabres travels the automated highway at 60 mph, bumper to bumper, using magnets embedded in the road for guidance. Drivers take a hands-off approach and wave both arms from windows.

On the Road to the Future

Global Consortium Test-Drives Automated Highway, Cars

By Don Phillips
Washington Post Staff Writer

SAN DIEGO

In the distant past, it didn't matter if a driver fell asleep. The horse knew the way home.

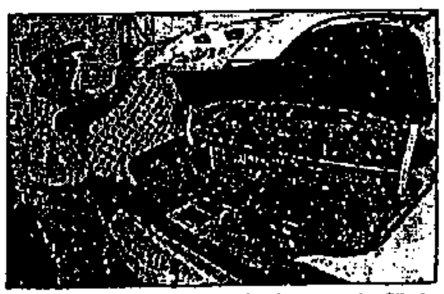
On a hot stretch of interstate highway express lanes here this week, technicians and auto officials were demonstrating to a new generation of driver how those days could come again. This time, all the horses would be under a hood.

"Ultimately it is conceivable you can get in your car in the morning and say, 'Take me to the office,'" said Jeremy Barnes, an official with Toyota Motor Sales U.S.A. Inc. On the way to work, the budding executive could read the paper, make cellular phone calls, eat—anything except touch the wheel, brake or accelerator—while the car does all the driving.

Don't look for a drive-itself auto in the showroom anytime soon, though, for a variety of technological, psychological and cost reasons. But there is little doubt that the basic technology is available and, in its most basic way, will work. And bit by bit, pieces of that technology are likely to show up within a few years on the cars we drive.

Toyota Motor Corp., General Motors Corp. and Honda Motor Co. are part of the National Automated Highway System Consortium, which also includes the federal and California governments, the University of California-Berkeley, Carnegie-Mellon University, Ohio State University and a variety of auto-related suppliers and companies.

See HIGHWAYS, F2, Col. 2



Toyota's Masahiro Mio checks the computer-filled trunk of a Camry used in the recent test.

The National Automated Highway System Consortium

Participants include:

- The U.S. Department of Transportation
- California Department of Transportation
- University of California-Berkeley
- Carnegie-Mellon University
- Ohio State University
- American Honda Motor
- Bechtel
- Delco Electronics
- General Motors
- Lockheed Martin
- Toyota Motor

Technologies seen to be in use:

- Adaptive cruise control: Senses vehicles ahead and alters speed accordingly.
- Obstacle-collision avoidance: Using radar, warns drivers or brakes when obstacles or other cars may cause a collision.
- Lane keeping: Using video cameras, sensors or magnets, warns the driver when the vehicle drifts across a lane.

On the Automated Highway, There Are Self-Driven Cars and Passengers

HIGHWAYS, From F1

This is the midpoint of a long road toward an operational automated highway sometime in the next decade.

It is a road that began as a concept in 1939 at the GM "Futurama" at the New York World's Fair, which forecast the interstate highway system and the automated highway. The interstate system is virtually complete, but there still are no operational automated highways.

The consortium held a sort of coming-out party this week on seven miles of express lanes of Interstate 15 just north of San Diego.

That section of highway is normally closed to ordinary traffic overnight and at midday. During those periods drivers on the adjacent lanes of I-15 are being treated to odd sights: for example, a "platoon" of eight Buick LeSabres driving 60 mph bumper-to-bumper—21 feet apart to be exact—with the drivers waving their arms out the window.

Of course, some of the regular I-15 drivers are tailgating even more impressively, and at a higher speed—although without the benefit of radar, radio data links between cars, magnets embedded in the highway or computer-controlled steering, brakes and throttle.

The Buick-Berkeley platoon "scenario" is one of several experimental concepts exhibited this week. They included some equipment already in service, such as Eaton VORAD Technologies' collision warning system for trucks. Other devices warn drivers that they are drifting off the road and then nudge the tires back automatically if the driver doesn't react.

Some of the scenarios require special roadway equipment, such as magnets embedded in the highway every four feet. But others are designed to allow cars to blend with normal traffic. Toyota demonstrated that a car can accelerate, steer and brake smoothly in stop-and-go traffic, all hands-off, using lasers to watch traffic and a visual imaging system using tiny television cameras to lock in on highway lane markings.

But technology has its limits. It's one thing to control a car on a limited access highway. But what would it do about a ball bouncing across a city street? Would it assume a child would be running after the ball? Not today.

Laser and radar systems today can't even reliably see something as large as a deer in the road, and "the human is not very radar-reflective either," said Mike Wolterman of Toyota.

There's another problem with all the scenarios. Will an American public that still hasn't fully accepted anti-lock brakes accept a computer-controlled car?

"We don't think people are yet ready to accept a car driving itself," said Scott Andrews, project general manager for Toyota's Intelligent Transportation System Group. That is why the Toyota scenario begins only with advice to the driver, who remains in charge. In later stages the car can be fully controlled by the computer.

Even then, Toyota is wary of the American driver. The next model of the Toyota Celsior, sold only in Japan, will offer "adaptive cruise control," a key component of automated cars that slows a car that is approaching an obstacle or is getting too close to the car ahead. The system will not be offered in the United States for five years or more.

"Usually we introduce our new technology in Japan; the Japanese people accept high technology better than this country," said Wolterman, who conversed while driver Bob Krick relaxed and let his Toyota Avalon put itself through its paces automatically.

Also ready, or nearly ready for deployment, is obstacle-collision avoidance, which uses radar to avoid large obstacles, and lane-keeping, which keeps cars from drifting off the road.

But the true automated highway? William M. Spreitzer, technical director for GM's North American Operations and often called the "father of the automated highway," has been involved in this research for 46 years. It's coming, he said.

"It's likely it will roll out over the world in little dribs and drabs and pieces," he said.

APPENDIX F AHS Key Publics Survey

NATIONAL AUTOMATED HIGHWAY

SYSTEM CONSORTIUM SURVEY

RESULTS

PREPARED FOR STRAT@COMM

MAY 1997

INTRODUCTION

Wirthlin Worldwide is pleased to present the results of National Automated Highway System Consortium Survey.

Although the most sophisticated procedures have been used to collect and analyze the information presented here, it must be remembered that surveys are not predictions. They are designed to measure public opinion within identifiable statistical limits of accuracy at specific points in time. This survey is in no way a prediction of opinion or action at any future point in time.

Dee Allsop, Ph.D., Senior Vice President of the Automotive and Public Affairs Team served as principle investigator for this study. Marian T. Chirichella, Research Manager, assisted in all phases of the research.

METHODOLOGY

Sample

Telephone interviews were conducted among one hundred decision-makers in the greater Washington, DC area. More specifically, interviews were conducted among members of Congress (14), Business Executives (27), State/Municipal Officials (37), and members of the Media (22). Overall, the margin of error for a sample size of one hundred is not larger than ± 9.8 percentage points at the 95% confidence level.

Questionnaire

The NAHSC questionnaire was developed jointly by the client and Wirthlin Worldwide. The survey instrument was comprised of eleven closed-end questions and two open-ends questions; interview length was estimated to be between six to seven minutes. The structure of the questionnaire was designed to address the following issues:

- Measure the awareness of Automated Highway Systems.
- Understand how people define Automated Highway Systems.
- Measure effectiveness of Automated Highway Systems' and Technology's ability to solve transportation problems.
- Measure support for Automated Highway Systems research.
- Measure support for government funding of Automated Highway Systems research.
- Measure potential benefits of Automated Highway Systems.

A copy of the questionnaire, completed with top line results, can be found in Attachment A.

DETAILED FINDINGS

While reading through this report, it is important to keep in mind the small sample sizes. Overall, differences in scores, either percents or mean scores, are not statistically significant at the 95% confidence level. Findings of this study may not be projected to the broader universe of key decision-makers.

- Unaided awareness of Automated Highway Systems is very high. The majority of respondents (88%) are aware of Automated Highway Systems (AHS) as they report having seen, heard, or read about this technology.

Respondent Type	Percent Aware
Congress	79%
Executives	89%
State/Municipal	89%
Media	91%

- More than one-half (57%) of respondents clearly understand that AHS is a method whereby "Specially equipped highways and vehicles that "talk" to each other, allowing vehicles to be operated automatically."
  - Familiarity is considerably higher among State/Municipal Officials (68%) and Executives (67%) than among members of the Media (41%) or Congress (36%).

  The remaining 43% of respondents believe that AHS technology relates to:

  - "Transportation management systems that coordinate traffic signals to increase the efficiency of traffic flow," (21%),
  - "Automated toll collection that automatically collects tolls when a driver passes a reader that debits a vehicle-mounted transponder;" (11%), or
  - "In-vehicle computers that provide drivers with directions for the most efficient route," (11%).

- When asked about solving our nation's most pressing transportation problems, respondents aware of the correct technological application of AHS were asked how helpful they thought AHS would be. The majority (88% or 50 respondents) of aware respondents say they AHS would indeed be helpful (35% Very Helpful and 53% Somewhat Helpful).

  On the other hand, respondents unaware of the correct technological application were asked how helpful they thought **technology** would be to solve our nation's transportation problems.

Nearly all (95% or 41 respondents) report that technology would be helpful (53% Very Helpful and 42% Somewhat Helpful).

- A statement briefly describing AHS was read to all respondents. Once informed of what AHS involves and proposes to accomplish, the majority (86%) of respondents favor the continuation of AHS research.

  Opposition to furthering AHS research was voiced by only 5% of respondents; namely, two State/Municipal Officials and three members of the Media.

- More than eight-in-ten (82%) of respondents feel that the federal government should continue to help fund this effort whereby highway and vehicle engineers work together on AHS technologies.

  Once again, opposition (totaling 6%) stems from State/Municipal Officials (two respondents) and members of the Media (four respondents).

- The importance of six potential benefits of AHS were measured on a five-point scale[1]. "AHS will offer improved safety by reducing accidents caused by human error" is perceived as the most important benefit. This is consistent across all respondent types. The following table below details the mean scores for all benefits across all respondent types:

Benefit	Total	Congress	Executives	State/ Municipal	Media
AHS will offer improved safety by reducing accidents caused by human error.	4.1	4.1	4.3	4.2	3.7
AHS will offer improved productivity and a healthier economy.	3.6	3.6	3.8	3.5	3.4
AHS will offer a cleaner environment.	3.6	3.4	3.7	3.6	3.3
AHS will offer better personal mobility.	3.5	3.4	3.5	3.6	3.3
AHS will provide highway users with real-world, near-term benefits.	3.4	3.5	3.5	3.5	2.8
AHS will be adaptable to the unique transportation conditions of virtually every region.	3.4	3.6	3.6	3.4	2.8

[1] 5-point scale where "5" indicates EXTREMELY IMPORTANT and "1" indicates NOT AT ALL IMPORTANT.

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ATTACHMENT 1

QUESTIONNAIRE
AND
VERBATIM COMMENTS

Survey Instrument for NAHSC

NAME: ________________________ **DATE:** __________

ORGANIZATION: ________________________

PHONE NUMBER: ________________________

N = 100
Margin of Error = ± 9.8

To Gate Keeper

Hello, my name is ________________ and I'm calling on behalf of Wirthlin Worldwide. May I please speak with **[Mr./Ms. NAME ON SURVEY]**?

The reason for my call is to ask for **[Mr./Ms. NAME ON SURVEY]'s** participation in a brief **5 MINUTE** confidential interview that will help us better understand attitudes toward an important transportation issue. We know how busy **[Mr./Ms. NAME ON SURVEY]** must be, but as a leader in **[HIS/HER]** field, **[HIS/HER]** participation would greatly help us understand how this issue is perceived by influential individuals.

To Target [Name on Survey]

Hello, my name is ________________ and I'm calling on behalf of Wirthlin Worldwide.

I'm calling to request your participation in a brief **5 MINUTE** confidential interview that will help us better understand the views of influential individuals like yourself toward an important transportation issue. As a leader in your field, your opinions on the issues we will be discussing are very important to us, and I urge you to be candid in your responses.

I want to assure you that your identity and responses will be kept strictly confidential. Data collected in this survey will be reported in aggregate form only, making it impossible to identify individual responses. Our survey is designed to capture opinions. We are not selling any products.

Do you have 5 minutes available to complete the survey?

1 YES **[CONTINUE WITH Q.1]**

2 NO **[ASK: Is there a specific time that would be better for you?]**

If YES: [RECORD TIME / DATE] ________________

If NO: [ASK: Is there an appropriate colleague in your office with whom I could speak?]

[RECORD]

NAME: ________________________

TITLE: ________________________

PHONE NUMBER: ________________________

1. Our nation will be facing many transportation concerns in the near future, including safety, congestion, and the environment. These concerns are expected to heighten as highway travel is forecast to increase 50% by the year 2020. At the same time, increasing highway capacity is becoming more difficult. Some people believe that technology can help. One of those technologies is called Automated Highway Systems, or AHS.

   Have you ever seen, heard, or read anything about Automated Highway Systems, or AHS?

   (Do __not read__ response categories. Circle only __one response__.)

   88% YES **[ASK Q.1A]**

   9% NO **[GO TO Q.2]**

   3% DON'T KNOW/REFUSED **[GO TO Q.2]**

   1A Where did you hear about Automated Highway Systems?
   See listouts

2. In your opinion, which of the following statements best describes your understanding of an Automated Highway System?

   (__Read__ each statement slowly and clearly. Circle only __one response__.)

   [ROTATE STATEMENTS]

   11% A Automated toll collection that automatically collects tolls when a driver passes a reader that debits a vehicle-mounted transponder. **[ASK Q.4.]**

   21% B Transportation management systems that coordinate traffic signals to increase the efficiency of traffic flow. **[ASK Q.4.]**

   57% C Specially equipped highways and vehicles that "talk" to each other, allowing vehicles to be operated automatically. **[ASK Q.3.]**

   11% D In-vehicle computers that provide drivers with directions for the most efficient route. **[ASK Q.4.]**

[ASK Q.3. ONLY OF THOSE WHO SELECT RESPONSE C IN Q.2]

3. How helpful do you believe **Automated Highway Systems** can be in solving our nation's most pressing transportation problems such as safety and congestion? Would it be......?

   (__Read__ response categories. Circle only __one response__.) **[CONTINUE WITH Q.5]**

N = 57

   35% VERY HELPFUL

   53% SOMEWHAT HELPFUL

   9% NOT VERY HELPFUL

   0% NOT AT ALL HELPFUL

   4% **[DO NOT READ]** NO OPINION

[ASK Q.4. ONLY OF THOSE WHO SELECT RESPONSE A, B, OR D IN Q.2]

4. How helpful do you believe **technology** can be in solving our nation's most pressing transportation problems? Would it be....?

(Read response categories. Circle only one response.) **[CONTINUE WITH Q.5]**

N = 43

53% VERY HELPFUL

42% SOMEWHAT HELPFUL

2% NOT VERY HELPFUL

0% NOT AT ALL HELPFUL

2% **[DO NOT READ]** NO OPINION

5. Now I'd like to tell you a little about Automated Highway Systems. An AHS is a system of highways and vehicles equipped with special equipment that "talk" to each other, allowing automatic operation of the vehicle. Many AHS technologies are road-ready or almost road-ready. These technologies include:

Adaptive Cruise Control, which senses vehicles ahead and alters speed accordingly,

Obstacle Detection and Collision Avoidance, which detects obstacles or other vehicles in the road and safely adjusts the vehicle's course, and

Lane Keeping, in which vehicle sensors track the highway lane, ensuring the vehicle stays in the proper lane.

