



Smart City Mobility Technologies

Toronto, 1959



Pilot Project Evaluation - Closed Circuit Television (circa 1959)

Los Angeles, 2009



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Problem Statement

Safety

33,561 highway deaths in 2012
5,615,000 crashes in 2012
Leading cause of death for ages 4, 11-27



Mobility

5.5 billion hours of travel delay
\$121 billion cost of urban congestion



Environment

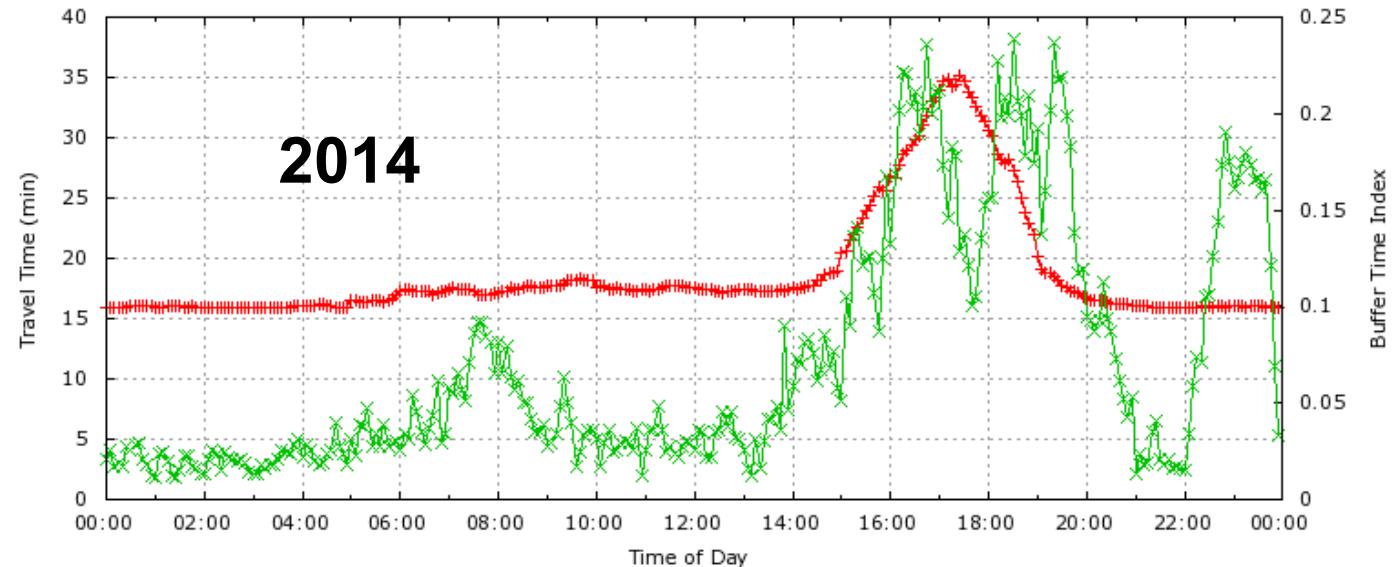
2.9 billion gallons of wasted fuel
56 billion lbs. of additional CO₂



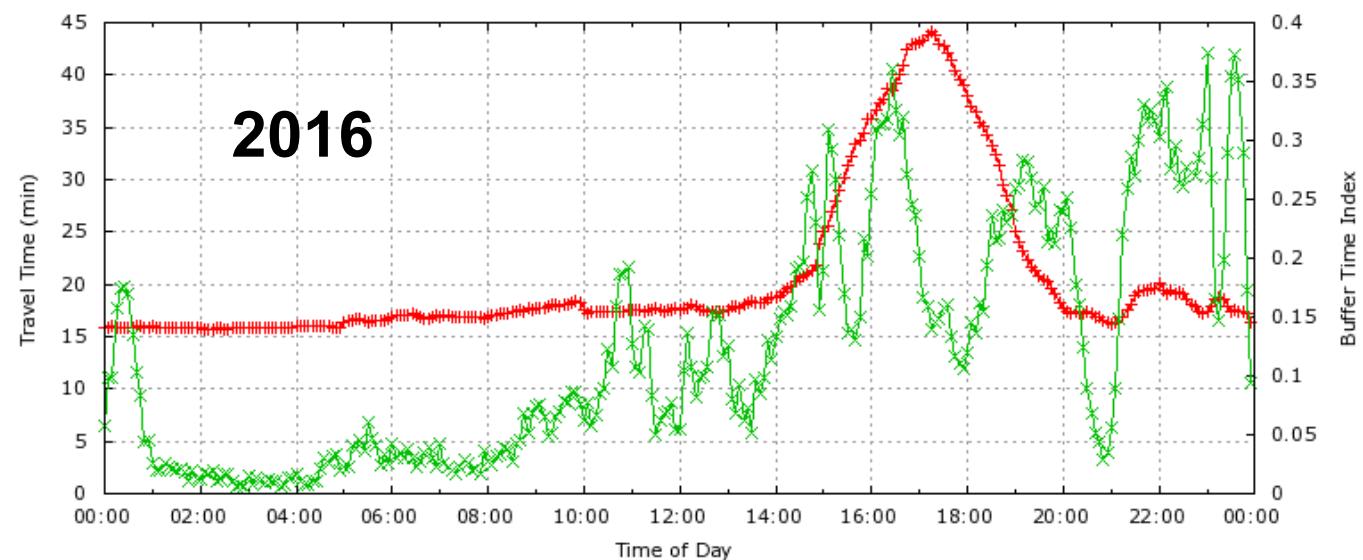


Local Example: I-80 East Bay

**Mean Travel
Times:
25% Increase**



**Travel Time
Variability:
50% higher**





Proposed Solutions: Deep Roots

Traffic Control--Urban Streets

- 1963 Toronto : Computer control of traffic signals
- 1965-70 San Jose: On-line traffic control
- 1972 Washington DC: The UTCS Experiment
- 1972-76 London, Glasgow: On-line traffic control

