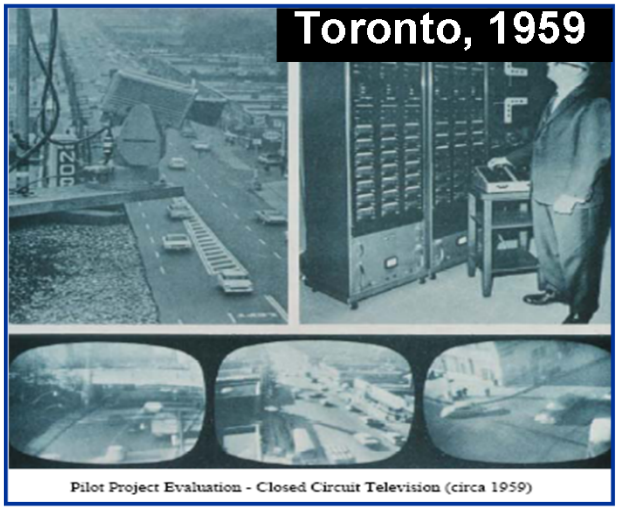
ISTTT22 FHWA Workshop

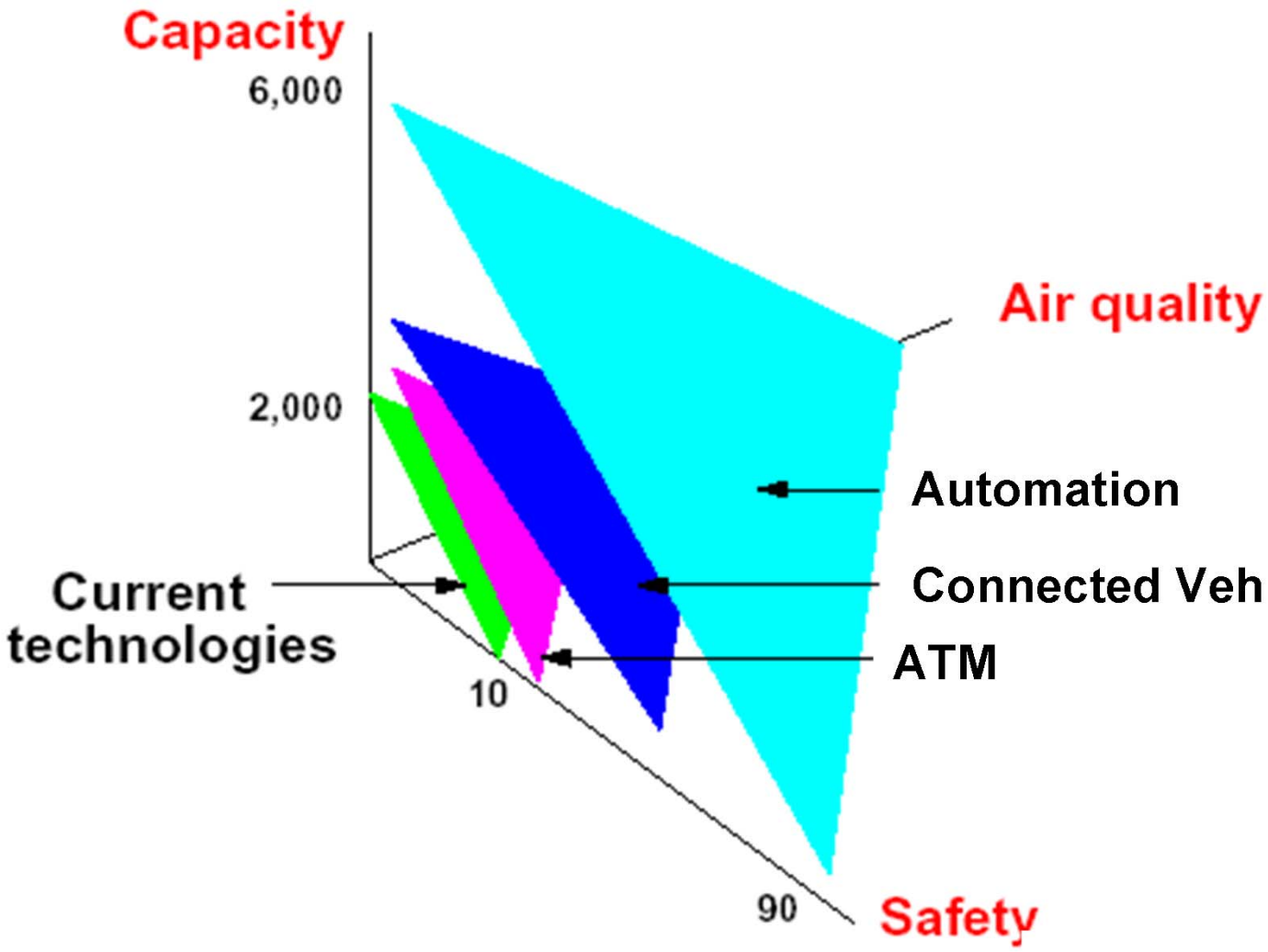
Getting There from Here: Traffic Modeling, Data Streams, and Prediction for Connected Vehicle Systems Planning and Operations



Alexander Skabardonis

Chicago, IL ,July 23, 2017

The Promise..