AHS has the potential to improve safety, decrease congestion, and improve air quality. Based on what you have just heard and what you may already know, do you FAVOR or OPPOSE AHS research?

(Do not read response categories. Circle only one response.)

86% FAVOR

5% OPPOSE

9% DON'T KNOW/REFUSED

6. Currently, highway and vehicle engineers are working together on AHS technologies, funded in part by the federal government. Do you believe the federal government should continue to help fund AHS research?

(Do not read response categories. Circle only one response.)

82% YES

6% NO

12% DON'T KNOW/REFUSED

7. AHS offers our nation many potential benefits. For each of the following potential AHS benefits, please rate the importance of that benefit. Please use a scale from 1 to 5 where "5" means the benefit is EXTREMELY IMPORTANT and "1" means the benefit is NOT AT ALL IMPORTANT.

[ROTATE AND READ STATEMENTS. ***Repeat scale for first two or three statements and then as needed. Circle only*** ***<u>one response</u>*** ***for each statement.*****]**

MEAN		EXTREMELY	NOT AT ALL 1				5	
3.4	A	AHS will provide highway users with real-world, near-term benefits. (If clarification is needed: such as improved safety, less congestion, and cleaner air.)	1	2	3	4	5	DK
3.4	B	AHS will be adaptable to the unique transportation conditions of virtually every region. (If clarification is needed: These conditions could include urban vs. rural highways; congested vs. uncongested traffic; flat or mountainous topography; automobile, truck, bus traffic; cold/wet and hot/dry climates.)	1	2	3	4	5	DK
4.1	C	AHS will offer improved safety by reducing accidents caused by human error.	1	2	3	4	5	DK
3.5	D	AHS will offer better personal mobility – More vehicles and people traveling more efficiently.	1	2	3	4	5	DK
3.6	E	AHS will offer improved productivity and a healthier economy – Goods move more swiftly, more predictably.	1	2	3	4	5	DK
3.6	F	AHS will offer a cleaner environment – Fewer emissions, less fuel wasted in stop-and-go congestion. Less land consumed by new highway construction.	1	2	3	4	5	DK

8. Are there any other thoughts you would like to express?

(Record a few key statements on the lines below.)

See Listouts

SAMPLE:

BASE = TOTAL REPONDENTS	100
Congress	14
Executives	27
State/Municipal	37
Media	22

Thank you for your time and cooperation!

STUDY #1131 NAHSC Q.1A

Question 1a. ***Where did you hear about Automated Highway Systems?***

CONGRESS

Briefing on ITS.
Course of her work. Work on Intelligent Transportation System.
Familiar with ITS.
In office.
Involved in creating a problem.
Magazine.
Newspaper.
On the Hill.
Other people.
Person he works for is member of Transportation Committee.
Publications.
Don't know.

EXECUTIVES

At work.
At work.
Congressional testimony.
Context of work.
Discussion and reports.
Division administration in California, a lot of testing done there.
Don't know.
Federal highway is leader in development.
FHS does a lot of research on ITS.
Head of strategic planning for FHA.
Intelligent Vehicle Program, ITS.
ITS America, ITS.
ITS, Intelligent Transportation System.
ITS.
Job.
Newspaper. He was just on AHS in San Diego.
Sponsored by his department.
Through work.
Work for Federal Highway.
Work for FHWA.
Work for U.S. DOT.
Work with it everyday. ITS.
Work, job.
Working in transportation. Intelligent Vehicle Highway System.
Works for FHWA.

STATE/MUNICIPAL

Attended AHS meetings.
Attended NAHS Symposium put on by ITS.
Belong to Institute of Transportation Engineers.
Call it ITS.
Conferences. MUTD member.
Convention AASHTO.
Familiar with ITS.
Familiar with ITS.
Get all of the ITS information.
Involved with ITS.
ITS America. On mailing list for CA Project.
ITS Coordinator.
ITS Coordinator. Associate Member of AHS.
ITS.
ITS. General Motors.
Journals.
Journals.
Magazine.
Magazine.
Magazine. Institute of Traffic Engineer.
Market package that uses their service.
Member of AHS Consortium.
Member of NAHS.
Professional literature. ITS.
Read about it in publications.
Research articles.
Stockholder's meeting.
Through involvement in ITS.
Through my job.
Trade magazine.
Trade publications. Better Roads. Roads and Bridges. ITS Magazines.
Was in one of the consortiums.
Work on it.
Work.
Workshop in Ft. Lauderdale by AHS.

MEDIA

Came up in research.
Corporate literature. Trade press.
General Motors
Her job.
His magazine.
His work.
Industry publications.
ITS materials.
Magazine.
New York Times Magazine.
Newspaper.
Periodicals.
Read press brief on San Diego test.
Television.
Television.
Through publications.
TV and publications.
Various publications.
Wrote about it.

TOTAL

At work.
At work.
Attended AHS meetings.
Attended NAHS Symposium put on by ITS.
Belong to Institute of Transportation Engineers.
Briefing on ITS.
Call it ITS.
Came up in research.
Conferences. MUTD member.
Congressional testimony.
Context of work.
Convention AASHTO.
Corporate literature. Trade press.
Course of her work. Work on Intelligent Transportation System.
Discussion and reports.
Division administration in California, a lot of testing done there.
Familiar with ITS.
Familiar with ITS.
Familiar with ITS.
Federal highway is leader in development.
FHS does a lot of research on ITS.
General Motors
Get all of the ITS information.
Head of strategic planning for FHA.
Her job.

His magazine.
His work.
In office.
Industry publications.
Intelligent Vehicle Program, ITS.
Involved in creating a problem.
Involved with ITS.
ITS America, ITS.
ITS America. On mailing list for CA Project.
ITS Coordinator.
ITS Coordinator. Associate Member of AHS.
ITS materials.
ITS, Intelligent Transportation System.
ITS.
ITS.
ITS. General Motors.
Job.
Journals.
Journals.
Magazine.
Magazine.
Magazine.
Magazine.
Magazine. Institute of Traffic Engineer.
Market package that uses their service.
Member of AHS Consortium.
Member of NAHS.
New York Times Magazine.
Newspaper.
Newspaper.
Newspaper. He was just on AHS in San Diego.
On the Hill.
Other people.
Periodicals.
Person he works for is member of Transportation Committee.
Professional literature. ITS.
Publications.
Read about it in publications.
Read press brief on San Diego test.
Research articles.
Sponsored by his department.
Stockholder's meeting.
Television.
Television.
Through involvement in ITS.
Through my job.
Through publications.
Through work.
Trade magazine.
Trade publications. Better Roads. Roads and Bridges. ITS Magazines.

TV and publications.
Various publications.
Was in one of the consortiums.
Work for Federal Highway.
Work for FHWA.
Work for U.S. DOT.
Work on it.
Work with it everyday. ITS.
Work, job.
Work.
Working in transportation. Intelligent Vehicle Highway System.
Works for FHWA.
Workshop in Ft. Lauderdale by AHS.
Wrote about it.
Don't know.
Don't know.

STUDY #1131 NAHSC Q.8

Question 8. ***Are there any other thoughts you would like to express?***

CONGRESS

Don't think it will be economic.
Focus on showing how it's going to work.
ITS is how they use this in Washington. Never heard of AHS.

EXECUTIVES

AHS is a long range proposal. ITS will bring benefits far quicker.
AHS is interesting.
AHS is way overrated for the present capability. Way too much money going into the project considering the time it's taking to complete.
Clarify time arising. Push research towards the vehicle. It's not clear who will pay for the supporting highway infrastructure.
Don't think survey is appropriate to his class of people, works for FHWA.
Entire survey is biased.
He was just on AHS in San Diego.
Increase use of technology is only way of having to deal with congestion, etc.
Technology is tremendous. Should be directed towards vehicles.
The most important immediate application will be in the work zone.
Two areas sometimes are overlooked. One, movement of goods increases in productivity. Two, the value of public transit for not only moving people, but also alleviating congestion that benefits the movement of goods.
She knows Richard Wirthlin and thinks very highly of him.
Vested interest in making the system work.
Would like a copy of report.

STATE/MUNICIPAL

AHS does offer potential for long distance traveling, however doesn't help urban which needs more attention at this time.
AHS is not going to completely solve highway problems.
AHS only addresses a part of the problem, only on the freeway.
AHS will be great in congested urban areas.
Before AHS can be implemented there is going to have to be a tremendous amount of education in simple terms to people.
Cost to individual and ability to equip existing roads biggest concern.
Don't know whether potential is there in short term.
Emerging technology, look forward to seeing more information.
Firmly believe operation of heavy vehicles will be where AHS will have it's most positive support.
Goes against human nature.
Has effect on region, economy, and environment.
It's destined to come about. Other benefits that haven't been discussed.
Need to make a start now. No need to wait 20 or 30 years from now.
The concept of infrastructure as far as highways. Separate lanes for AHS.
The government has to stay in the highly.

The way to go.
The whole highway system is moving in this direction, but needs a lot of support and lobbying.
Would like copy of statement when it's compiled.

MEDIA

AHS is viable only if it offers users attractive benefits not available in manual lane such as speed limit of 100.
Cost of system to consumers.
Good overall, but doesn't think he'd like to commute in one.
Government needs to crack down on individual driver ability. More stringent driver test.
I think it's marvelous technology.
No, he's a reporter. Doesn't give any opinions.
Nonsense, people will not give up their control.
Not much knowledge of subject.
Questions overly general.
Transportation is a very important issue. Technology alone is not going to help solve it.
Would like to know when this will be implemented.

TOTAL

AHS does offer potential for long distance traveling, however doesn't help urban which needs more attention at this time.
AHS is a long range proposal. ITS will bring benefits far quicker.
AHS is interesting.
AHS is not going to completely solve highway problems.
AHS is viable only if it offers users attractive benefits not available in manual lane such as speed limit of 100.
AHS is way overrated for the present capability. Way too much money going into the project considering the time it's taking to complete.
AHS only addresses a part of the problem, only on the freeway.
AHS will be great in congested urban areas.
Before AHS can be implemented there is going to have to be a tremendous amount of education in simple terms to people.
Clarify time arising. Push research towards the vehicle. It's not clear who will pay for the supporting highway infrastructure.
Cost of system to consumers.
Cost to individual and ability to equip existing roads biggest concern.
Don't know whether potential is there in short term.
Don't think it will be economic.
Don't think survey is appropriate to his class of people, works for FHWA.
Emerging technology, look forward to seeing more information.
Entire survey is biased.
Firmly believe operation of heavy vehicles will be where AHS will have it's most positive support.
Focus on showing how it's going to work.
Goes against human nature.
Good overall, but doesn't think he'd like to commute in one.
Government needs to crack down on individual driver ability. More stringent driver test.
Has effect on region, economy, and environment.
He was just on AHS in San Diego.
I think it's marvelous technology.
Increase use of technology is only way of having to deal with congestion, etc.

It's destined to come about. Other benefits that haven't been discussed.
ITS is how they use this in Washington. Never heard of AHS.
Need to make a start now. No need to wait 20 or 30 years from now.
No, he's a reporter. Doesn't give any opinions.
Nonsense, people will not give up their control.
Not much knowledge of subject.
Questions overly general.
Technology is tremendous. Should be directed towards vehicles.
The concept of infrastructure as far as highways. Separate lanes for AHS.
The government has to stay in the highly.
The most important immediate application will be in the work zone.
The way to go.
The whole highway system is moving in this direction, but needs a lot of support and lobbying.
Transportation is a very important issue. Technology alone is not going to help solve it.
Two areas sometimes are overlooked. One, movement of goods increases in productivity. Two, the value of public transit for not only moving people, but also alleviating congestion that benefits the movement of goods.
She knows Richard Wirthlin and thinks very highly of him.
Vested interest in making the system work.
Would like a copy of report.
Would like copy of statement when it's compiled.
Would like to know when this will be implemented.

ATTACHMENT 2

CROSS TABULATIONS

WIRTHLIN WORLDWIDE
NAHSC STUDY CROSS TABULATIONS / 1131-31 / APRIL - MAY 1997

Table 1

Q 1: Our nation will be facing many transportation concerns in the near future, including safety, congestion, and the environment. These concerns are expected to heighten as highway travel is forecasted to increase 50% by the year 2020. At the same time, increasing highway capacity is becoming more difficult. Some people believe that technology can help. One of those technologies is called Automated Highway Systems, or AHS.

Have you ever seen, heard, or read anything about Automated Highway Systems, or AHS?

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understanding		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Somewhat Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base= Total Respondents	100	14**	27**	37*	22**	88*	9**	57*	43*	50*	41*	86*	5**	82*	6**
	100%	100%**	100%**	100%*	100%**	100%*	100%**	100%*	100%*	100%*	100%*	100%*	100%**	100%*	100%**
Yes	88	11	24	33	20	88	-	56	32	49	30	76	4	73	5
	88%	79%	89%	89%	91%	100%	-	98%H	74%	98%J	73%	88%	80%	89%	83%
No	9	3	2	2	2	-	9	-	9	-	9	8	1	6	1
	9%	21%	7%	5%	9%	-	100%	-	21%G	-	22%I	9%	20%	7%	17%
Don't Know/ Refused	3	-	1	2	-	-	-	1	2	1	2	2	-	3	-
	3%	-	4%	5%	-	-	-	2%	5%	2%	5%	2%	-	4%	-

Columns Tested (5% risk level) - A/B/C/D - E/F - G/H - I/J - K/L - M/N
small base; ** very small base (under 30) ineligible for significant testing

Table 2

Q 2: In your opinion, which of the following statements best describes your understanding of an Automated Highway System?

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understanding		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Somewhat Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Total Respondents	100	14**	27**	37*	22**	88*	9**	57*	43*	50*	41*	86*	5**	82*	6**
	100%	100%**	100%**	100%*	100%**	100%*	100%**	100%*	100%*	100%*	100%*	100%*	100%**	100%*	100%**
Automated toll collection that automatically collects toll when driver passes a reader that debits a vehicle-mounted transponder	11	2	4	1	4	10	1	-	11	-	10	10	1	8	2
	11%	14%	15%	3%	18%	11%	11%	-	26%G	-	24%I	12%	20%	10%	33%
Transportation management systems that coordinate traffic signals to increase the efficiency of traffic flow	21	4	3	6	8	16	5	-	21	-	20	16	3	14	3
	21%	29%	11%	16%	36%	18%	56%	-	49%G	-	49%I	19%	60%	17%	50%
Specially equipped highways and vehicles that "talk" to each other, allowing vehicles to be operated automatically	57	5	18	25	9	56	-	57	-	50	-	51	1	50	1
	57%	36%	67%	68%	41%	64%	-	100%H	-	100%J	-	59%	20%	61%	17%

Table 2 (Continued)

Q 2: In your opinion, which of the following statements best describes your understanding of an Automated Highway System?

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understanding		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Somewhat Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Total Respondents	100	14**	27**	37*	22**	88*	9**	57*	43*	50*	41*	86*	5**	82*	6**
	100%	100%**	100%**	100%*	100%**	100%*	100%**	100%*	100%*	100%*	100%*	100%*	100%**	100%*	100%**
In-vehicle computers that provide drivers with directions for the most efficient route	11	3	2	5	1	6	3	-	11	-	11	9	-	10	-
	11%	21%	7%	14%	5%	7%	33%	-	26%G	-	27%I	10%	-	12%	-

Table 3

Q 3: How helpful do you believe AUTOMATED HIGHWAY SYSTEMS can be in solving our nation's most pressing transportation problems such as safety and congestion? Would it be....?