Freeway Surveillance/Control

- 1963 Chicago : Ramp metering
- 1967 Detroit: Demand-Capacity Metering
- 1968 Dallas: Corridor Control
- 1970 Boston: Moving Merge Systems
- 1970 Los Angeles: Freeway Control/Incident Detection

Traveler Information

- 1940 New York: Highway advisory radio (HAR)
- late 50's New York: Variable Message Signs
- 1969 Washington DC: Route guidance system
- 1970's Japan (Tokyo) and Germany (Berlin): route information/guidance

Highway Automation

- 1939 World's Fair: GM Car of the future
- 1950's Detroit: GM studies
- 1968-73 MIT and Princeton studies on automated highways and PRT
- 1970-80: Columbus: Ohio State studies/experiments



European Approaches: ATM

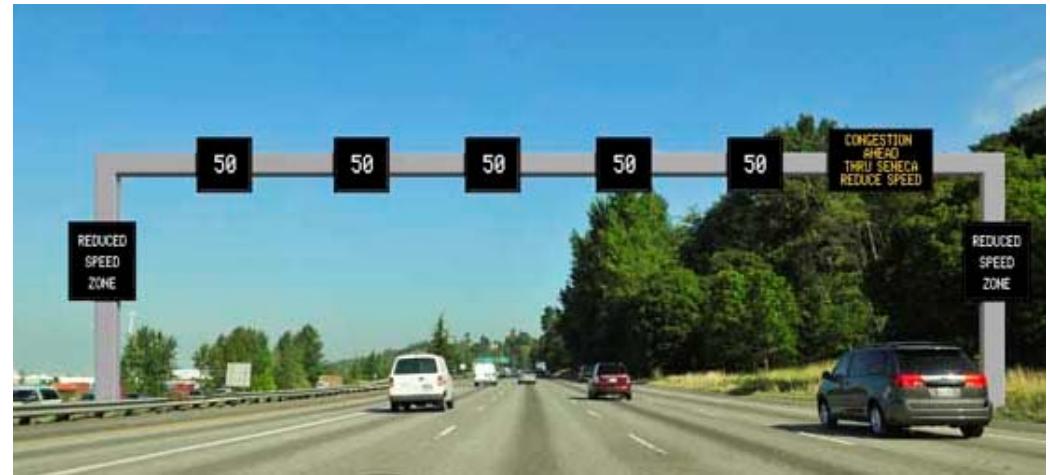




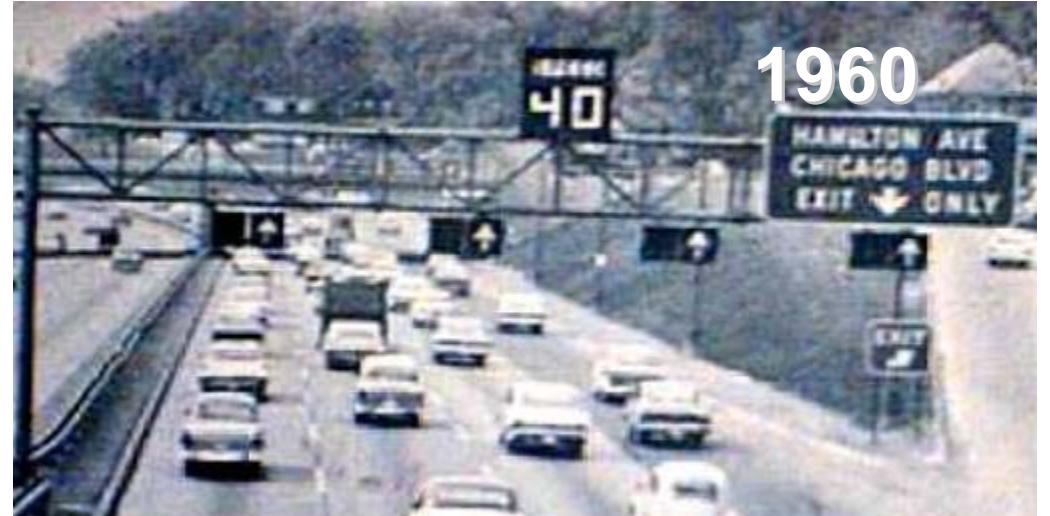
US Approach: ATDM = ATM + Demand Management (1)