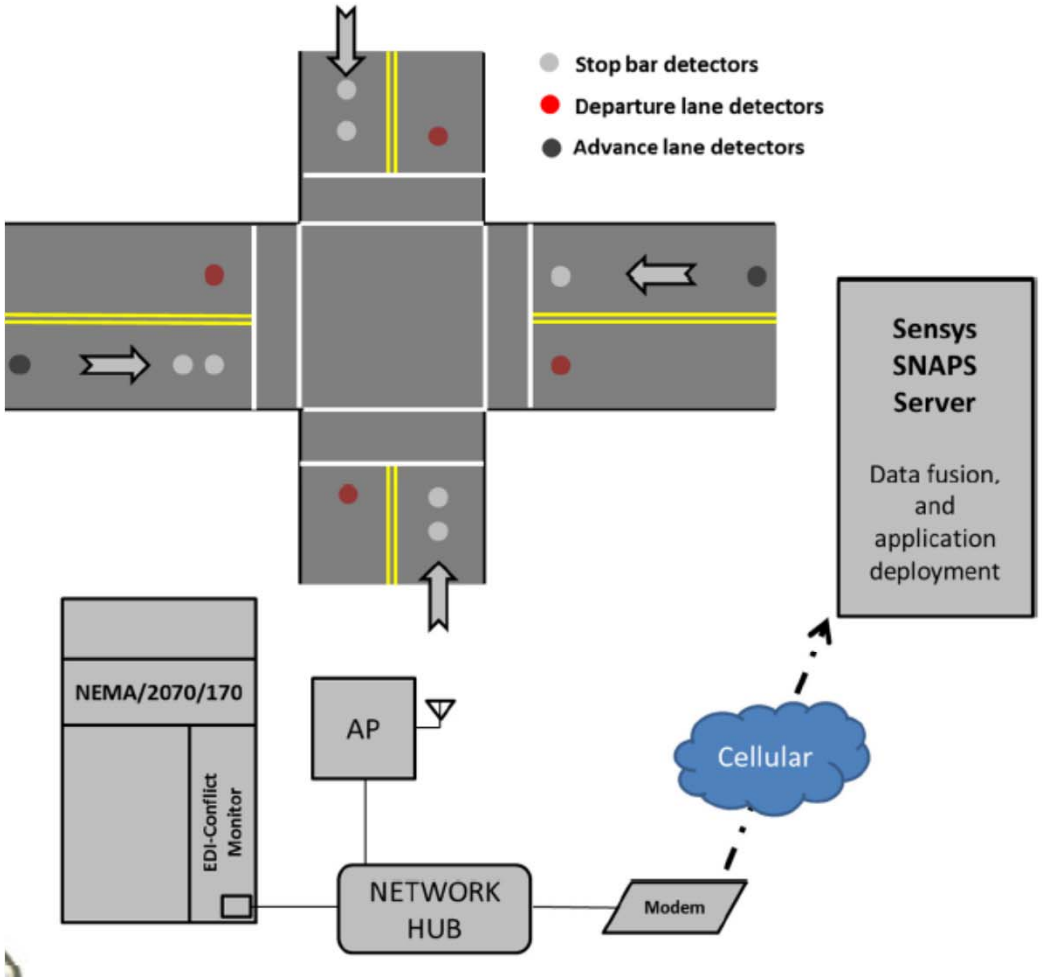

Capacity
6,000
2,000
Current technologies
10
90
Safety
Air quality
Automation
Connected Veh
ATM

Data, Data, Data…..

Conventional Paradigm:

Collect the minimum data on a "Typical Day" at a Single Location

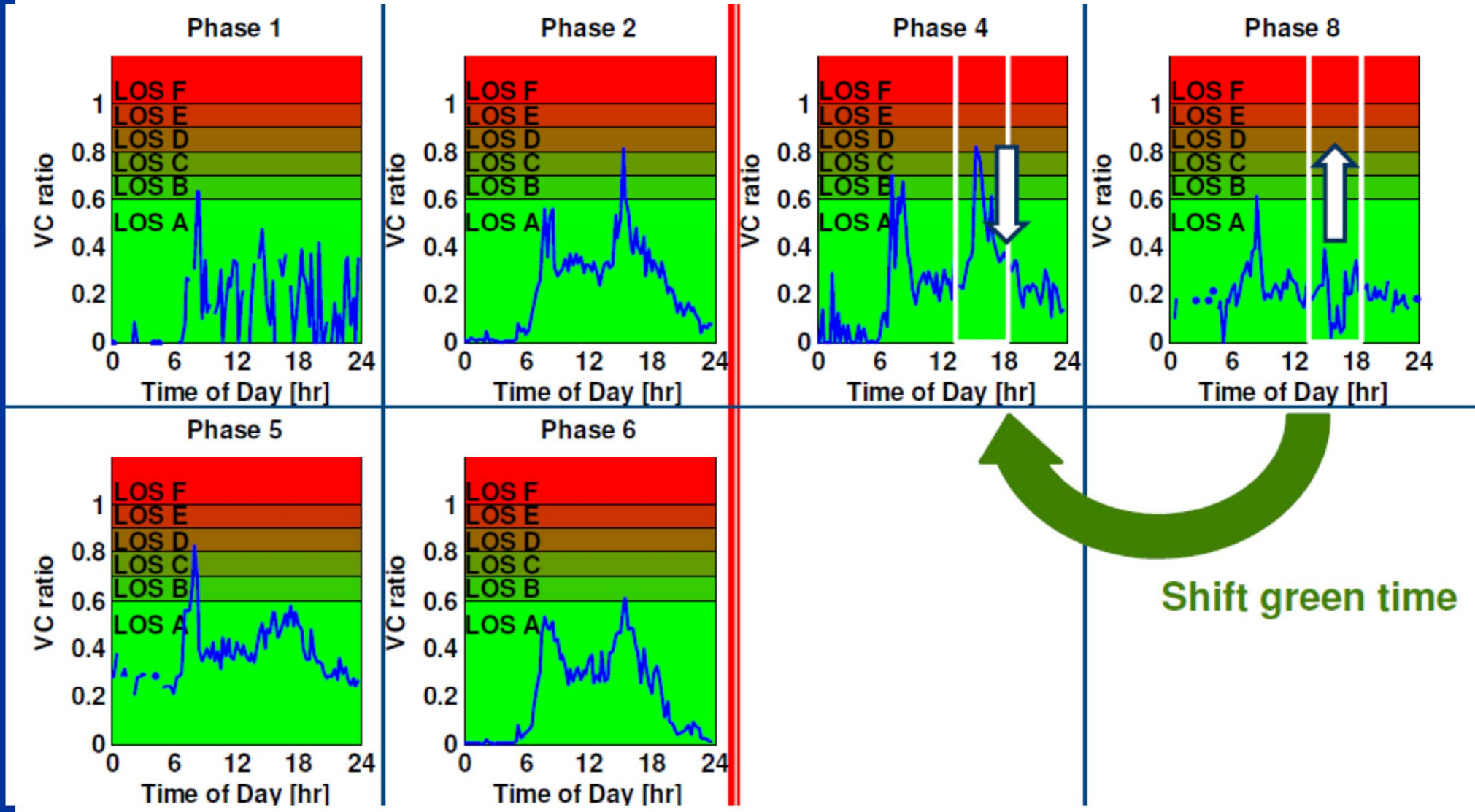
Progress: HR Data – Traffic Signals



Danville Intersection

Skabardonis, Varaiya, "Control Strategies for Corridor management," UC Report TO008, 2016