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understand-ing		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Some-what Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Respondents who selected spe-cially equipped highways and vehi-cles that "talk" to each other in Q.2.	57*	5**	18**	25**	9**	56*	-**	57*	-**	50*	-**	51*	1**	50*	1**
	100%*	100%**	100%**	100%**	100%**	100%*	-**	100%*	-**	100%*	-**	100%*	100%**	100%*	100%**
**D/S (Total Help-ful - Total Not)	45	3	13	23	6	44	0	45	0	50	0	44	1	42	1
	79%	60%	72%	92%	67%	79%	0%	79%	0%	100%	0%	86%	100%	84%	100%
Total Helpful	50	4	15	24	7	49	-	50	-	50	-	47	1	46	1
	88%	80%	83%	96%	78%	88%	-	88%	-	100%	-	92%	100%	92%	100%
Very Helpful	20	-	10	7	3	19	-	20	-	20	-	19	-	19	-
	35%	-	56%	28%	33%	34%	-	35%	-	40%	-	37%	-	38%	-
Somewhat Helpful	30	4	5	17	4	30	-	30	-	30	-	28	1	27	1
	53%	80%	28%	68%	44%	54%	-	53%	-	60%	-	55%	100%	54%	100%
Total Not Helpful	5	1	2	1	1	5	-	5	-	-	-	3	-	4	-
	9%	20%	11%	4%	11%	9%	-	9	-	-	-	6%	-	8%	-
Not Very Helpful	5	1	2	1	1	5	-	5	-	-	-	3	-	4	-
	9%	20%	11%	4%	11%	9%	-	9%	-	-	-	6%	-	8%	-

Table 3 (Continued)

Q 3: How helpful do you believe AUTOMATED HIGHWAY SYSTEMS can be in solving our nation's most pressing transportation problems such as safety and congestion? Would it be....?

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understand-ing		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Some-what Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Respondents who selected specially equipped highways and vehicles that "talk" to each other in Q.2.	57*	5**	18**	25**	9**	56*	-**	57*	-**	50*	-**	51*	1**	50*	1**
	100%*	100%**	100%**	100%**	100%**	100%*	-**	100%*	-**	100%*	-**	100%*	100%**	100%*	100%**
Not At All Helpful	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No Opinion	2	-	1	-	1	2	-	2	-	-	-	1	-	-	-
	4%	-	6%	-	11%	4%	-	4%	-	-	-	2%	-	-	-

Table 4

Q 4: How helpful do you believe TECHNOLOGY can be in solving our nation's most pressing transportation problems?

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understanding		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Somewhat Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base respondent who selected automated toll collection/ transportation management system/ in-vehicle computers in Q.2.	43*	9**	9**	12**	13**	32*	9**	-**	43*	-**	41*	35*	4**	32*	5**
	100%*	100%**	100%**	100%**	100%**	100%*	100%**	-**	100%*	-**	100%*	100%*	100%**	100%*	100%**
**D/S (Total Helpful - Total Not Helpful)	40	9	9	11	11	29	9	0	40	0	41	34	2	32	3
	93%	100%	100%	92%	85%	91%	100%	0%	93%	0%	100%	97%	50%	100%	60%
Total Helpful	41	9	9	11	12	30	9	-	41	-	41	34	3	32	4
	95%	100%	100%	92%	92%	94%	100%	-	95%	-	100%	97%	75%	100%	80%
Very Helpful	23	4	7	7	5	19	4	-	23	-	23	21	-	19	1
	53%	44%	78%	58%	38%	59%	44%	-	53%	-	56%	60%	-	59%	20%
Somewhat Helpful	18	5	2	4	7	11	5	-	18	-	18	13	3	13	3
	42%	56%	22%	33%	54%	34%	56%	-	42%	-	44%	37%	75%	41%	60%
Total Not Helpful	1	-	-	-	1	1	-	-	1	-	-	-	1	-	1
	2%	-	-	-	8%	3%	-	-	2%	-	-	-	25%	-	20%

Table 4 (Continued)

Q 4: How helpful do you believe TECHNOLOGY can be in solving our nation's most pressing transportation problems?

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understanding		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Somewhat Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base respondent who selected automated toll collection/ transportation management system/ in-vehicle computers in Q.2.	43*	9**	9**	12**	13**	32*	9**	-**	43*	-**	41*	35*	4**	32*	5**
	100%*	100%**	100%**	100%**	100%**	100%*	100%**	-**	100%*	-**	100%*	100%*	100%**	100%*	100%**
Not Very Helpful	1	-	-	-	1	1	-	-	1	-	-	-	1	-	1
	2%	-	-	-	8%	3%	-	-	2%	-	-	-	25%	-	20%
Not At All Helpful	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No Opinion	1	-	-	1	-	1	-	-	1	-	-	1	-	-	-
	2%	-	-	8%	-	3%	-	-	2%	-	-	3%	-	-	-

Table 5

Q 5: Now I'd like to tell you a little about Automated Highway Systems. An AHS is a system of highways and vehicles equipped with special equipment that "talk" to each other, allowing automatic operation of the vehicle. Many AHS technologies are road-ready or almost read-ready. These technologies include: ADAPTIVE CRUISE CONTROL, OBSTACLE DETECTION AND COLLISION AVOIDANCE, LANE KEEPING.

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understand-ing		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Some-what Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Total Respondents	100 100%	14** 100%**	27** 100%**	37* 100%*	22** 100%**	88* 100%*	9** 100%**	57* 100%*	43* 100%*	50* 100%*	41* 100%*	86* 100%*	5** 100%**	82* 100%*	6** 100%**
Favor	86 86%	14 100%	24 89%	31 84%	17 77%	76 86%	8 89%	51 89%	35 81%	47 94%	34 83%	86 100%	- -	78 95%	1 17%
Oppose	5 5%	- -	- -	2 5%	3 14%	4 5%	1 11%	1 2%	4 9%	1 2%	3 7%	- -	5 100%	- -	5 83%
Don't Know / Refused	9 9%	- -	3 11%	4 11%	2 9%	8 9%	- -	5 9%	4 9%	2 4%	4 10%	- -	- -	4 5%	- -

Table 6

Q 6: Currently, highway and vehicle engineers are working together on AHS technologies, funded in part by the federal government. Do you believe the federal government should continue to help fund AHS research?

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understanding		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Somewhat Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Total Respondents	100	14**	27**	37*	22**	88*	9**	57*	43*	50*	41*	86*	5**	82*	6**
	100%	100%**	100%**	100%*	100%**	100%*	100%**	100%*	100%*	100%*	100%*	100%*	100%**	100%*	100%**
Yes	82	11	23	33	15	73	6	50	32	46	32	78	-	82	-
	82%	79%	85%	89%	68%	83%	67%	88%	74%	92%	78%	91%	-	100%	-
No	6	-	-	2	4	5	1	1	5	1	4	1	5	-	6
	6%	-	-	5%	18%	6%	11%	2%	12%G	2%	10%	1%	100%	-	100%
Don't Know / Refused	12	3	4	2	3	10	2	6	6	3	5	7	-	-	-
	12%	21%	15%	5%	14%	11%	22%	11%	14%	6%	12%	8%	-	-	-

Table 7 AHS WILL PROVIDE HIGHWAY USERS WITH REAL-WORLD, NEAR-TERM BENEFITS

Q 7A: AHS offers our nation many potential benefits. For each of the following potential AHS benefits, please rate the importance of that benefit. Please use a scale from 1 to 5 where "5" means the benefit is EXTREMELY IMPORTANT and "1" means the benefit is NOT AT ALL IMPORTANT.

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understanding		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Somewhat Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Total Respondents	100 100%	14** 100%**	27** 100%**	37* 100%*	22** 100%**	88* 100%*	9** 100%**	57* 100%*	43* 100%*	50* 100%*	41* 100%*	86* 100%*	5** 100%**	82* 100%*	6** 100%**
(5) Extremely Important	17 17%	1 7%	7 26%	8 22%	1 5%	15 17%	- -	10 18%	7 16%	10 20%	7 17%	16 19%	- -	17 21%	- -
(4)	29 29%	6 43%	7 26%	11 30%	5 23%	26 30%	3 33%	16 28%	13 30%	16 32%	13 32%	28 33%	- -	26 32%	- -
(3)	31 31%	5 36%	7 26%	12 32%	7 32%	27 31%	4 44%	19 33%	12 28%	16 32%	12 29%	29 34%	- -	26 32%	1 17%
(2)	5 5%	1 7%	- -	2 5%	2 9%	5 6%	- -	3 5%	2 5%	2 4%	2 5%	3 3%	2 40%	3 4%	2 33%
(1) Not At All Important	11 11%	- -	4 15%	3 8%	4 18%	8 9%	2 22%	4 7%	7 16%	3 6%	5 12%	7 8%	3 60%	7 9%	3 50%
Don't Know / Refused	7 7%	1 7%	2 7%	1 3%	3 14%	7 8%	- -	5 9%	2 5%	3 6%	2 5%	3 3%	- -	3 4%	- -
Mean	3.4	3.5	3.5	3.5	2.8	3.4	2.9	3.5	3.3	3.6	3.4	3.5	1.4	3.5	1.7
Standard Deviation	1.20	0.78	1.36	1.16	1.21	1.16	1.17	1.11	1.30	1.08	1.23	1.11	0.55	1.14	0.82
Standard Error	0.12	0.22	0.27	0.19	0.28	0.13	0.39	0.15	0.20	0.16	0.20	0.12	0.24	0.13	0.33

Table 8 AHS WILL BE ADAPTABLE TO THE UNIQUE TRANSPORTATION CONDITIONS OF VIRTUALLY EVERY REGION

Q 7B: AHS offers our nation many potential benefits. For each of the following potential AHS benefits, please rate the importance of that benefit. Please use a scale from 1 to 5 where "5" means the benefit is EXTREMELY IMPORTANT and "1" means the benefit is NOT AT ALL IMPORTANT.

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understanding		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Somewhat Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Total Respondents	100 100%	14** 100%**	27** 100%**	37* 100%*	22** 100%**	88* 100%*	9** 100%**	57* 100%*	43* 100%*	50* 100%*	41* 100%*	86* 100%*	5** 100%**	82* 100%*	6** 100%**
(5) Extremely Important	20 20%	3 21%	8 30%	8 22%	1 5%	19 22%	1 11%	12 21%	8 19%	12 24%	8 20%	18 21%	- -	19 23%	- -
(4)	20 20%	4 29%	3 11%	10 27%	3 14%	16 18%	3 33%	11 19%	9 21%	11 22%	9 22%	20 23%	- -	18 22%	1 17%
(3)	35 35%	6 43%	10 37%	11 30%	8 36%	31 35%	3 33%	20 35%	15 35%	17 34%	15 37%	32 37%	- -	31 38%	- -
(2)	17 17%	1 7%	4 15%	6 16%	6 27%	14 16%	2 22%	10 18%	7 16%	9 18%	6 15%	14 16%	3 60%	12 15%	3 50%
(1) Not At All Important	4 4%	- -	- -	2 5%	2 9%	4 5%	- -	2 4%	2 5%	- -	1 2%	1 1%	2 40%	1 1%	2 33%
Don't Know / Refused	4 4%	- -	2 7%	- -	2 9%	4 5%	- -	2 4%	2 5%	1 2%	2 5%	1 1%	- -	1 1%	- -
Mean	3.4	3.6	3.6	3.4	2.8	3.4	3.3	3.4	3.3	3.5	3.4	3.5	1.6	3.5	2.0
Standard Deviation	1.13	0.93	1.12	1.17	1.02	1.15	1.00	1.13	1.13	1.06	1.07	1.04	0.55	1.05	1.10
Standard Error	0.11	0.25	0.22	0.19	0.23	0.13	0.33	0.15	0.18	0.15	0.17	0.11	0.24	0.12	0.45

Table 9 AHS WILL OFFER IMPROVED SAFETY BY REDUCING ACCIDENTS CAUSED BY HUMAN ERROR

Q 7C: AHS offers our nation many potential benefits. For each of the following potential AHS benefits, please rate importance of that benefit. Please use a scale from 1 to 5 where "5" means the benefit is EXTREMELY IMPORTANT and "1" means the benefit is NOT AT ALL IMPORTANT.

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understanding		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Somewhat Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Total Respondents	100 100%	14** 100%**	27** 100%**	37* 100%*	22** 100%**	88* 100%*	9** 100%**	57* 100%*	43* 100%*	50* 100%*	41* 100%*	86* 100%*	5** 100%**	82* 100%*	6** 100%**
(5) Extremely Important	43 43%	5 36%	15 56%	17 46%	6 27%	38 43%	3 33%	23 40%	20 47%	23 46%	20 49%	42 49%	- -	41 50%	1 17%
(4)	31 31%	6 43%	6 22%	12 32%	7 32%	28 32%	2 22%	21 37%	10 23%	18 36%	9 22%	28 33%	- -	25 30%	- -
(3)	13 13%	2 14%	2 7%	6 16%	3 14%	12 14%	1 11%	7 12%	6 14%	6 12%	6 15%	9 10%	2 40%	9 11%	2 33%
(2)	7 7%	1 7%	1 4%	2 5%	3 14%	6 7%	1 11%	4 7%	3 7%	2 4%	2 5%	5 6%	2 40%	5 6%	2 33%
(1) Not At All Important	2 2%	- -	1 4%	- -	1 5%	- -	2 22%	- -	2 5%	- -	2 5%	1 1%	1 20%	1 1%	1 17%
Don't Know / Refused	4 4%	- -	2 7%	- -	2 9%	4 5%	- -	2 4%	2 5%	1 2%	2 5%	1 1%	- -	1 1%	- -
Mean	4.1	4.1	4.3	4.2	3.7	4.2	3.3	4.1	4.0	4.3	4.1	4.2	2.2	4.2	2.7
Standard Deviation	1.03	0.92	1.07	0.91	1.22	0.93	1.66	0.91	1.18	0.84	1.17	0.95	0.84	0.97	1.37
Standard Error	0.11	0.25	0.21	0.15	0.27	0.10	0.55	0.12	0.18	0.12	0.19	0.10	0.37	0.11	0.56

Table 10 AHS WILL OFFER BETTER PERSONAL MOBILITY - MORE VEHICLES AND PEOPLE TRAVELING MORE EFFICIENTLY

Q 7D: AHS offers our nation many potential benefits. For each of the following potential AHS benefits, please rate importance of that benefit. Please use a scale from 1 to 5 where "5" means the benefit is EXTREMELY IMPORTANT and "1" means the benefit is NOT AT ALL IMPORTANT.