Example: Variable Speed Limits

I-5, Seattle, WS



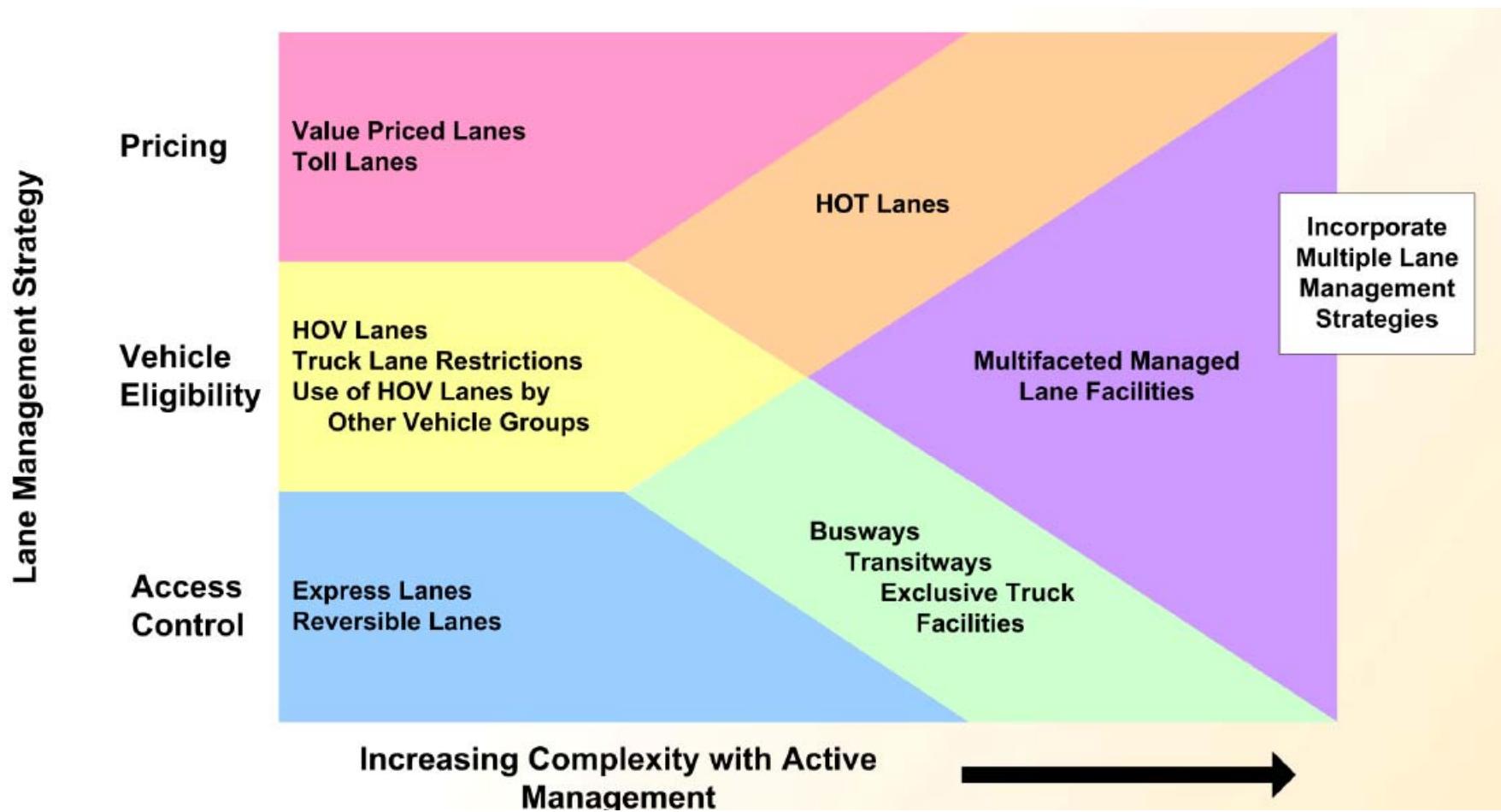
Lodge Freeway,
Detroit, MI





US Approach: ATDM = ATM + Demand Management (2)