HR Data Application: Intersection Performance

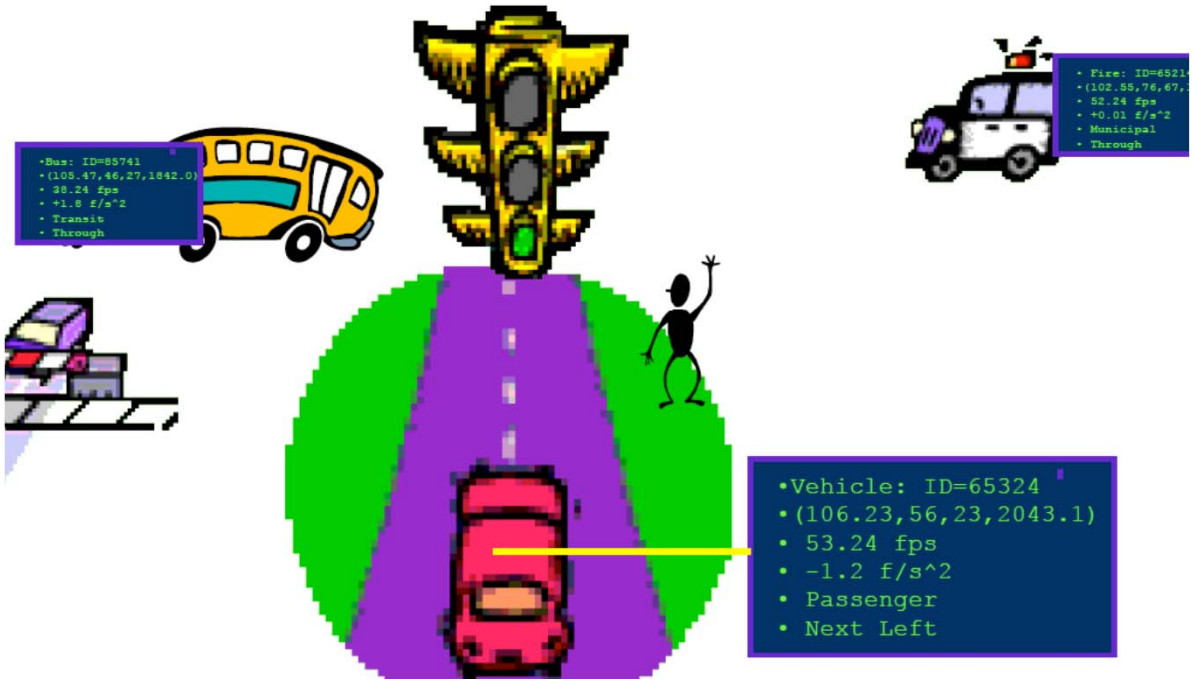


15 min V/C and LOS

Data, Data, Data…._CAVs

V2V: r*eduction in tart up lost time & saturation headway*

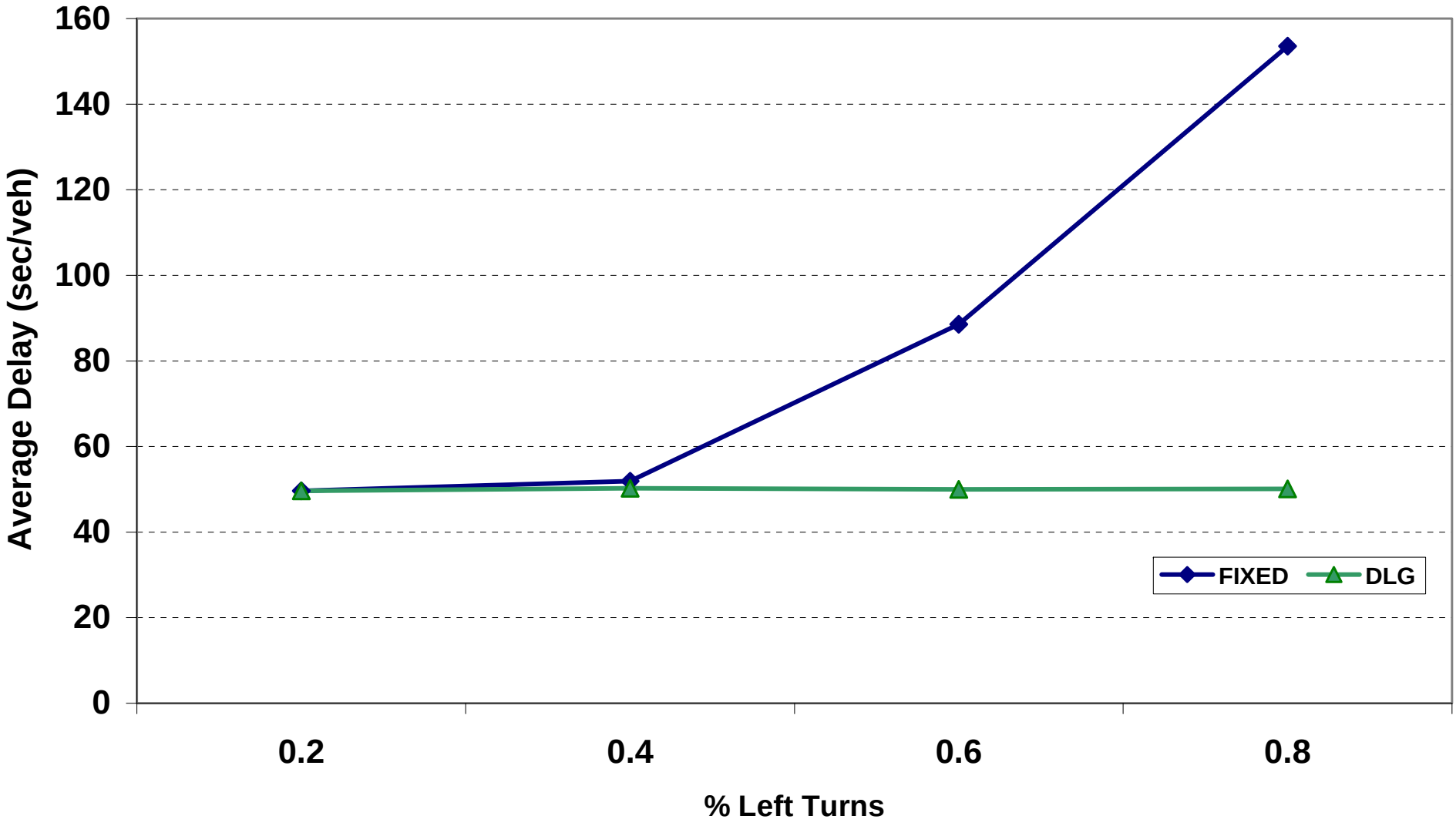
V2I: Each Vehicle a sensor



MultiModal Intelligent Traffic Signal System (MMITSS)