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understanding		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Somewhat Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Total Respondents	100 100%	14** 100%**	27** 100%**	37* 100%*	22** 100%**	88* 100%*	9** 100%**	57* 100%*	43* 100%*	50* 100%*	41* 100%*	86* 100%*	5** 100%**	82* 100%*	6** 100%**
(5) Extremely Important	20 20%	1 7%	5 19%	9 24%	5 23%	19 22%	1 11%	11 19%	9 21%	11 22%	9 22%	20 23%	- -	20 24%	- -
(4)	31 31%	6 43%	9 33%	13 35%	3 14%	27 31%	2 22%	15 26%	16 37%	15 30%	16 39%	30 35%	- -	27 33%	1 17%
(3)	29 29%	4 29%	7 26%	10 27%	8 36%	25 28%	3 33%	21 37%	8 19%	20 40%J	8 20%	25 29%	1 20%	25 30%	1 17%
(2)	10 10%	1 7%	5 19%	2 5%	2 9%	7 8%	3 33%	6 11%	4 9%	2 4%	4 10%	8 9%	- -	8 10%	- -
(1) Not At All Important	6 6%	1 7%	- -	3 # 8%	2 9%	6 7%	- -	2 4%	4 9%	2 4%	2 5%	2 2%	4 80%	1 1%	4 67%
Don't Know / Refused	4 4%	1 7%	1 4%	- -	2 9%	4 5%	- -	2 4%	2 5%	- -	2 5%	1 1%	- -	1 1%	- -
Mean	3.5	3.4	3.5	3.6	3.3	3.5	3.1	3.5	3.5	3.6	3.7	3.7	1.4	3.7	1.8
Standard Deviation	1.12	1.04	10.3	1.16	1.27	1.14	1.05	1.05	1.23	1.01	1.11	1.01	0.89	0.99	1.33
Standard Error	0.11	0.29	0.20	0.19	0.28	0.12	0.35	0.14	0.19	0.14	0.18	0.11	0.40	0.11	0.54

Table 11 AHS WILL OFFER IMPROVED PRODUCTIVITY AND A HEALTHIER ECONOMY - GOODS MOVE MORE SWIFTLY, MORE PREDICTABLY

Q 7E: AHS offers our nation many potential benefits. For each of the following potential AHS benefits, please rate the importance of that benefit. Please use a scale from 1 to 5 where "5" means the benefit is EXTREMELY IMPORTANT and "1" means the benefit is NOT AT ALL IMPORTANT.

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understanding		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Somewhat Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Total Respondents	100 100%	14** 100%**	27** 100%**	37* 100%*	22** 100%**	88* 100%*	9** 100%**	57* 100%*	43* 100%*	50* 100%*	41* 100%*	86* 100%*	5** 100%**	82* 100%*	6** 100%**
(5) Extremely Important	19 19%	2 14%	7 26%	7 19%	3 14%	17 19%	1 11%	10 18%	9 21%	10 20%	9 22%	19 22%	- -	19 23%	- -
(4)	32 32%	5 36%	8 30%	11 30%	8 36%	29 33%	3 33%	19 33%	13 30%	17 34%	13 32%	30 35%	- -	26 32%	1 17%
(3)	33 33%	5 36%	9 33%	14 38%	5 23%	28 32%	3 33%	21 37%	12 28%	19 38%	12 29%	29 34%	- -	30 37%	- -
(2)	7 7%	1 7%	2 7%	2 5%	2 9%	6 7%	1 11%	3 5%	4 9%	2 4%	3 7%	6 7%	1 20%	5 6%	1 17%
(1) Not At All Important	5 5%	- -	- -	3 8%	2 9%	4 5%	1 11%	2 4%	3 7%	2 4%	2 5%	1 1%	4 80%	1 1%	4 67%
Don't Know / Refused	4 4%	1 7%	1 4%	- -	2 9%	4 5%	- -	2 4%	2 5%	- -	2 5%	1 1%	- -	1 1%	- -
Mean	3.6	3.6	3.8	3.5	3.4	3.6	3.2	3.6	3.5	3.6	3.6	3.7	1.2	3.7	1.7
Standard Deviation	1.06	0.87	0.95	1.12	1.19	1.04	1.20	0.98	1.16	0.99	1.09	0.94	0.45	0.94	1.21
Standard Error	0.11	0.24	0.19	0.18	0.27	0.11	0.40	0.13	0.18	0.14	0.17	0.10	0.20	0.10	0.49

Table 12 LESS LAND CONSUMED BY NEW HIGHWAY CONSTRUCTION

Q 7F: AHS offers our nation many potential benefits. For each of the following potential AHS benefits, please rate the importance of that benefit. Please use a scale from 1 to 5 where "5" means the benefit is EXTREMELY IMPORTANT and "1" means the benefit is NOT AT ALL IMPORTANT. AHS WILL OFFER A CLEANER ENVIRONMENT - FEWER EMISSIONS, LESS FUEL WASTED IN STOP-AND-GO CONGESTION.

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understand-ing		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Some-what Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Total Respondents	100 100%	14** 100%**	27** 100%**	37* 100%*	22** 100%**	88* 100%*	9** 100%**	57* 100%*	43* 100%*	50* 100%*	41* 100%*	86* 100%*	5** 100%**	82* 100%*	6** 100%**
(5) Extremely Important	22 22%	3 21%	9 33%	6 16%	4 18%	21 24%	- -	11 19%	11 26%	11 22%	11 27%	21 24%	- -	22 27%	- -
(4)	30 30%	3 21%	5 19%	16 43%	6 27%	27 31%	2 22%	20 35%	10 23%	19 38%	10 24%	30 35%	- -	25 30%	1 17%
(3)	27 27%	4 29%	9 33%	10 27%	4 18%	24 27%	3 33%	16 28%	11 26%	15 30%	10 24%	22 26%	2 40%	23 28%	2 33%
(2)	13 13%	4 29%	2 7%	3 8%	4 18%	9 10%	3 33%	7 12%	6 14%	4 8%	5 12%	11 13%	1 20%	10 12%	1 17%
(1) Not At All Important	4 4%	- -	1 4%	1 3%	2 9%	3 3%	1 11%	1 2%	3 7%	1 2%	3 7%	2 2%	2 40%	2 2%	2 33%
Don't Know / Refused	4 4%	- -	1 4%	1 3%	2 9%	4 5%	- -	2 4%	2 5%	- -	2 5%	- -	- -	- -	- -
Mean	3.6	3.4	3.7	3.6	3.3	3.6	2.7	3.6	3.5	3.7	3.5	3.7	2.0	3.7	2.3
Standard Deviation	1.11	1.15	1.15	0.96	1.30	1.08	1.00	1.01	1.25	0.97	1.25	1.06	1.00	1.08	1.21
Standard Error	0.11	0.31	0.23	0.16	0.29	0.12	0.33	0.14	0.19	0.14	0.20	0.11	0.45	0.12	0.49

Table 13 SUMMARY TABLE OF MEANS

Q 7: AHS offers our nation many potential benefits. For each of the following potential AHS benefits, please rate importance of that benefit. Please use a scale from 1 to 5 where "5" means the benefit is EXTREMELY IMPORTANT and"1" means the benefit is NOT AT ALL IMPORTANT.

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understanding		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Somewhat Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Total Respondents	100 100%	14** 100%**	27** 100%**	37* 100%*	22** 100%**	88* 100%*	9** 100%**	57* 100%*	43* 100%*	50* 100%*	41* 100%*	86* 100%*	5** 100%**	82* 100%*	6** 100%**
AHS will provide highway users with real world near term benefits	3.4	3.5	3.5	3.5	2.8	3.4	2.9	3.5	3.3	3.6	3.4	3.5	1.4	3.5	1.7
AHS will be adaptable to the unique transportation conditions of virtually every region	3.4	3.6	3.6	3.4	2.8	3.4	3.3	3.4	3.3	3.5	3.4	3.5	1.6	3.5	2.0
AHS will offer improved safety by reducing accidents caused by human error	4.1	4.1	4.3	4.2	3.7	4.2	3.3	4.1	4.0	4.3	4.1	4.2	2.2	4.2	2.7
AHS will offer better personal mobility - more vehicles and people traveling more efficiently	3.5	3.4	3.5	3.6	3.3	3.5	3.1	3.5	3.5	3.6	3.7	3.7	1.4	3.7	1.8

Table 13 SUMMARY TABLE OF MEANS (Continued)

Q 7: AHS offers our nation many potential benefits. For each of the following potential AHS benefits, please rate importance of that benefit. Please use a scale from 1 to 5 where "5" means the benefit is EXTREMELY IMPORTANT and"1" means the benefit is NOT AT ALL IMPORTANT.

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understand-ing		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Some-what Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Total	100	14**	27**	37*	22**	88*	9**	57*	43*	50*	41*	86*	5**	82*	6**
Respondents	100%	100%**	100%**	100%*	100%**	100%*	100%**	100%*	100%*	100%*	100%*	100%*	100%**	100%*	100%**
AHS will offer improved productivity and a healthier economy - Goods move more swiftly, more predictably	3.6	3.6	3.8	3.5	3.4	3.6	3.2	3.6	3.5	3.6	3.6	3.7	1.2	3.7	1.7
AHS will offer a cleaner environment - Fewer emission, less fuel wasted in stop-and-go congestion. Less land consumed by new highway construction	3.6	3.4	3.7	3.6	3.3	3.6	2.7	3.6	3.5	3.7	3.5	3.7	2.0	3.7	2.3

Table 14 RESPONDENT TYPES

B 1: RESPONDENT TYPES, AHS AWARENESS, AHS UNDERSTANDING, SOLVING TRANSPORTATION PROBLEMS, AHS RESEARCH, CONTINUED AHS FUNDING

		Respondent Types				AHS Awareness		AHS Understanding		Solving Transportation Problems		AHS Research		Continued AHS Funding	
	Total	Congress	Executives	State/ Municipal	Media	Yes	No	Vehicles "Talk"	All Others	AHS Very Somewhat Helpful	Technology Very Somewhat Helpful	Favor	Oppose	Yes	No
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
Base = Total	100	14**	27**	37*	22**	88*	9**	57*	43*	50*	41*	86*	5**	82*	6**
Respondents	100%	100%**	100%**	100%*	100%**	100%*	100%**	100%*	100%*	100%*	100%*	100%*	100%**	100%*	100%**
Congress	14	14	-	-	-	11	3	5	9	4	9	14	-	11	-
	14%	100%	-	-	-	13%	33%	9%	21%	8%	22%	16%	-	13%	-
Executives	27	-	27	-	-	24	2	18	9	15	9	24	-	23	-
	27%	-	100%	-	-	27%	22%	32%	21%	30%	22%	28%	-	28%	-
State / Municipals	37	-	-	37	-	33	2	25	12	24	11	31	2	33	2
	37%	-	-	100%	-	38%	22%	44%	28%	48%J	27%	36%	40%	40%	33%
Media	22	-	-	-	22	20	2	9	13	7	12	17	3	15	4
	22%	-	-	-	100%	23%	22%	16%	30%	14%	29%	20%	60%	18%	67%

APPENDIX G Demo Days Survey

Pre-Ride Survey

As a leader in your field, your views about AHS are very important to the National Automated Highway System Consortium. With your permission, we would like to capture your opinions about AHS before and after your test ride.

Please be assured that the results of our survey will be kept strictly confidential and will be reported only in aggregate form, making it impossible to identify individual responses.

Q1. Have you ever ridden in an AHS-equipped vehicle before?

80 Yes 43%	106 No 57%	n=186

YES TO Q1

Q2. Having previously experienced an AHS test ride, how helpful do you believe AHS can be in solving our nation's most pressing transportation problems? n=80

46 Very helpful 58%	27 Somewhat helpful 34%	
1 Not very helpful 1%	0 Not at all helpful .00%	3 No opinion 4%

Q3. More specifically, how helpful do you believe AHS technologies can be in improving highway safety?

60 Very helpful 75%	17 Somewhat helpful 21%	
3 Not very helpful 4%	0 Not at all helpful .00%	0 No opinion .00%

Q4. How helpful do you believe AHS technologies can be in providing congestion relief?

29 Very helpful 36%	43 Somewhat helpful 54%	
5 Not very helpful 6%	1 Not at all helpful 1%	1 No opinion 1%

Pre-Ride Survey (Continued)

Q5. How soon do you think the first AHS technologies will be available to the general public? [***IF PROMPTING NEEDED***: These technologies would include obstacle detection/collision avoidance systems, adaptive cruise control that automatically maintains your vehicle's speed in sync with other traffic, and technologies that ensure your vehicle stays within its lane.]

45 In the next 5 years
56%

23 In the next 10 years
29%

11 In the next 25 years
14%

1 I do not believe AHS technologies ever will be available to the general public.
1%

What do you see as the chief barrier to general public use of AHS technologies?

34 Cost
43%

4 Technical Feasibility
5%

21 Public Acceptance
26%

1 Privacy Concerns
1%

20 Liability Issues
25%

Q7. When buying a new car, how much total additional cost would you be willing to pay for AHS features such as obstacle detection/collision avoidance systems, adaptive cruise control that automatically maintains your vehicle's speed in sync with other traffic, and technologies that ensure your vehicle stays within its lane?

15 19% — $0-$500

30 48% — $500-1,000

21 26% — $1,000-1,500

13 16% — $Over $1,500

1 1% — I am not interested in cars equipped with AHS technologies

NO TO Q1

Q2. As you prepare for your initial AHS test ride, how helpful do you believe AHS can be in solving our most pressing transportation problems? n=106

60 Very helpful 57%

42 Somewhat helpful 40%

1 Not very helpful 1%

0 Not at all helpful .00%

3 No opinion 2%

Q3. More specifically, how helpful do you believe AHS technologies will be in improving highway safety?

77 Very helpful 73%

28 Somewhat helpful 26%

0 Not very helpful .00%

0 Not at all helpful .00%

1 No opinion 1%

Q4. How helpful do you believe AHS technologies will be in providing congestion relief?

51 Very helpful 48%

45 Somewhat helpful 42%

5 Not very helpful 5%

4 Not at all helpful 4%

1 No opinion 1%

Q5. How soon do you think the first AHS technologies will be available to the general public? [***IF PROMPTING NEEDED***: These technologies would include obstacle detection/collision avoidance systems, adaptive cruise control that automatically maintains your vehicle's speed in sync with other traffic, and technologies that ensure your vehicle stays within its lane.]

49 In the next 5 years 46%

40 In the next 10 years 38%

16 In the next 25 years 15%

1 I do not believe AHS technologies ever will be available to the general public 1%

Pre-Ride Survey (Continued)

Q6. What do you see as the chief barrier to general public use of AHS technologies?

38 Cost
36%

4 Technical Feasibility
4%

35 Public Acceptance
33%

3 Privacy Concerns
3%

26 Liability Issues
24%

Q7. When buying a new car, how much total additional cost would you be willing to pay for AHS features such as obstacle detection/collision avoidance systems, adaptive cruise control that automatically maintains your vehicle's speed in sync with other traffic, and technologies that ensure your vehicle stays within its lane?

15 — $0-$500
14%

50 — $500-1,000
47%

25 — $1,000-1,500
24%

15 — Over $1,500
14%

1 — I am not interested in cars equipped with AHS technologies.
1%

Thank you for your time!

Post-Ride Survey

As a leader in your field, your views about AHS are very important to the National Automated Highway System Consortium. With your permission, we would like to capture your opinions about AHS following your test ride.

Please be assured that the results of our survey will be kept strictly confidential and will be reported only in aggregate form, making it impossible to identify individual responses. n=198

Q1. Having just experienced AHS technologies in an actual highway setting, how helpful do you believe AHS can be in solving our nation's most pressing transportation problems?

125 Very helpful	70 Somewhat helpful	
63%	35%	
1 Not very helpful	1 Not at all helpful	1 No opinion
>1%	>1%	>1%

Q2. More specifically, how helpful do you believe AHS technologies can be in improving highway safety?