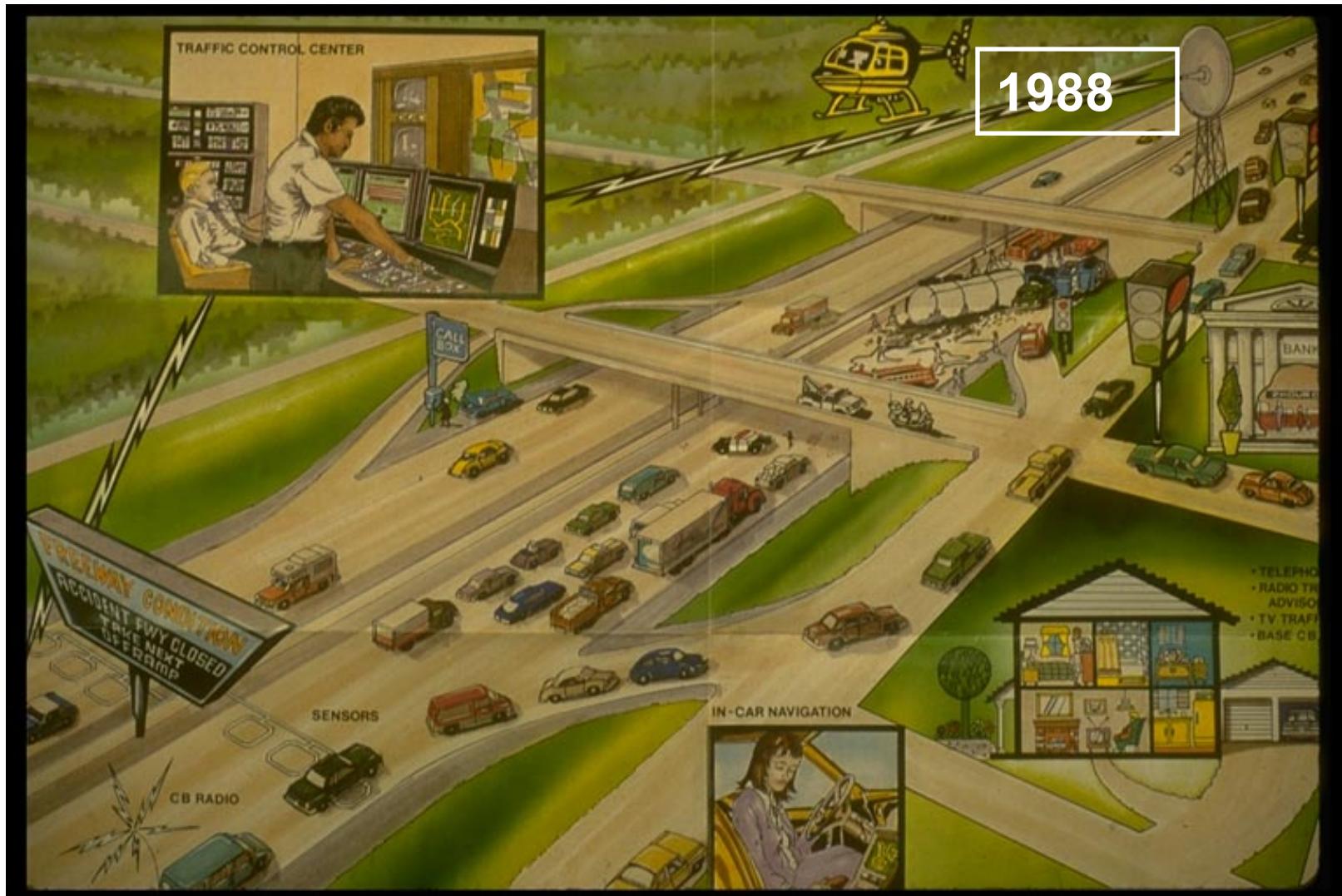
Managed Lanes





Integrated Corridor Management (ICM)

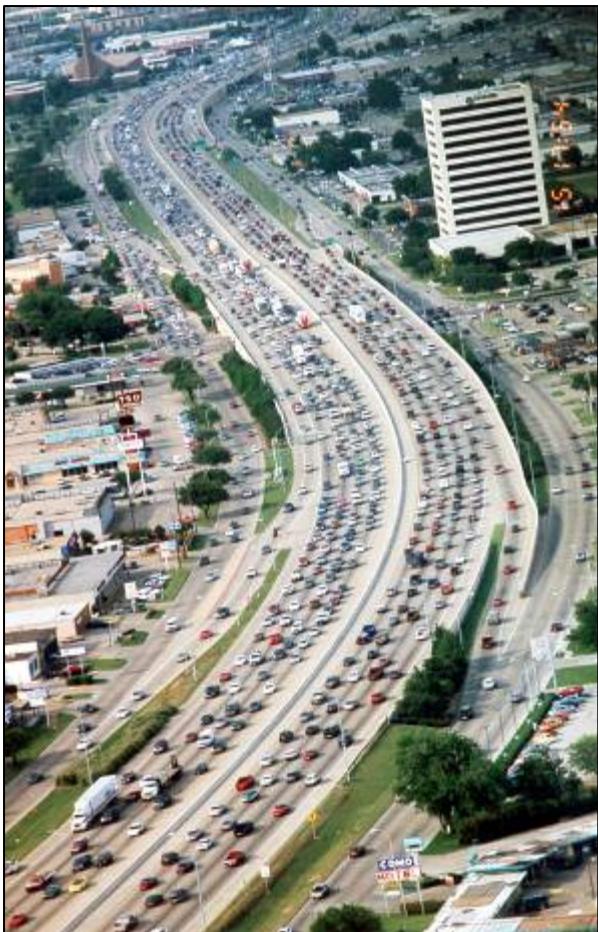
Corridor Traffic Management & Information Vision