L Head, Presentation, TRB Signal Systems Committee, Tucson, AZ, 2016

CAVs & Traffic Signals: Dynamic Lane Grouping



CAVs: ECO -Driving

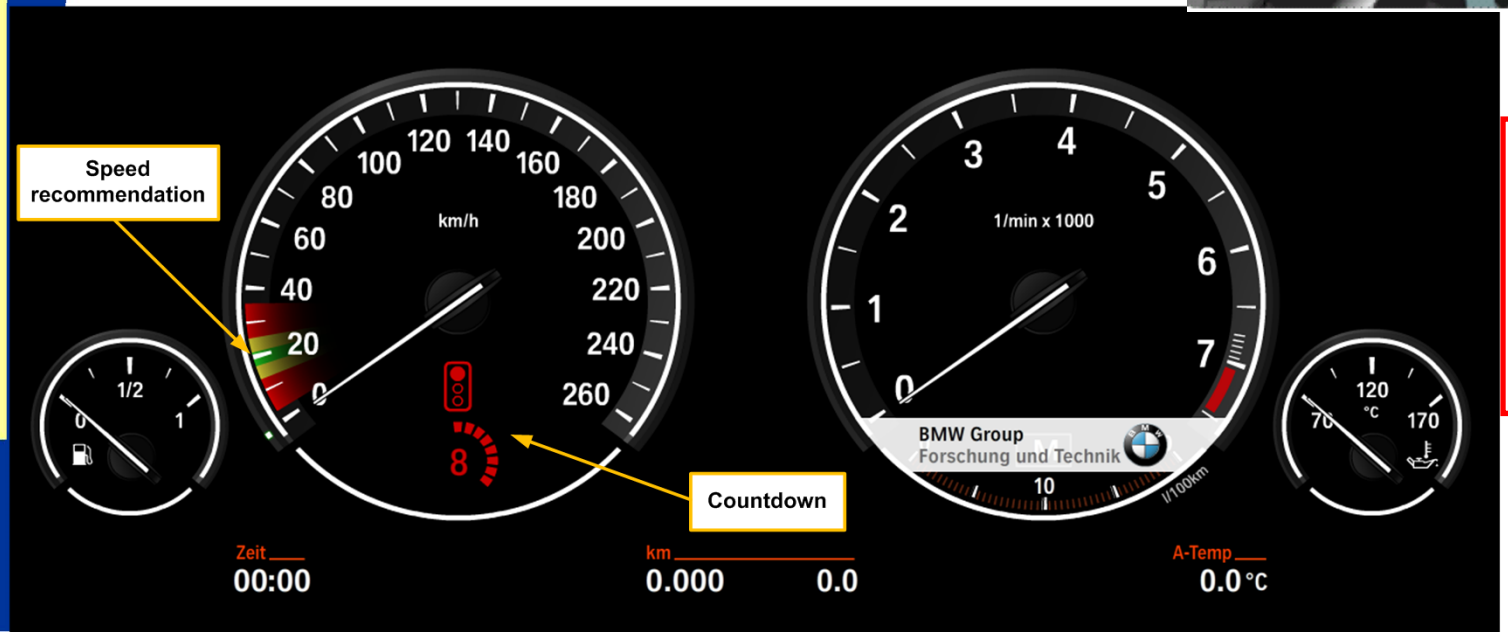
Messages

“Here I am”

Signal Phase & Timing (SPaT)

Speed Advisory

source: UC PATH & BMW)



Field Test

14% Reduction in Fuel Use

Challenges

- **Data**

  Penetration Rate (will change over time)

  Communication Protocols

  Operational Characteristics

  Regulations

- **Agencies Operational Analyses ("Highway Capacity Manual Procedures")**

  Use of "adjustment factors"