149 Very helpful	45 Somewhat helpful	
75%	23%	
4 Not very helpful	0 Not at all helpful	0 No opinion
2%	.00%	.00%

Q3. How helpful do you believe AHS technologies can be in providing congestion relief?

78 Very helpful	95 Somewhat helpful	
39%	48%	
20 Not very helpful	1 Not at all helpful	4 No opinion
10%	>1%	2%

Post-Ride Survey (Continued)

Q4. How soon do you think the first AHS technologies will be available to the general public? [***IF PROMPTING NEEDED***: These technologies would include obstacle detection/collision avoidance systems, adaptive cruise control that automatically maintains your vehicle's speed in sync with other traffic, and technologies that ensure your vehicle stays within its lane.]

88 In the next 5 years 44%	73 In the next 10 years 37%
35 In the next 25 years 18%	2 I do not believe AHS technologies will 1% ever be available to the general public

Q5. What do you see as the chief barrier to general public use of AHS technologies?

80 Cost 40%	4 Technical Feasibility 2%	
66 Public Acceptance 33%	2 Privacy Concerns 1%	44 Liability Issues 22%

Q6. You've just witnessed many AHS technologies in action. When buying a new car, how much additional would you be willing to pay for AHS features such as those you've just experienced (i.e. collision avoidance systems, adaptive cruise control that automatically maintains your vehicle's speed in sync with other traffic, and technologies that ensure your vehicle stays within its lane)?

33 $0-$500 17%	65 $500-1,000 33%
63 $1,000-1,500 31%	30 Over $1,500 15%
7 I am not interested in cars equipped with AHS technologies 4%	

Q7. Of the following, which best describes your ride experience?

50 Exciting 25%	3 Frightening 2%	82 Educational/Informative 41%
0 Uninformative .00%	60 Impressive 30%	0 Ordinary/Mundane .00%
3 Other 2%		

Post-Ride Survey (Continued)

Q8. Did your test ride alter your perceptions about AHS?

78 Yes	117 No
40%	60%

If you answered yes, please briefly describe how:

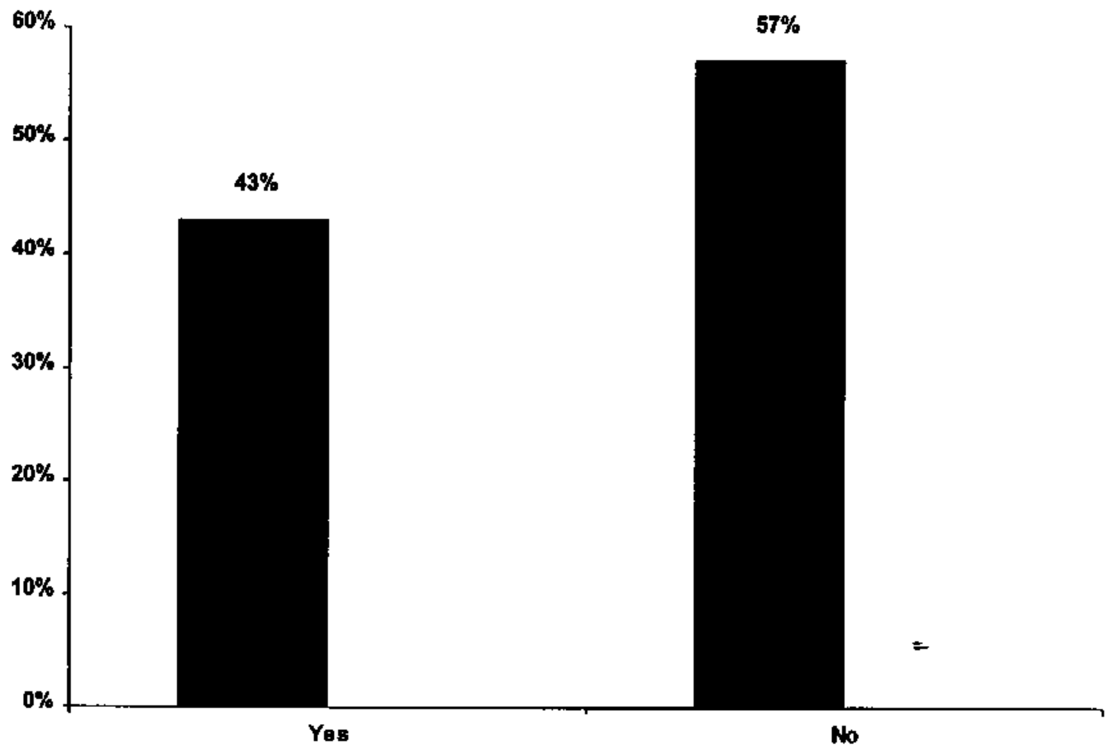
Q9. Of the following, which best describes your test ride description/narration?

190 96%	Clear and informative	3 2%	Too complex/technical
2 1%	Too simplified	3 1%	No Answer

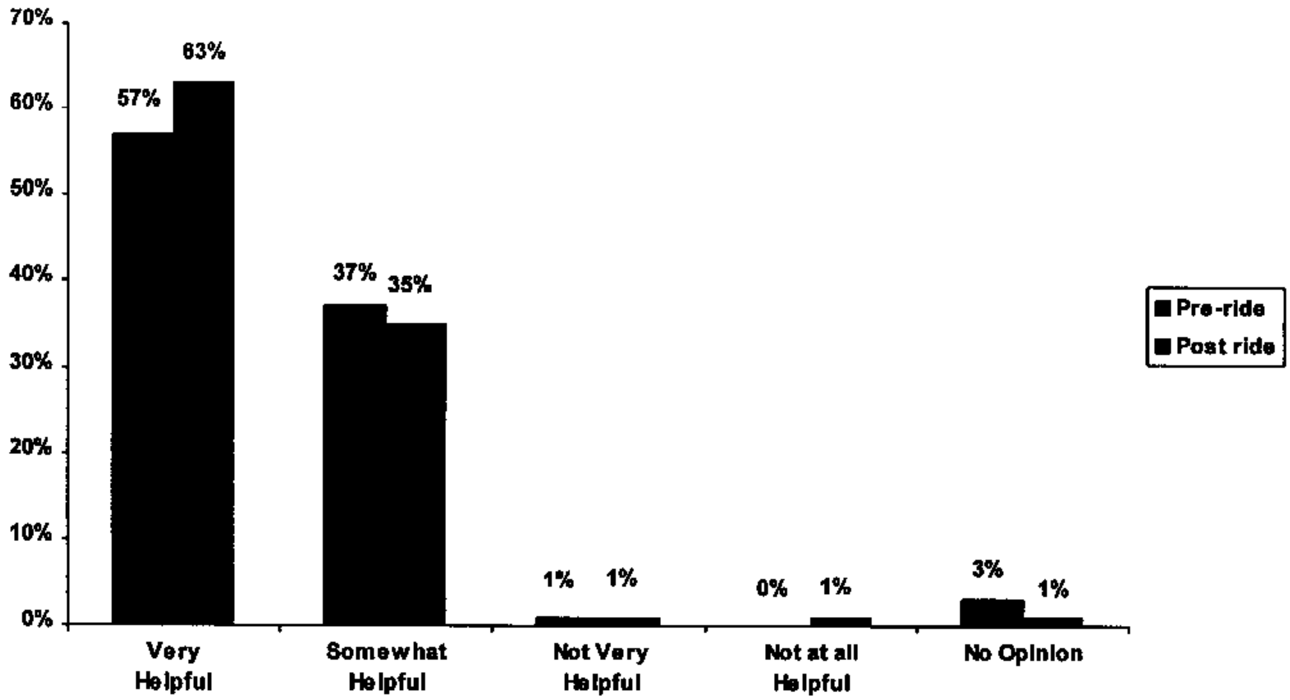
Q10. Which scenario did you test ride?

23 11%	Gray – Evolutionary [IF PROMPTING NEEDED: Toyota]
7 4%	Blue -- Control Transition [If Prompting Needed: Honda]
20 10%	Tan -- Control Transition [IF PROMPTING NEEDED: Ohio St. Univ./Honda]
21 11%	Purple -- Trucking [IF PROMPTING NEEDED: Eaton Vorad]
61 31%	Red -- Free Agent Multi-Platform [IF PROMPTING NEEDED: Carnegie Mellon/Houston Metro]
47 24%	Green -- Platooning [IF PROMPTING NEEDED: Cal-Berkeley-PATH/ Buick]
14 7%	Orange -- Maintenance [IF PROMPTING NEEDED: Caltrans/ Lockheed Martin]
5 3%	Don't know

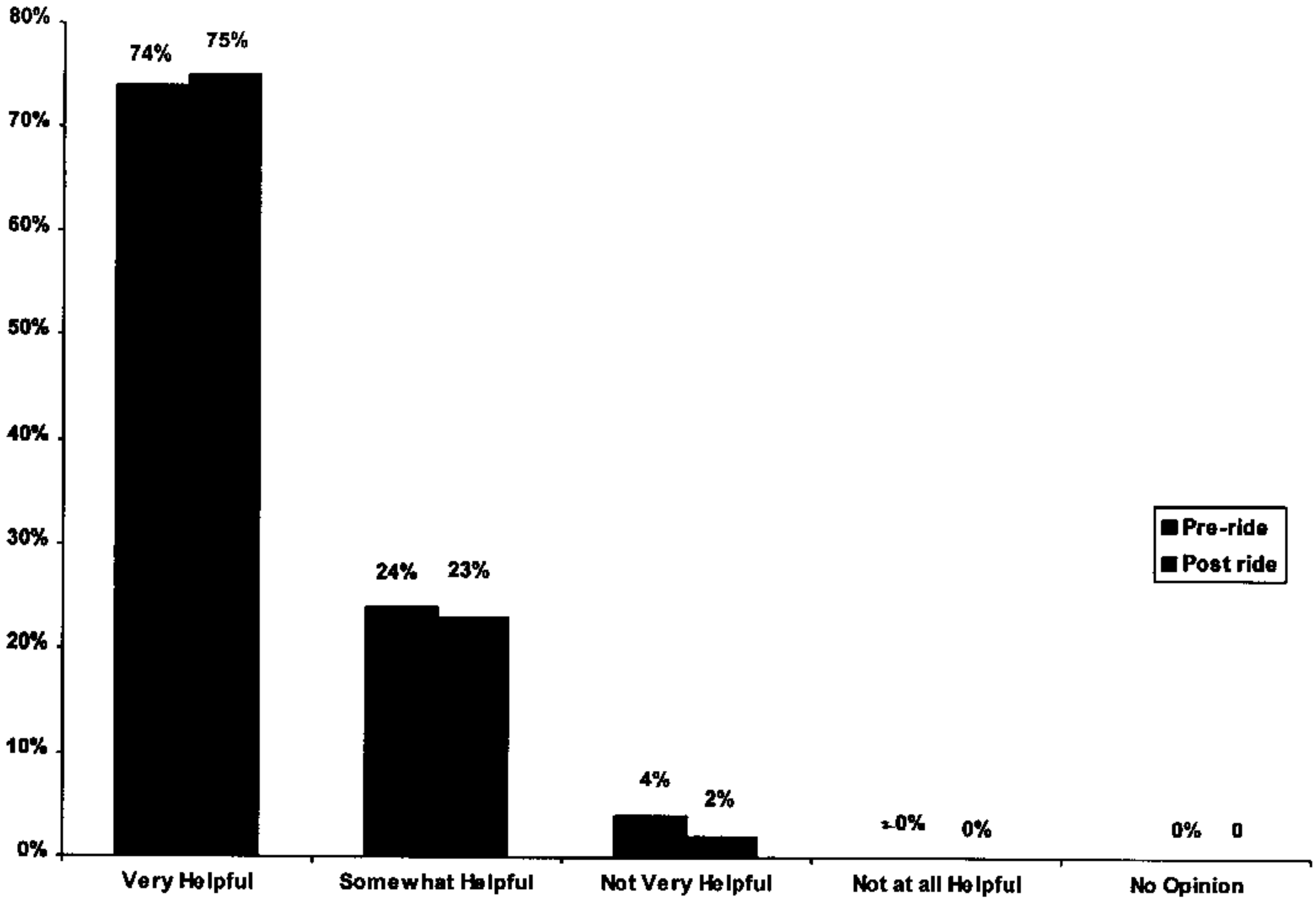
1. Have you ever ridden in an AHS-equipped vehicle before? N=186



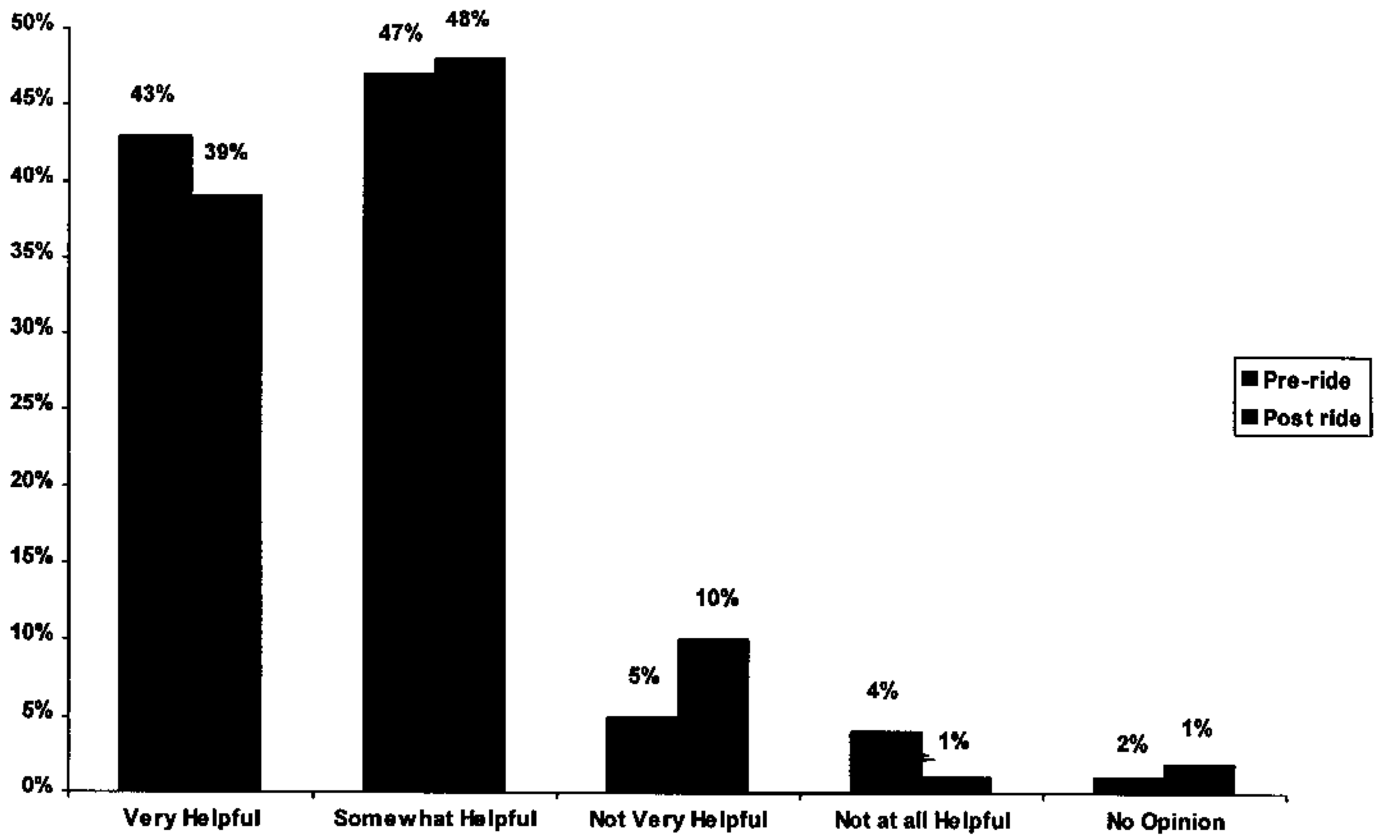
2. Having previously experienced an AHS ride, how helpful do you believe AHS can be in solving our nation's most pressing transportation problems? (Pre-ride N=186, Post ride N=198)