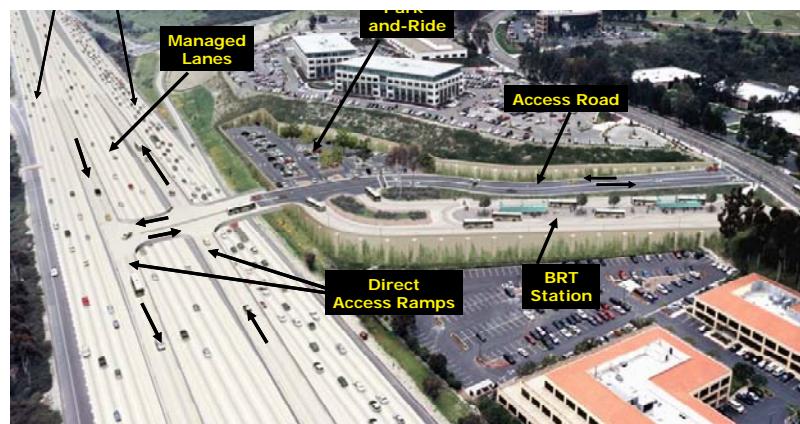


USDOT ICM Programs

US-75 ICM Corridor, Dallas, TX

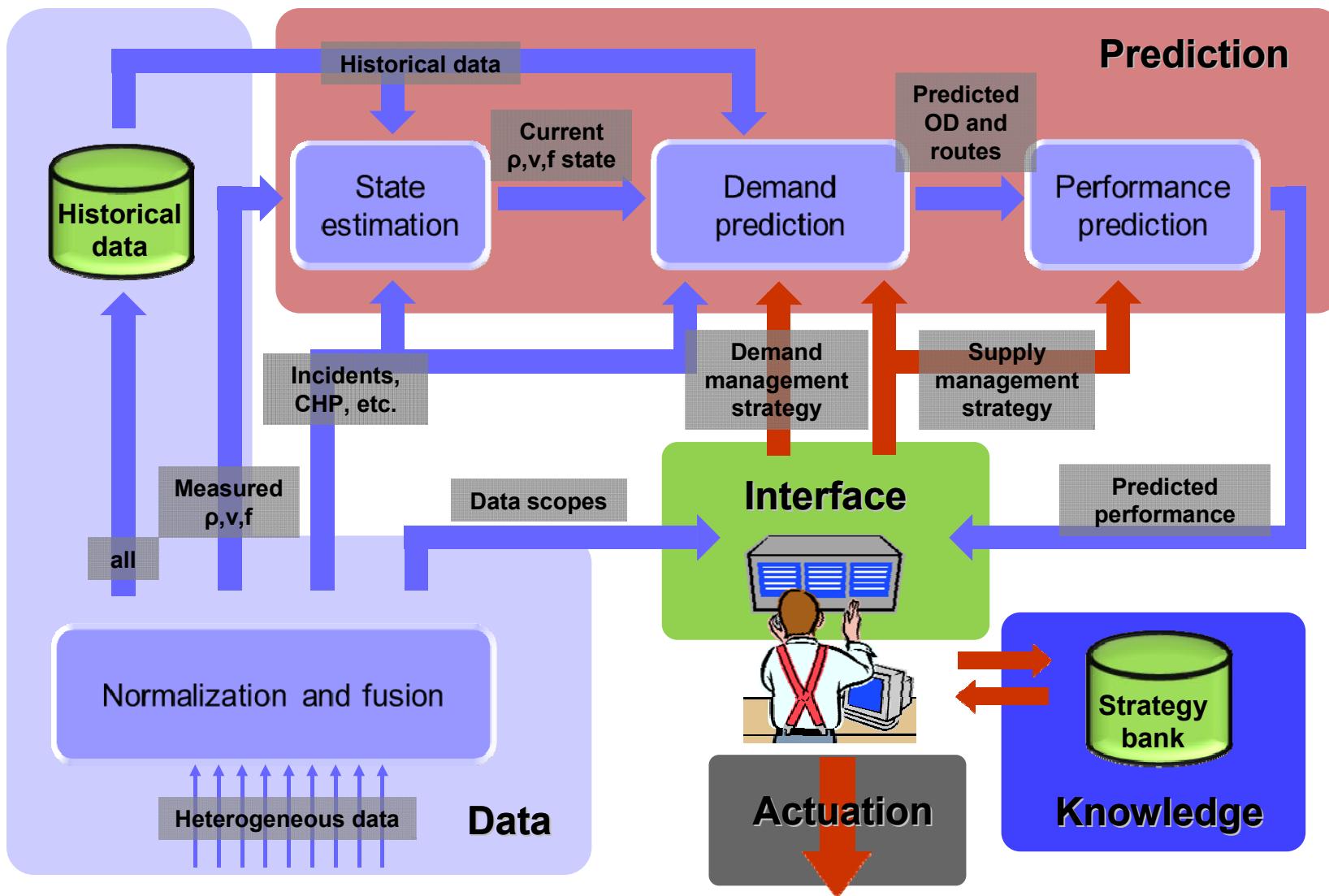


I-15 ICM Corridor, San Diego, CA





CA CC I-210: Decision Support





Connected Vehicles (CV)

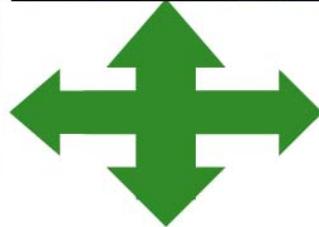
Safety Applications Mobility Applications