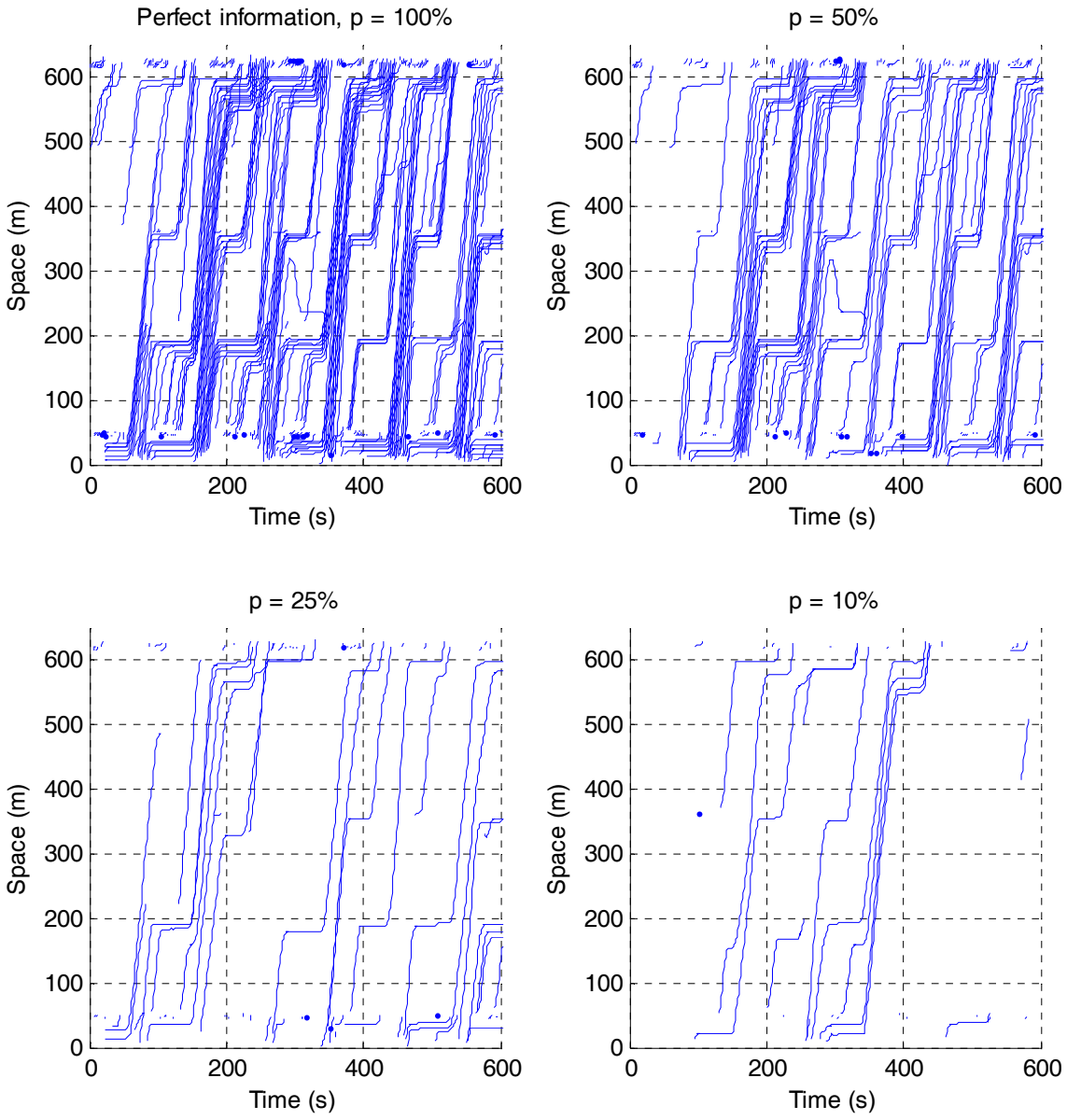
  Example: Critical Intersection control strategy improves intersection capacity by 7%

  Source of factors

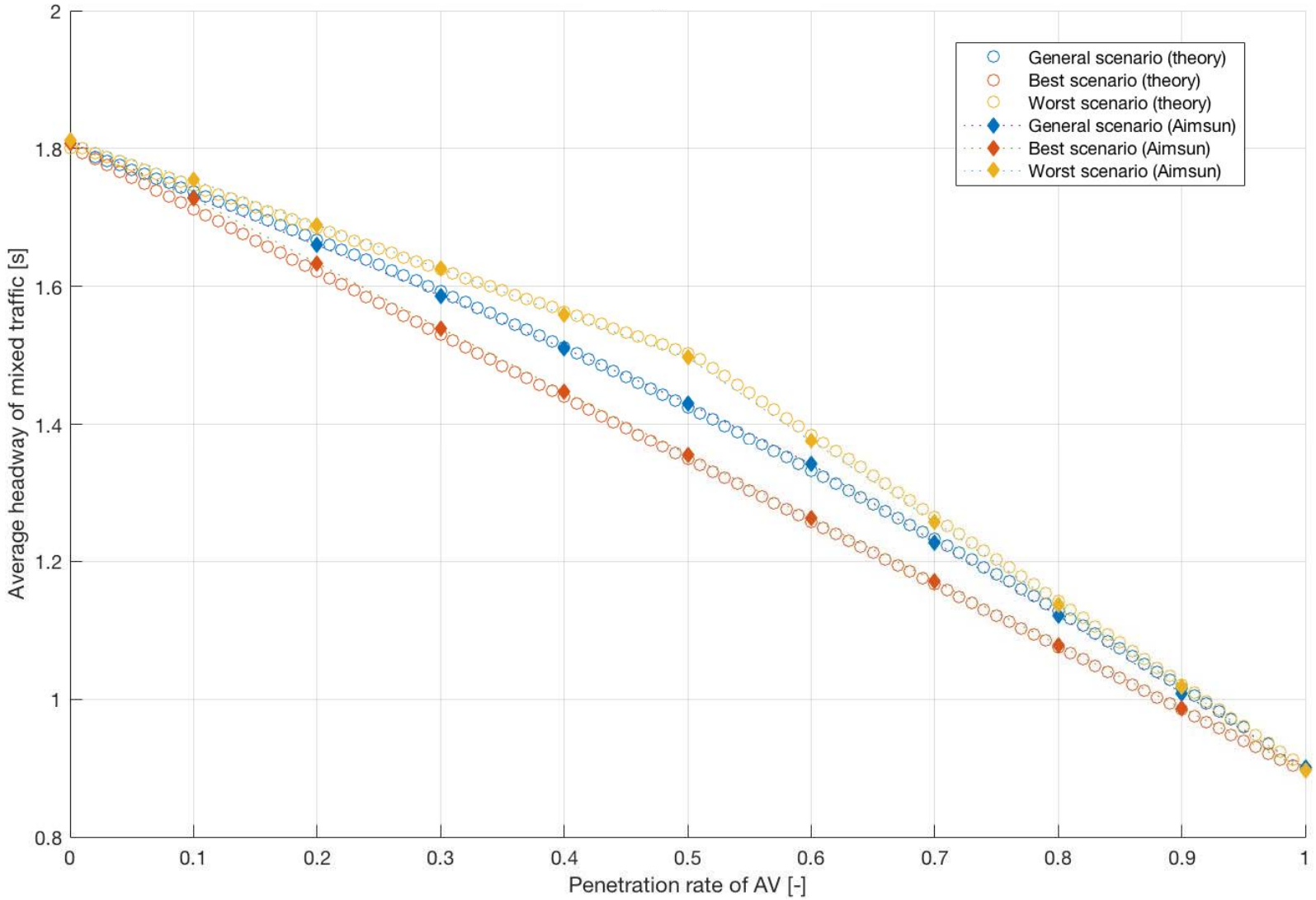
  Field data (not yet available)