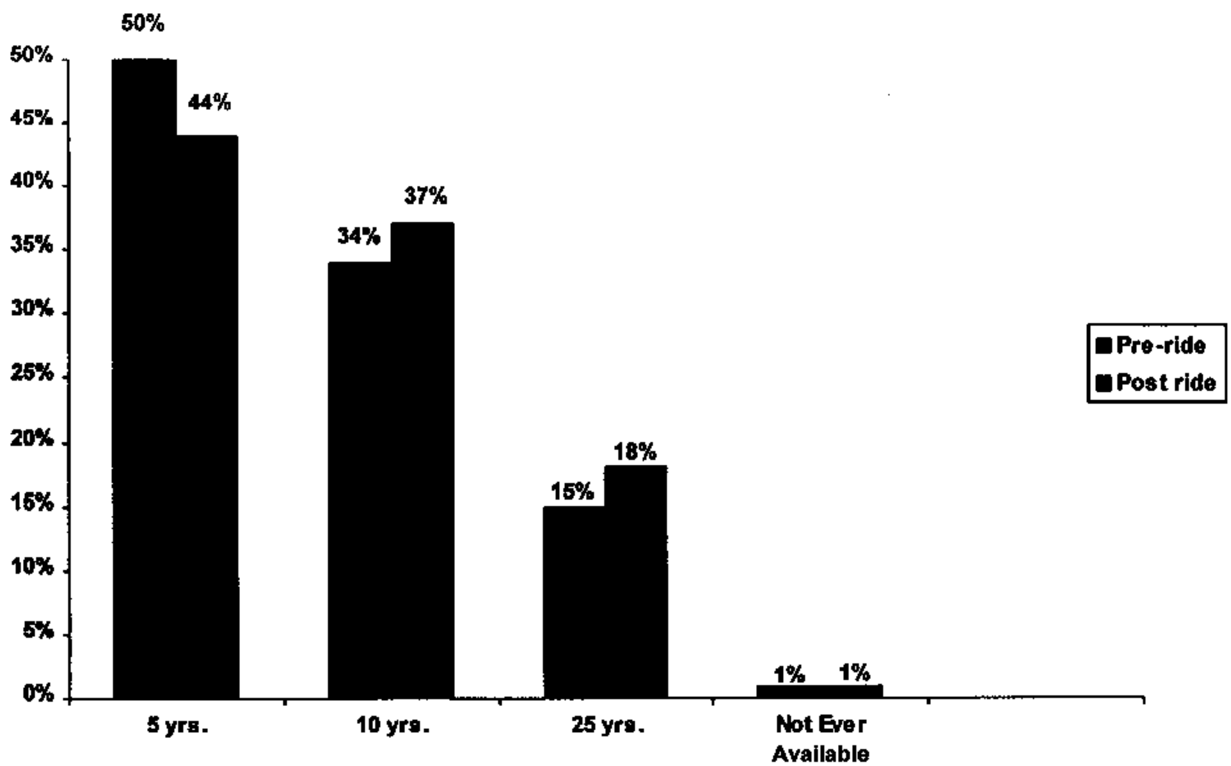
3. How helpful do you believe AHS technologies can be in improving highway safety?



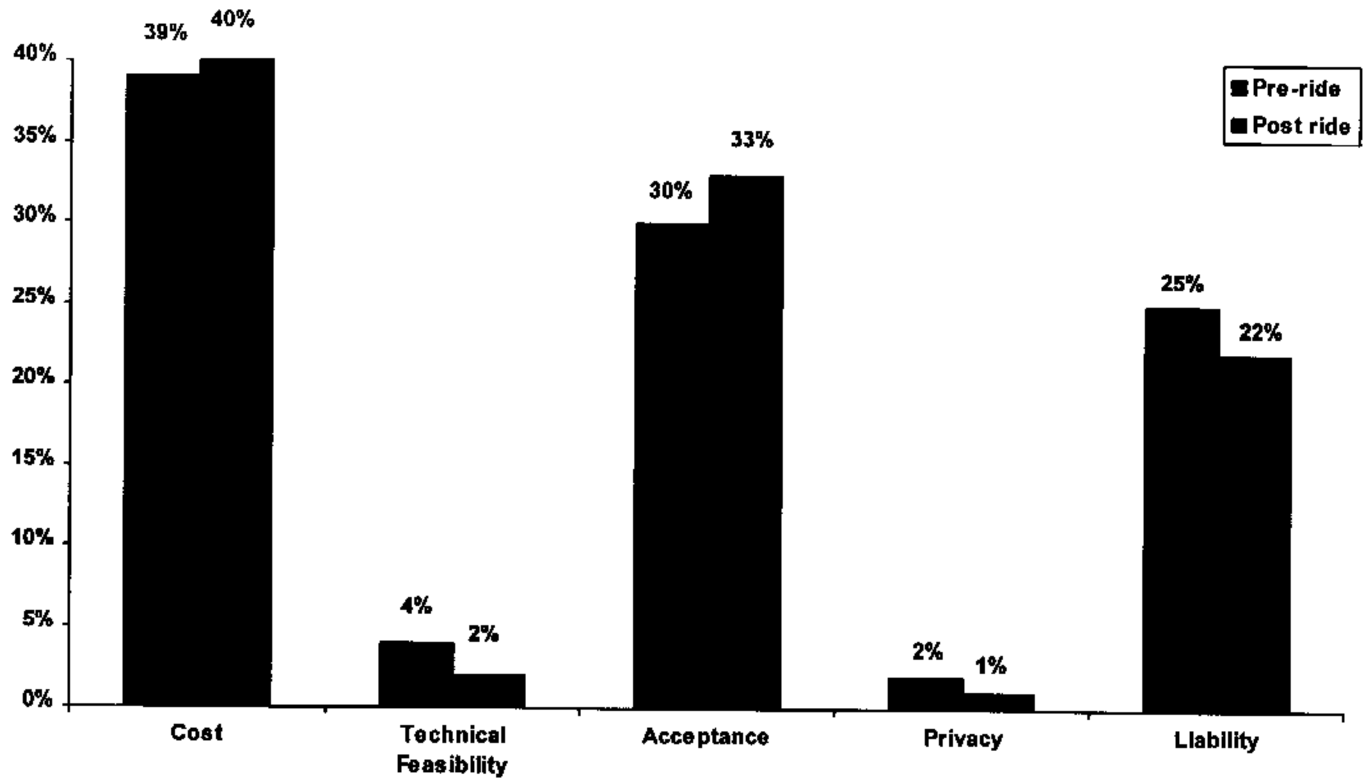
4. How do you believe AHS technologies will be in providing congestion relief?



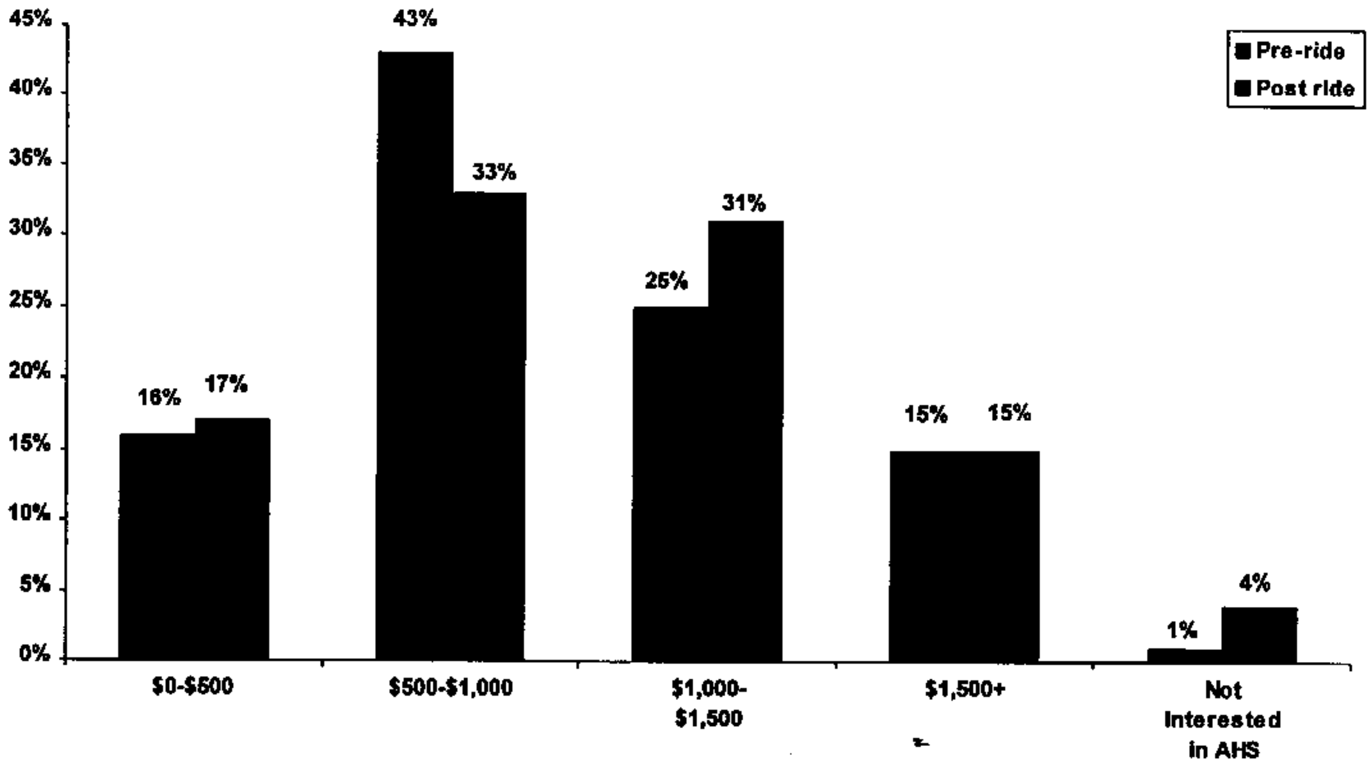
5. How soon do you think the first AHS technologies will be available to the general public?



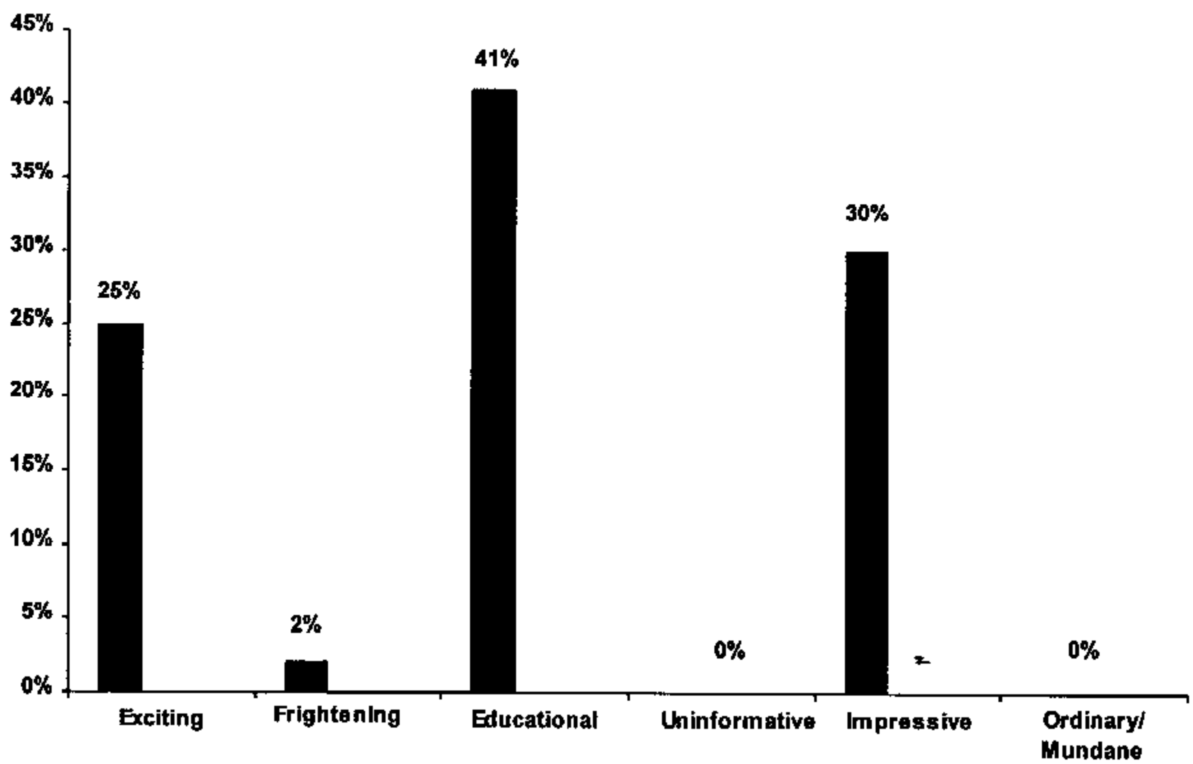
6. **What do you see as the chief barrier to general public use of AHS technologies?**



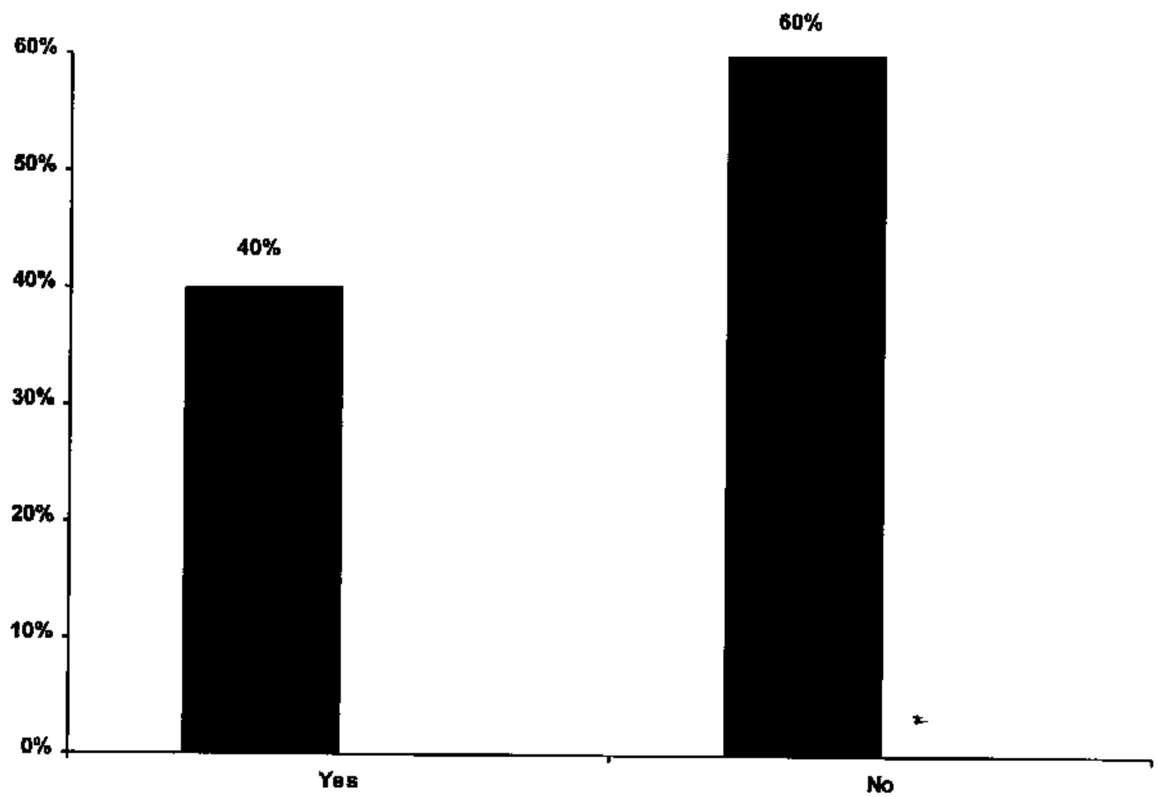
7. When buying a new car, how much additional would you be willing to pay for AHS features such as those you've just experienced?