V2V, I2V, V2I

**Vehicles
and Fleets**



Drivers/Operators



Maritime



Rail

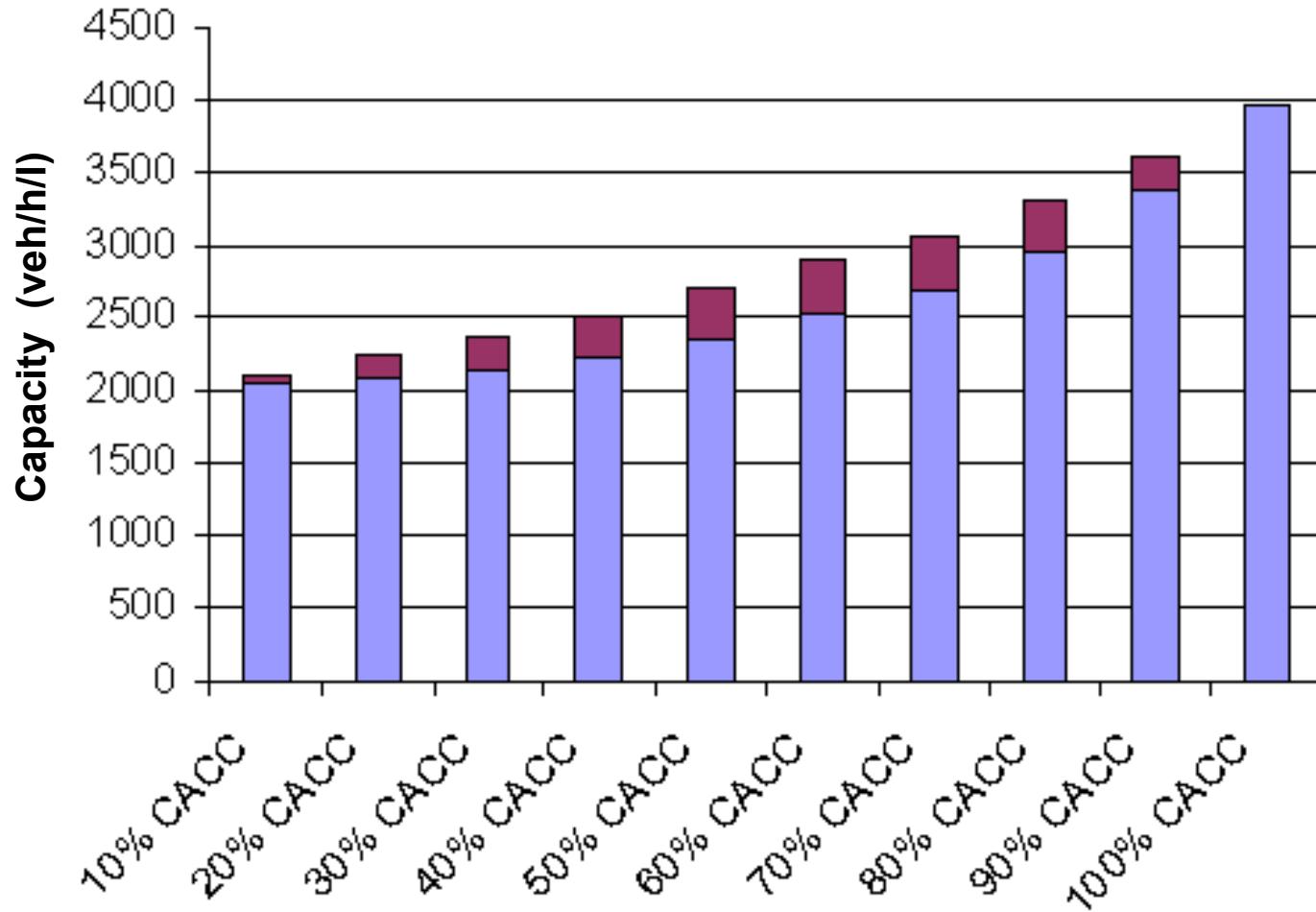
Wireless Devices

Infrastructure



CV Applications: Lane Capacity

Cooperative Adaptive Cruise Control (CACC)