  Simulation (assumptions)

Impact of Penetration Rates: NGSIM Data



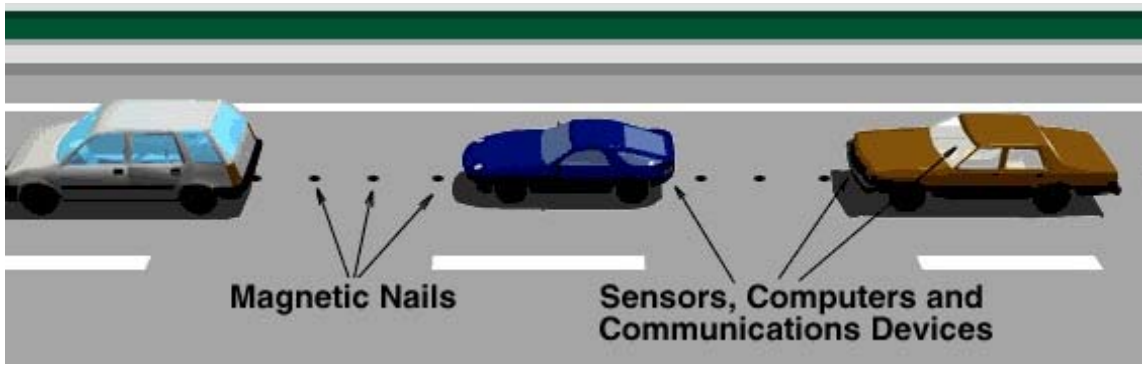
CAVs Saturation Headway



CAVs Freeways

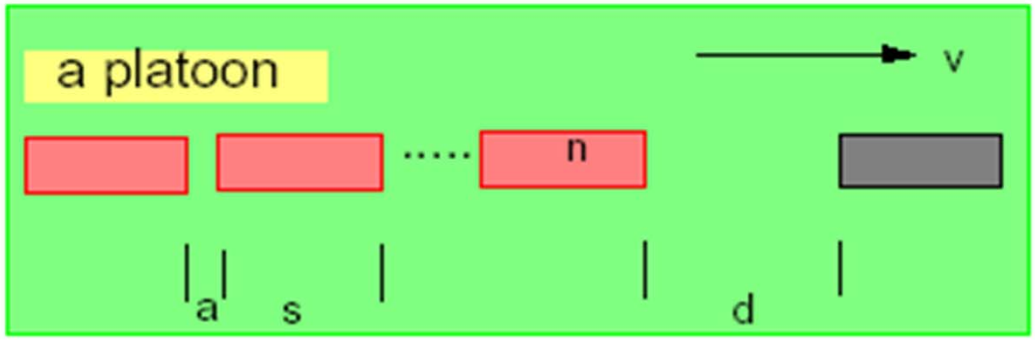
Background: AHS Implementation

- Dedicated AHS lanes
- Automated Check-in
- Automated Check-out
- Lateral and Longitudinal Controls
- Automated merging/diverging
- Malfunction Management & Analysis