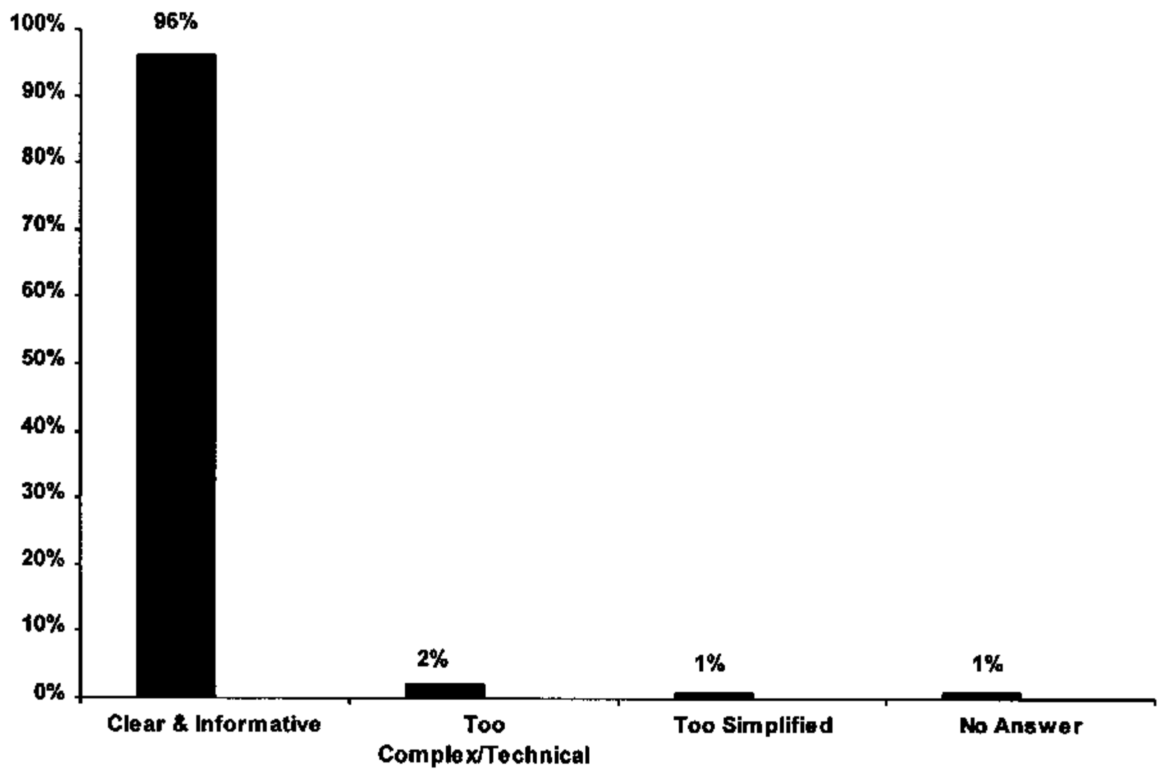
8. (Post Ride) Of the following, which best describes your ride experience?



9. Did your test ride alter your perceptions about AHS?



10. Of the following, which best describes your test ride description/narration?



APPENDIX H San Diego Regional Public Education & Marketing Actions

San Diego Regional Public Education & Marketing Actions

Organization/Individual Briefed	Activity	Date
Mira Mar Marines/Lt. Osborne	Babiarz/tapes-Carrigan & Smilgis mtg.-Osborne @ TMC also	11/14/96
TMC (Trans. Mgt. Center)	Grand Opening/Display	11/15/96
CAATS (CA Alliance Adv. Trans. Systems)	Quinlan, Babiarz & Puentes	11/19/96
ASCE(American Society Civil Engrs)	Bill Gouse (15min./technical)	11/26/96
Dialogue (Public Policy Agency)	Babiarz update with new tape	11/26/96
RTA (Regional Technology Alliance)	Babiarz to Exec Dir., Full Bd. of Dir. to be scheduled	11/27/96
Senator Kelley	Staffer, Frank Delima @ private meeting	12/10/96
RTTA	Babiarz -CD ROM/AV presentation/update	12/13/96
AAA Management Group	Manny Fuentes Made presentation to local/ regional mgt.	12/13/96
Assemblyman Goldsmith	Babiarz showed new tapes, trifolds	12/12/96
Congressman Ron Packard	Gary Gallegos to brief @ private meeting	12/17/96
USC Student presentation	Harout Keuroghlian (818)875-2233	12/6/96
Presentation Practice Sessions	Larson/ Babiarz presented to Caltrans audience, approx. 60	1/3/97
EDC (Economic Dev. Corp.)	Babiarz met with Ron/Rochelle, Ron to assign EDC liaison Jan	12/23/96
Dialogue	Babiarz wrote/faxed Jan intro for March + specifics	1/3/97
Oceanside Kiwanis	Larson did luncheon presentation	1/3/97
MTDB Management Committee	Babiarz / Larson briefed Management Comm.	1/8/97
Assemblyman Goldsmith,75th District	Buick tape @ regular I-15 monthly meeting	1/9/97
Senator Feinstein	Babiarz /Larson presentation to Mike Richmond, SD Chief of staff	1/8/97
Congressman Brian Bilbray, 49th District	Babiarz /Larson presentation to Pat Baker, Chief of Staff	1/9/97
Supvr. Ron Roberts	Babiarz /Larson presentation to Ron Roberts & Dwane Crenshaw	1/13/97
Congressman Bob Filner, 50th District	Babiarz /Larson briefing to Sam Ward, Special Assistant	1/14/97
Ernie Osuna, Community liaison	Lunch with Pub Ed/AHS For local assistance on receptions	1/15/97
Senator Barbara Boxer	Babiarz briefed Dan Hammer, Nina liaison Edith to DC ofc	1/17/97
Governor Wilson	Babiarz /Larson briefed Mike McGee, Office Director	1/21/97
Congressman Randy Cunningham, 51st Dist.	Babiarz /Larson with Kathy Stafford, District Director	1/23/97
SANDAG Board of Directors @ annual retreat	Gallegos briefed, Babiarz /Larson individual mtgs. Upon request	1/29/97
State Senators Ray Haynes, 36th District	Babiarz briefed Riverside & Temecula ofc. Staffs, Exposition referrals to NTP	2/3/97
State Senator Steve Peace, 40th District	Babiarz /Larson met with Shere Mann, Dist. Coord., sent add tape req.	2/4/97
Buick Invitational @ Torrey Pines	Coordinated aspects with Dobel	Feb. 3-9

San Diego Regional Public Education & Marketing Actions

Organization/Individual Briefed	Activity	Date
State Senator Wm. Craven, 37th District	Babiarz /Larson met with Carol Cox, Chief of Staff	2/26/97
Senator DeDe Alpert	Babiarz /Larson met with Jimmy Jackson	2/18/97
WTS (Women's Transportation Seminar)	Babiarz /Larson /Carrigan/Gouse/Smilgis @ SANDAG	2/20/97
SANDAG/Gary Bonelli, Communications Director	Babiarz /Larson /Carrigan//Smilgis met after WTS for Pub Ed rep.	2/20/97
UCSD Form	Babiarz met with & addressed AHS project: Fenton Carey, DoT Assoc. Admin. Research, Tech. & Analysis; Frank Purcell, Dept. Chief of Staff for Duke Cunningham, DC ofc; John Auerbach, Council on Competitiveness, DC Ofc; Julie Meier - Wright, Ca Secy Trade & Commerce; Larry Papay, Bechtel	2/24/97 2/24/97 2/24/97 2/24/97 2/24/97
Chamber, Transportation Leadership Council Mtg.	Rudy Fernandez, Gov. Ofc. Of CA/Mexico Affairs, Trade & Commerce; D. Cruz Gonzalez, Transportation Director for City of San Diego	2/25/97
Senator David Kelly, 37th District	Babiarz did briefing directly with Senator Kelly, Discussed Intl.	2/28/97
Congressman Duncan Hunter, 52nd District	Babiarz met with Wendell Cutting, District Administrator	3/4/97
Rudy Fernandez, Gov. Ofc. Of CA/Mexico Affairs	Larson, Babiarz, Ernie Osuna met & provided detailed briefing. Larson presented Hank Russell	3/7/97
City 0of San Diego	Carrigan/ Babiarz projected CD group presentation including: D. Cruz Gonzales, Transportation Dir. Allen Holden Jr., Deputy Director, Traffic Engrg. Division, Larry P. Van Way, Sr. Caltrans Coordinator, Gonzalo Lopez, Manager of Ofc. Of Intl. Trade & Technology	3/12/97
Del Mar.Rotary	Larson presented, Hank Russell Attached	3/13/97
Caltrans, District 11	Larson, Babiarz, Carrigan mtg with Sergio Pallares, Chief of Intl. Studies	3/14/97
City Councilmember Harry Mathis, District 1	Babiarz provided detailed briefing to Bob Kennedy, Council Rep	3/19/97
Deputy Mayor Barbara Warden	Babiarz provided tape/literature in advance of briefing to Mark Freed	3/19/97
County Supvr. Pam Slater	Babiarz & Garry Bonelli briefed John Weil, Chief of Staff & Triha	3/19/97
County Supvr. Bill Horn	Babiarz left tape for Ernie Cowan, Dir of Communications & provided follow-up briefing. Ernie is former Mayor of Escondido	3/19/97
TLC(Transportation Leadership Council)	Babiarz provided follow-up with interest of corp/membership chairs	3/25/97
ITS Planning Committee	Babiarz rescheduled @ mtg with chair	3/26/97

San Diego Regional Public Education & Marketing Actions

Organization/Individual Briefed	Activity	Date
	Patti Beaucamp	
SAFE(San Diego Svc. Authority for Freeway Emergencies)	Babiarz met & gave briefing to Mike Perkins & set Bd. Presentation	3/26/97
Senator Chafee/Edith Page	Accommodations/briefing tailored in respond to developing situations	3/27/97
Consult Genral of Mexico in San Diego	Gallegos, Pallares & Babiarz @ 11:30	4/1/97
MTDB, Executive Committee	Babiarz re-scheduled for May mgt. Mtg with Gallegos	4/3/97
Chamber of Commerce, Membership Chair	Babiarz briefed Bill Harshman for NAHSC Assocs. Membership	4/7/97
ITS Deployment AdHoc Committee	John West chaired mtg & agenda	4/9/97
Per Frank Quan, Dist 7	San Diego DPC, Jerry Cordell req. tape/CD mailing	4/10/97
Per Frank Quan, Dist 7	Tech Exposition, Dave Draxler Exec Dir req. info for Oct EXPOSITION	4/10/97
Rancho Berardo Rotary Club	Garry Bonelli made AHS presentation along with other topics	4/10/97
SANTEC (Regional Traffic Engrs Council)	Desired drive participation, possible AHS Associate Membership 25-30 Membership list from Dennis Thompson/SANDAG (595-5325)	4/10/97
Co Supvr. Horn, Chief of Staff & Trans. Chief	Larson, Babiarz & RTTA intern provided detailed followup briefing	4/11/97
FHWA "97 Natl. Research & Technical Conference	Babiarz /Dick Merrell /Lois exhibited AHS@ Innovation Room	4/11/97
FHWA/AHS Briefing & Projected Presentation @ TMC	Babiarz gave AHS briefing to approx. 50 FHWA Regional Dirs @ 1:30 with followup mailing of tapes/CDs upon request	4/14-16/97 Attached
Acting American Consultant & Staff (Charles F. Brown)	Osuna, Gallegos, Bonelli, Larson, Pallegas, Babiarz, Breckenridge briefed	4/16/97
Assemblywoman Denise Ducheny	Babiarz met with Ducheny & briefed Leg Assts.	4/25/97
Tourism and Convention Bureau (Ives Ramos)	Osuna, Gallegos, Bonelli, Larson, Pallegas, Babiarz, Breckenridge briefed	4/16/97
VP/GM Mattell, Tijuana, (David Smart)	Osuna, Babiarz, & Stoner briefed maquiladoro tour	4/24/97
Chamber of Commerce Corp Dev Mtg & Membership	Babiarz brought on Chamber as NAHSC Associate Member	4/22/97
ITS Steering Committee	Babiarz presented to approx. 20	4/23/97
Assemblyman Steve Baldwin - 77th District	Babiarz met with Baldwin, briefed Chief of Staff & Leg Assts.	4/25/97
City of San Diego, Mayor Golding	Carrigan, Larson and Babiarz briefed Mike McLaughlin	4/28/97
Assemblyman Bruce Thompson, 66th District	Babiarz briefed Dave Reynolds, Chief of Staff at 2 PM	5/19/97
Assemblyman Bill Morrow, 73rd District	Babiarz briefed Lee Lafave, District Coordinator, Oceanside office at 11 AM	5/19/97
Assemblyman Howard Kaloogian, 74th District	Babiarz briefed Jennefer Perkins, Chief of Staff at 9:30 AM	5/19/97