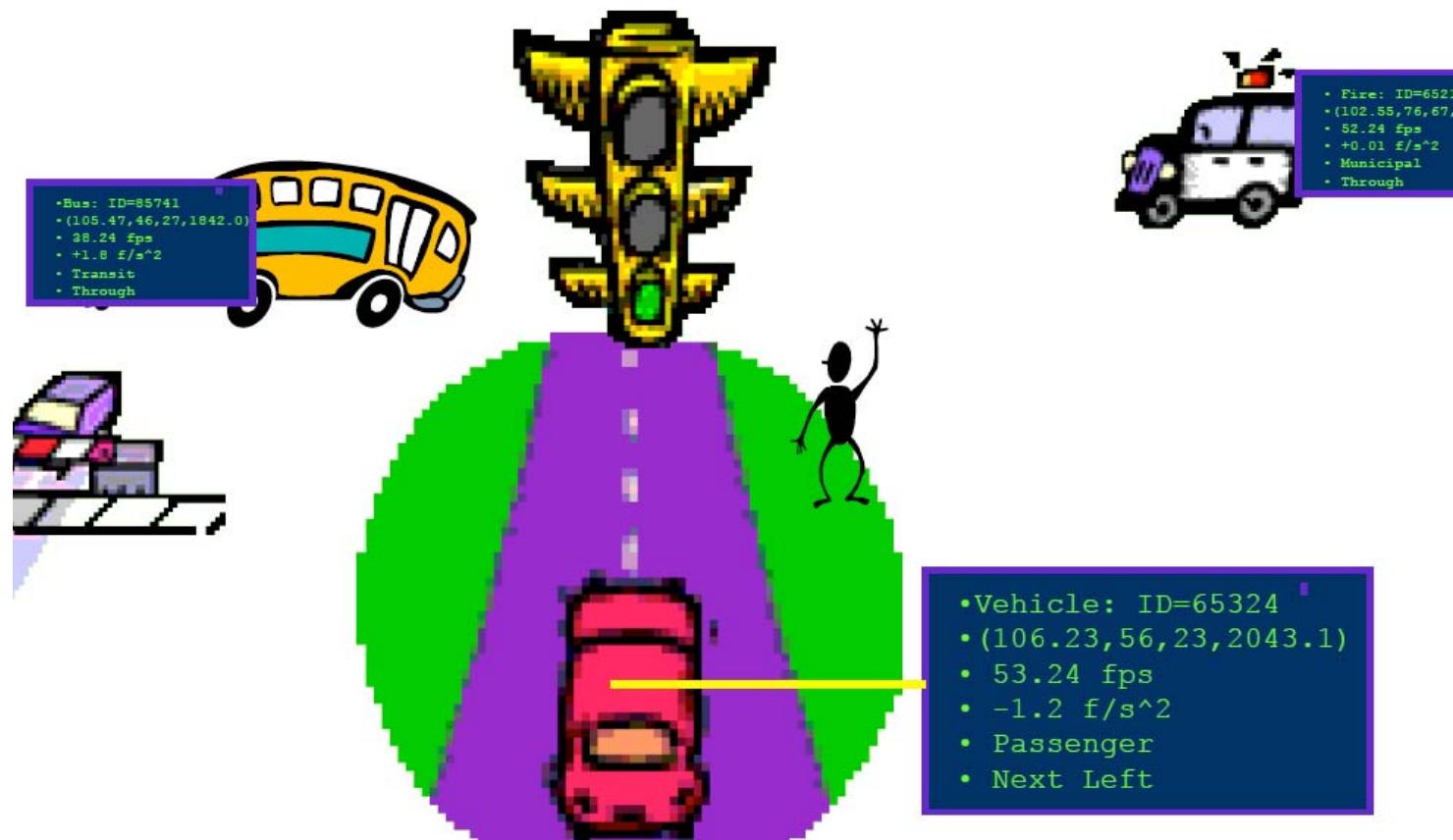




CV Applications: Traffic Signals (1)

Each vehicle/ped/bike a sensor: *Here I am*

MMITSS: Multi Modal Intelligent Signal System





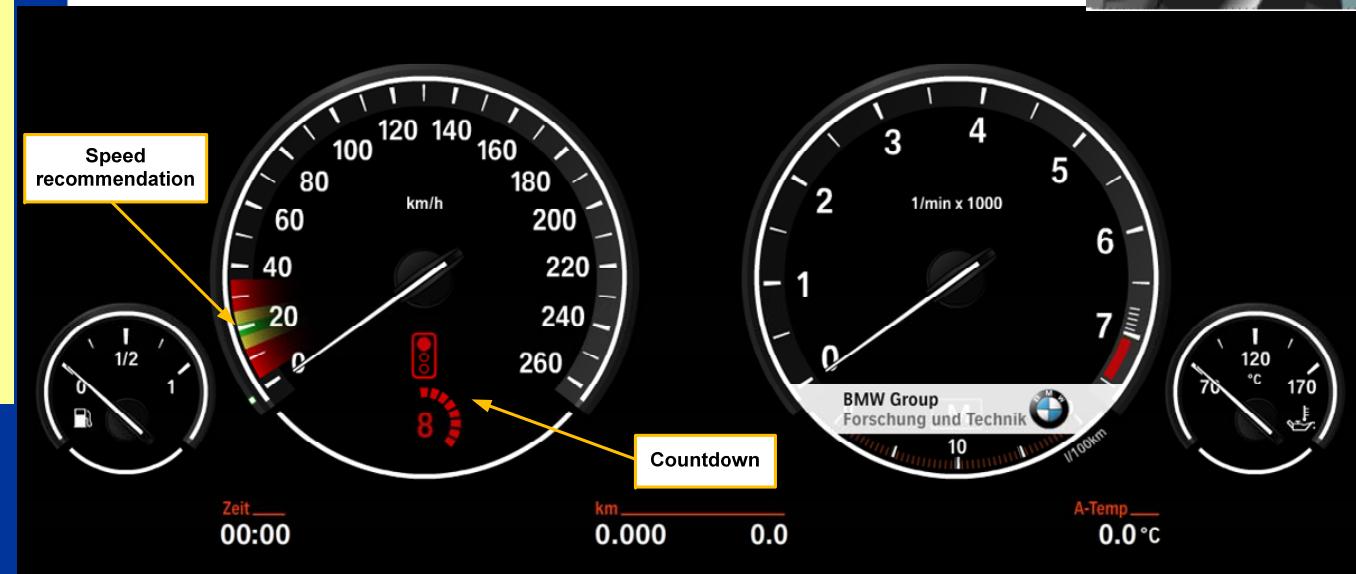
CV Applications: Traffic Signals (2)

Messages

“Here I am”

Signal Phase & Timing (SPaT)