AHS Demo: San Diego 1997

Models: Capacity of AHS Lane



Capacity = C = v . n / [ns + a(n - 1) + d] veh / lane / hour

Assume v = 72 k/h, s = 5m. Then

n	a	d	C
1	-	30	2,100
5	2	60	3,840
15	2	60	6,600
20	1	60	8,000

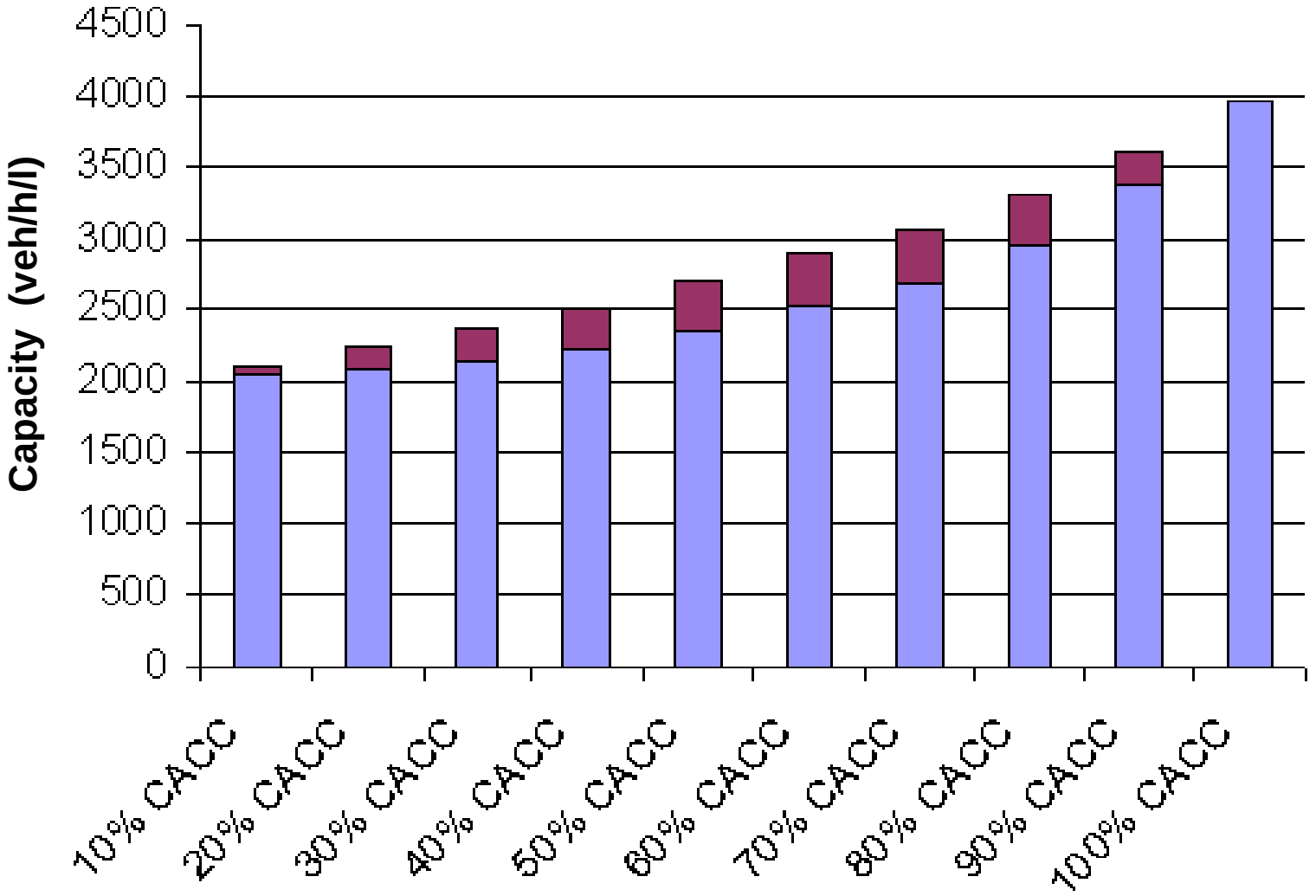
Notes

n=20 yields nearly 4 times today's capacity

capacity proportional to speed

Model: CACC Lane Capacity

Cooperative Adaptive Crouse Control (CACC)



Challenges

- **Data**

  Curent *TMC systems are not equipped to handle CAV data*

  No standards/procedures for collecting, processing integrating CAV data into existing operations

- **Models**
- **Simplified assumptions on car-following-lane changing**
- **Interactions with manually driven vehicles**
- **Calibration to real trajectories – not CAVs**
- **Operational and communication protocols**

- **Agencies on Operational & Planning Analyses**

  Use of "adjustment factors"

  What will be the capacity of freeway lane?

  What link capacity to use in 2030 transportation plans?

  Pool Fund Study-Oregon DOT

Implementation Challenges
Background: Initial Deployment Plans