San Diego Regional Public Education & Marketing Actions

Organization/Individual Briefed	Activity	Date
Assemblyman Howard Wayne, 78th District	Babiarz briefed Chief of Staff, Gayl Jaasklinen at 10 AM	5/20/97
Assemblywoman Susan Davis, 76th District	Babiarz briefed Donna Smith and Susan Lawrence at 10:30 AM	5/22/97
Senator Boxer's San Diego Office with Dan Hammer, District Director	Carrigan, Larson, Babiarz briefed with more specifics, schedule ride	5/21/97
Sabre Springs Planning Group	Babiarz briefed at Morning Creek Elementary Multi-Purpose Center at 7 PM	5/21/97
Congressman Bilbray	Larson and Babiarz briefed with Chief of Staff at TMC ride to be rescheduled	5/27/97
Congressman Cunningham	Larson and Babiarz briefed with Chief of Staff at TMC followed by AHS ride	5/29/97
CTA (CA Truck Assn) & ITS/CVO	Briefing at TMC from 9:30 - 11:30 AM	5/29/97
Congressman Ron Packard	Larson and Babiarz provided briefing and AHS ride	5/30/97
Senator Boxer's District Director, Dan Hammer	Ride coordinated with Ron Packard and his District Director	5/30/97
ITS America Conference	Babiarz provided specific AHS conversations and sessions with Noah Rifkin, currently CALSPAN RL; Tom Bulger, President Government Relations, Inc. (ITS Lobbyist); Mark Miller, also Government Relations Inc. called for information per Tom Bulger and Bob Neff, Eaton Vorad; Fenton Carey, DOT Research Technology & Analysis; Richard Spicer, SCAG; Nina invited to brief assn. + MTA in July; Pete Mirelez, Colorado DOT; Eric Lindquist, Texas Trans. Institute, Mobility Analysis Program	6/2 - 4/97
ITS America Exposition	Babiarz: Specific NTP info for AHS Exposition in August provided to CC&G, Kamal Karna, Ph.D.; Access Control Technologies, Inc, Pete Marfin, President; Philips Car Systems; Francis J. Dance Project Mgt.; ASGI, Stephen L. Briggs, President; ATKINS, David Parrett, Marketing Manager	
Senator Boxer's D.C. office; Rob Alexander	Briefing by Babiarz, Page, Perkowski and Cune	6/2/97
Congressman Ron Packard's DC ofc. Eric Mondero	Briefing by Babiarz, Page, Perkowski and Cune	6/2/97
Congressman Randy "Duke" Cunningham DC ofc.	Briefing by Babiarz, Page, Perkowski and Cune	6/2/97
Capitol Hill Club	Specific AHS briefings at social function with: Michael J. Peitkiewicz, Sr. Asst. to Congressman Jack Quinn, NY; Renee M. Smith, Legi. Asst. to Congressman Gerald Soloman, NY; Frank R. Petramale, Leg. Dir/Counsel to	6/4/97

San Diego Regional Public Education & Marketing Actions

Organization/Individual Briefed	Activity	Date
	Congressman Soloman, NY; Charles Barenthaler, Pres. NY State Soicety of DC, Nat'l. Conf. of State Societies; Mary Ellen Holcomb, Newspaper Assn. Of America	
Eric Mondero at Packard's office	Regional representation follow-up meeting	6/2/97
Frank Percell at Cunningham's office	Regional representation follow-up meeting	6/2/97
NTSB	Personal invite to brief Bd/staff per Hammerschmidt; Geo. Washington Black, Board Member; Michael P. O'Neill, Federal Investigator; James Henderson, Hazardous Materials Accident Investigator; Byrd J. Raby, Heavy Vehicle Specialist Investigator; Michele Ann McMurtry, P.E.; Rod Weber, St. Highway Engr.; Jennifer Hopkins	6/5/97
NAHSC Stakeholders Forum	Babiarz attended/opportunity for reg. info. & followup	6/ 5 - 6/97
DoT, Research Technology & Analysis	Detailed meeting on regional specifics with Carey @ 10 am	6/9/97
Congressman Duncan Hunter's DC Leg. Aide	Babiarz and Page to Michael Harrison @ 1:30 p.m.	6/9/97
Congressman Brian Bilbray's DC Leg. Aide	Babiarz and Page briefing to Paige Hinds	6/10/97
Congressman Bob Filner's DC Leg. Aide	Babiarz and Cune briefing to Victor Castillo	6/10/97
Congressman Jay Kim's DC Leg. Aide	Babiarz and Cune briefing to Daniel Mathews	6/10/97
PB, Washington Office	Gene McCormick, PE Sr. VP Dir. of Strategic Marketing	6/10/97
Fenton Carey, Dot Research Technology Analysis	Nina dropped calendar/info.per Carey req.	6/11/97
Senator Feinstein's Dir. of Spec. Projects	Babiarz/Cune briefed Christian N. Kierig	6/11/97
Cal. Highway Partol	Larson provided briefing	6/16/97
APWA (Public Wks)	Mtg. To set agenda for July presentation	6/18/97
Congressman Geo. Brown's DC office	Babiarz sent info. and tape to Patrick Quinlan in DC office	6/20/97
Calstart membership presentation	Babiarz sent tape and literature	6/20/97
WTS luncheon	Topic trucking; Eaton Vorad CWS & AHS, Nina attended	6/26/97
Rancho Bernardo Community Group	Babiarz presented to approx. 80 at eve. forum	6/26/97
CEAL (Comm External Assn. Liason)	Larson/Gallegos provided briefing	6/26/97
Congressman Geo. Brown's DC office	Babiarz sent info. and tape to Linda Kasper, Geo. wants ride	6/26/97
County Supervisor Greg Cox	Babiarz, Larson provided briefing	7/1/97
Mayor Golding's Press Secretary	Babiarz, Larson met with Joe Carberry to engage Mayor in Demo	7/2/97

San Diego Regional Public Education & Marketing Actions

Organization/Individual Briefed	Activity	Date
Chamber of Commerce Military Affairs	Babiarz presented to approx. 120 at am meeting	7/8/97
APWA San Diego & Imperial Counties	Jim Larson guest speaker @ July luncheon @ Sheraton 4 Points	7/10/97
SCAG (So. CA Assn. Of Govts.)	Babiarz presented to Transportation Communications Comm.	7/10/97
APWA (San Diego Conference at Four Points	Babiarz gave AHS presentation to 4-hour regional meeting 8 - 1 p.m.	7/16/97
SAFE (Sand Diego Svc. Authority for Freeway Emergencies)	Babiarz briefed full board of directors and member agencies @ 2p.m.	7/17/97
Rancho Bernardo Community Planning Board	Babiarz & Larson gave presentation @ Oaks North Comm. Ctr.	7/17/97
Transportation Town Hall Forum, sponsored by Goldsmith	Gallegos, Larson, Babiarz participated in a 4-hour meeting	7/19/97
Federal Military Accountants	Larson spoke to approx. 80 @ monthly luncheon	7/30/97
Rancho Penasquitos Sunrise Club (RP Rotary Club)	Babiarz addressed approx 50 @ Carmel Highlands Doubletree @ 7 am	7/31/97
KUSI-TV Morning Show	Larson guest for Roger Hedgecock segment on AHS	7/31/97
CoHo Radio Program with Roger Hedgecock	Larson guest for discussion on trans. congestion solutions	8/1/97
Secretary of Trans. Slater visit	All gathered at NSA for welcome and speech	8/2/97
Congressman Bud Shuster	Day long visit	8/4/97
Senator Boxer's district dir., Dan Hammer	Walk through Exposition site with advance team for senator's 8/7 ride/visit	8/4/97
Councilman Harry Mathis' office	Babiarz met to discuss specifics for reception speech	8/5/97
Opening Night Reception	Presidio	8/7/97
CAATS/NAHSC Congressional Reception	North Island Club	8/8/97
Mexico Informational Tour	Border Crossing/Matrix/Cetta Winery/Cultural Center	8/9/97
SAME (Society of Military Engineers)	Larson spoke to approx 80 at monthly luncheon	8/13/97
State Assemblywoman Denise Ducheny	Larson, Babiarz met with and gave briefing on Demo '97 and border trip	8/14/97
Regional debriefing meeting	Set for noon @ Alcapulco to review regional team efforts	8/22/97
San Diego Association for Computing Machinery	Babiarz spoke to evening industry assn. about Demo '97	8/27/97
Del Mar Rotary Club	Larson spoke to 60-70 at breakfast about Demo '97	8/28/97
ITE San Diego Chapter	Babiarz invited to addrress 60 - 80 @ monthly lunch on Demo '97	9/4/97
Assn. Of Environmental Professionals	Babiarz spoke @ Marriott Mission Valley lunch	9/25/97

APPENDIX I Media Event Attendees

Media Event Attendees

Name	Publication	Event
?, Roger	Auto Parts News	SL
Akc, David	Reuters	SL, DD
Alcorn, Jonathon	Zuma Press	DD
Anderson, Erik	KPBS	DD
Armstrong, Patricia	Swiss TV	SL, DD
Arner, Mark	San Diego Union-Tribune	SL, DD
Aronovsky, James	Scientific American	LL
Baker, Leland	San Diego Daily Times	SL
Ballard, James	KFMB-TV	DD
Beatty, John	KGTV-TV San Diego	SL
Bennet, James	Orange County Register	DD
Bierck, Richard	U.S. News & World Report	LL
Biggs, Jason	Auto Parts News	SL
Boril, John	CBS News	SL, DD
Borrello, Tony	CBS News	SL
Brandt, Chris	Transportation Topics	SL, DD
Brooker, Peter	Rex Group	LL
Bryant, Bob	Public Roads	SL, DD
Burn, Matthew	The Learning Channel	LL
Calvo, Dana	Associated Press	LL
Camilo, John	Speed Vision	DD
Campbell, Chuck	Motorhome Magazine	DD
Cannon, Bill	Motor Age	DD
Caza, Jerome	Video Journalist	DD
Chang, Farland	NBC News	LL
Chongchua, Phoebe	KGTV-TV San Diego	DD
Clothier, Mark	The Roanoke Times	SL, DD
Compton, Cynthia	World Business Review	DD
Connelly, Russ	KUSI-TV (ind.) San Diego	DD
Cox, Jaime	KFMB-TV	DD
Curran, Michael	Inside ITS	SL, DD
Damerst, Doug	AAA Car and Travel	SL, DD
Davis, Tom		SL
del Aguila, Leo	National Public Radio	LL
Delport, D	M6 Television	DD
DeMarco, Tony	Business Editor	DD
Doerfinger, Brian	CBS This Morning	SL
Doubek, Tony	San Diego Union-Tribune	SL
Dracacci, Marie	MK Press	DD
Feldstein, Dan	Houston Chronicle	SL, DD
Flynn, Larry	Roads & Bridges magazine	SL
Fonseca, John	Hypermedia	SL

Event Key: SL = Short Lead; LL = Long Lead; DD = Demonstration Day

Media Event Attendees

Name	Publication	Event
Foussatt, Donna	World Business Review	DD
Frank, Jeff	North County Times	DD
Gagno, Larry	Pomerado News	SL
Garcia, Nandy	Camera Press	DD
Garcia, Odilan	Channel 12, XFWT	SL
Garcia, Ted	KFMB TV	DD
Gilbert, Jean	KUSI	SL
Gilchrist, Jai	KUSI	DD
Gilroy, Roger	ITS America	SL, DD
Guffory, Stephan	M6 Television	DD
Hall, Scott	KFMB TV	DD
Harring, Donna	Pomerado News	SL
Henderson, Susan	Good Morning America	LL
Hoffman, Jon	KFMB Traffic	SL
Hong, Patrick	Road & Track	LL, SL
Hughes, Sandra	CBS Evening News with Dan Rather	SL
Isur, Tatiana	Pacific Press International	SL
Jessen, Peder	TV2 Denmark	SL
Johnson, Lanny	ZDF German Television	DD
Johnson, Nancy	ITS World	SL, DD
Jones, Jennifer	TF1 - French TV	SL, DD
Joyce, Chris	National Public Radio	LL
Juenger, George	ZDF German Television	DD
Kasindorf, Martin	USA Today	LL
Kaye, Jefferey	News Hour with Jim Lehrer	SL, DD
Kellermann, George	ARD, German Television	SL
Kelley, Tom	American Driving Force mag.	SL, DD
Kelly, Kevin	KUSI	DD
Klein, Joe	Gamma (photo wire)	SL, DD
Kruse, Peter	ZDF German Television	DD
Kruze, Gretta	WJLA-TV	LL
Kuhue, Maik	ARD, German Television	SL
Lacombe, Milly	Pacific Press International	SL
Lago, Sergio	Hypermedia	SL, DD
Laird, Frank	NBC-TV, Channel 7/39	DD
Lankes, Elyane	Pro 7 German TV	SL
Leavitt, Wendy	Trucking Technology Magazine	LL, SL
Lee, Diana	News Hour with Jim Lehrer	SL, DD
Leiken, Katherine	ARD, German Television	SL, DD
Lewis, Alan	News Hour with Jim Lehrer	SL, DD
Lewotsky, Kristin	Laser Parts	SL
Li, Deming	Chinese Daily News	DD

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Media Event Attendees

Name	Publication	Event
Libert, Tara	Swiss TV	SL, DD
Linett, Scott	San Diego Union-Tribune	DD
Long, Robert	Better Roads	DD
Lyons, Tracey	MSNBC	LL
Madison, Greg	KGTV	DD
Maguhn, Diana	Pro 7 German TV	DD
Marritt, Kelley	KOGO Radio	SL
Marshall, L.S.	Transportation Technology	SL, DD
Martin, Norman	Automotive Industries	SL, DD
Masciola, Carol	Orange County Register	SL, DD
Mason, Peter	Discovery Channel/Popular Science	LL
McDonald, Brady	Orange County Register	DD
Mikaelian, Gasia	KFMB TV	DD
Montoya, Alexandra	Univision	LL
Morand, Philippe	TF1 - French TV	DD
Moss, Andrea	North County Times	SL
Nangle, Craig	Motor Age	DD
Nielsen, Ulla Pors	TV2 Denmark	SL, DD
Nienhus, Kevin	Where Edmonton Magazine	SL, DD
Oakes, Robert	Contra Costa Times	SL
O'Connor, Dennis	Trucking Technology Magazine	SL, DD
Oldham, Scott	Popular Mechanics	LL
Palar, Andre	CBS News	SL
Patley, Dave	New York Times	SL
Paul, Max	NBC News	LL
Perkins, Melanie	PBS/Nova	SL, DD
Perrin, Edward	TF1 - French TV	SL
Phillips, Don	Washington Post	SL, DD
Poroy, Dennis	Associated Press	LL, SL
Pund, Ernest	The Press-Enterprise	SL, DD
Purdum, Todd	New York Times	SL, DD
Rector, David	National Public Radio	LL
Redfield, Paul	North County Times	SL
Reynolds, Kim	Road & Track	SL
Rheins, Bruce	CBS Evening News with Dan Rather	SL
Rodrigues, Tanya	San Diego Union-Tribune	DD
Ryder, Androu	Heavy Duty Trucking	LL
Sharaf, Monroe	News Hour with Jim Lehrer	SL, DD
Siegloch, Klaus	ZDF German Television	DD
Spangingerg, Guy	Popular Mechanics	LL
Sproule, Terry	Where Edmonton Magazine	SL, DD
Stalder, Hans Peter	Swiss TV	SL, DD

Event Key: SL = Short Lead; LL = Long Lead; DD = Demonstration Day

Media Event Attendees

Name	Publication	Event
Sturgess, Stephen	Heavy Duty Trucking	LL, DD
Toscano, Ceasar	Univision	LL
Vander, Besse	KGTV	SL
Vanderveen, Paul	Swiss TV	SL, DD
Vaugh, Mark	Autoweek	LL, DD
Vivier, Thierry	France 2 TV	SL
Weeks, Jerome	Dallas Morning News	SL, DD
Weiner, Phil	ARD, German Television	SL
Weingarten, Tara	Newsweek	SL, DD
Weisbaum, Herb	CBS This Morning	SL
Wilson, Richard	MIT Press/Japan Publication	DD
Wing, Betsy	ITS Review	SL, DD
Wright, Maury	EDN Magazine	SL, DD

Totals:
Long lead (LL) = 25
Short lead (SL) = 78
Demo Days (DD) = 79
Total media outlets - 120

Event Key: SL = Short Lead; LL = Long Lead; DD = Demonstration Day