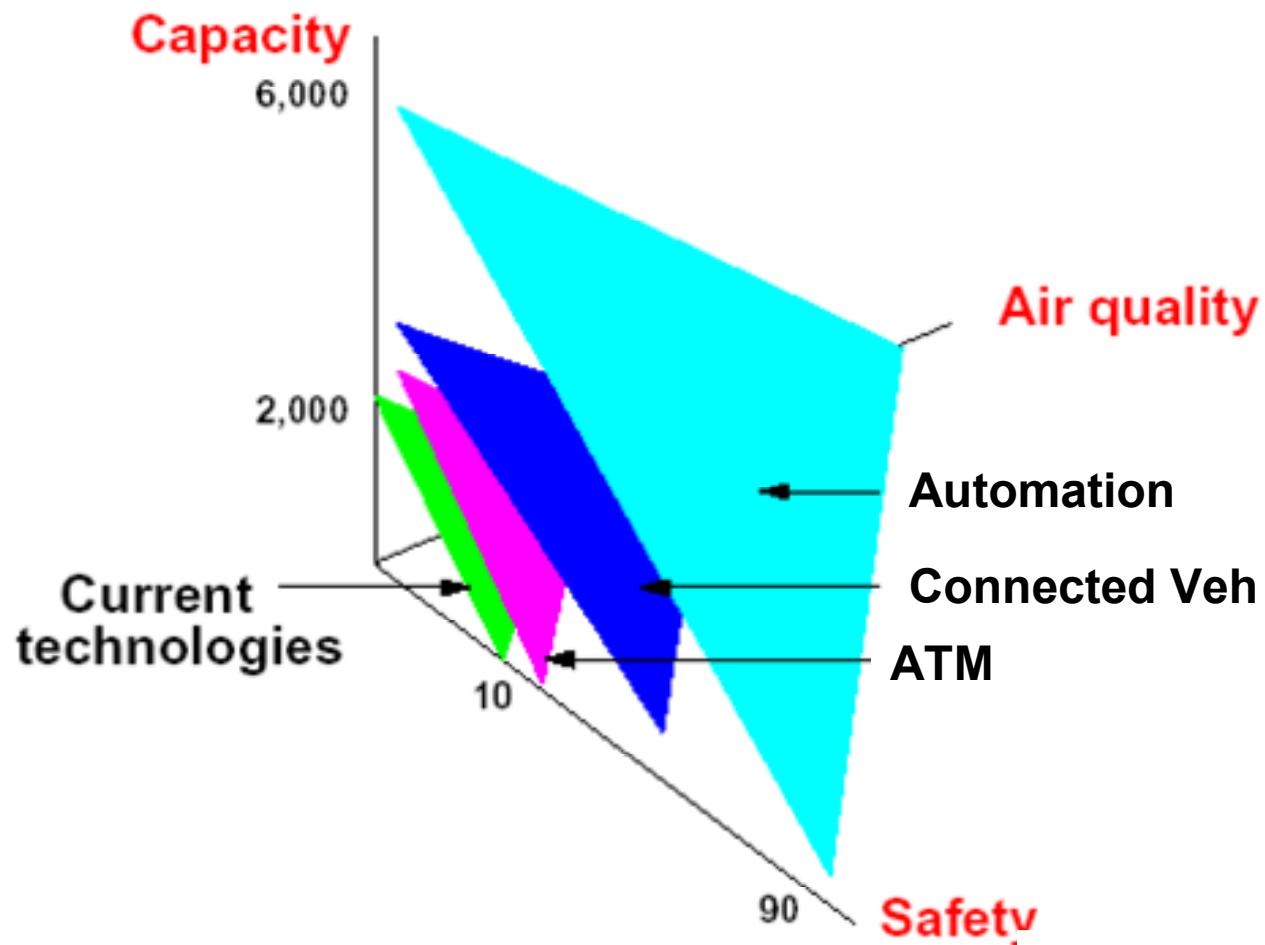
Application: Dynamic Speed Advisory (source: UC & BMW)



**14% Reduction
in Fuel Use**

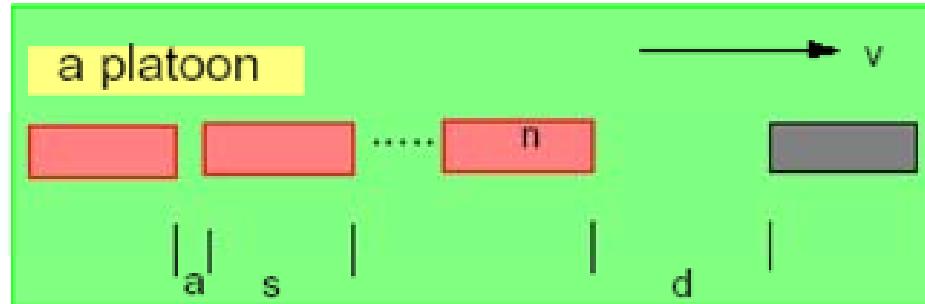


Looking Ahead: Beyond Connected Veh





Example: Capacity of AHS Lane



$$\text{Capacity} = C = v \cdot n / [ns + a(n - 1) + d] \text{ veh / lane / hour}$$

Assume $v = 72 \text{ k/h}$, $s = 5\text{m}$. 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