ICM, CAV, Smart Cities: Bringing it all together

ITS Alaska

Joy Bhattacharya, PE, PTOE
Principal, Transportation
Stantec

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Dream Big - The year is 2050

- 2/3 of population in Smart Cities
- Sustainable homes, offices, stores, parking lots, streets
- Smart grid balancing renewable energy, storage, distribution

- Car charges itself while you sleep
- Drives you to office – Safe & timely
- No parking - Car handles other activities

More Resilient Cities

Mobile City

Safe City

Economically Viable

Good Governance – Plan, Execute, Manage

Culturally Vibrant

Clean City

Ecologically Sustainable

Green City

Being Resilient
by Using Technology to Leverage Existing Infrastructure

People
- Social programs
- Smarter care
- Education

Environment
- Pollution control
- Water quality
- Climate change adaptation

Energy
- Energy efficiency
- Smarter meters
- Reduced emissions

Location Services
- Efficient delivery
- Smarter shopping
- Just-in-time

Transportation
- Autonomous vehicles
- Accessibility
- Trip reliability

City Planning
- Communication
- Buildings
- Security
- Technology

Emergency Response
- Incident response
- Natural disasters
- Police and Fire

Infrastructure
- Traffic planning
- Roads
- Construction

New Mobility Revolution

The concept of a connected, multimodal ecosystem featuring physical conveyances (i.e. vehicles, bikes, trains) and remote communications (i.e. telecommuting, tele-education, tele-shopping) to efficiently and affordably connect people to goods, services, work, and community.

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What Should Agencies Do?

- **PARTICIPATE** – DON'T WAIT
- Baby steps - **plan infrastructure** needs and building data and computing capacity to position your city
- **Experiment and Test**
- **Track and monitor** federal and state developments and make your voices heard
- Gain Stakeholder & Public Confidence

Source: National League of Cities

Participate

SF – Smart City Plan

- **Basic infrastructure** (Institutional, Operational, Technical)

- Uses "smart" solutions to **improve infrastructure and services**

- Meets the goals of the City

  o Zero waste by 2020

  o Reduce greenhouse gas emission by 25%

  o Transportation: 50% non-driving mode share

Plan Infrastructure

ICM – Defined by FHWA

Integrated

>>>>>> *combining or coordinating separate agencies so as to provide a harmonious, interrelated "whole" . . .*

Corridor

>>>>>> *a travel shed of trips anchored by one or more highway, arterial, or rail line*

Management

>>>>>> *jointly managing all the travel therein in order to achieve defined objectives*

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Traditional Agency Responsibilities

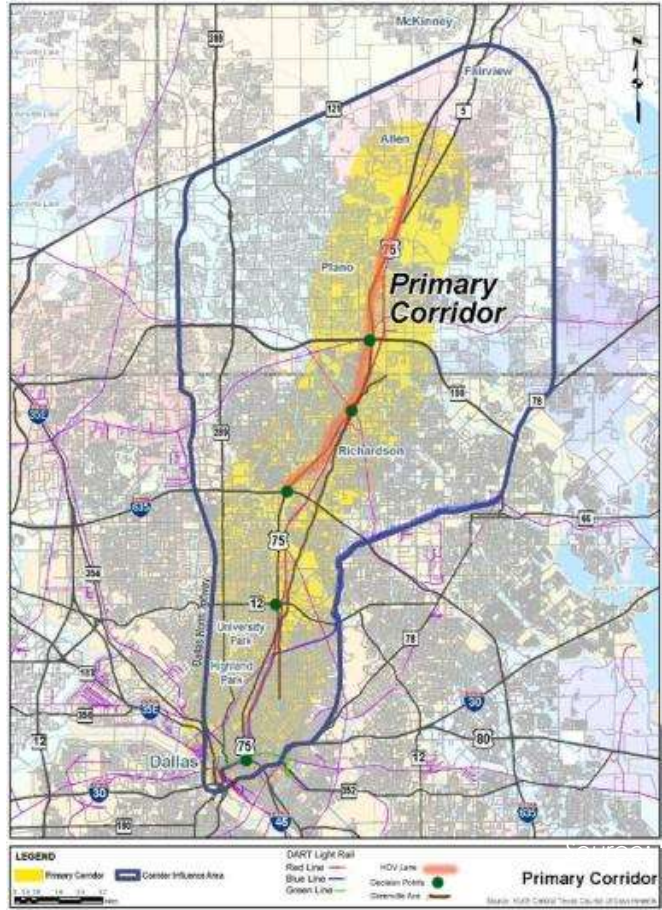|		
	Collision	Autonomous response to Incidents on 'their' facilities
	Ridership	Provide NextBus and Traveler Information to own Agency services
	Commute Routes	Maps and connections
	Supply	Parking Information System

Integrated Management – DSS
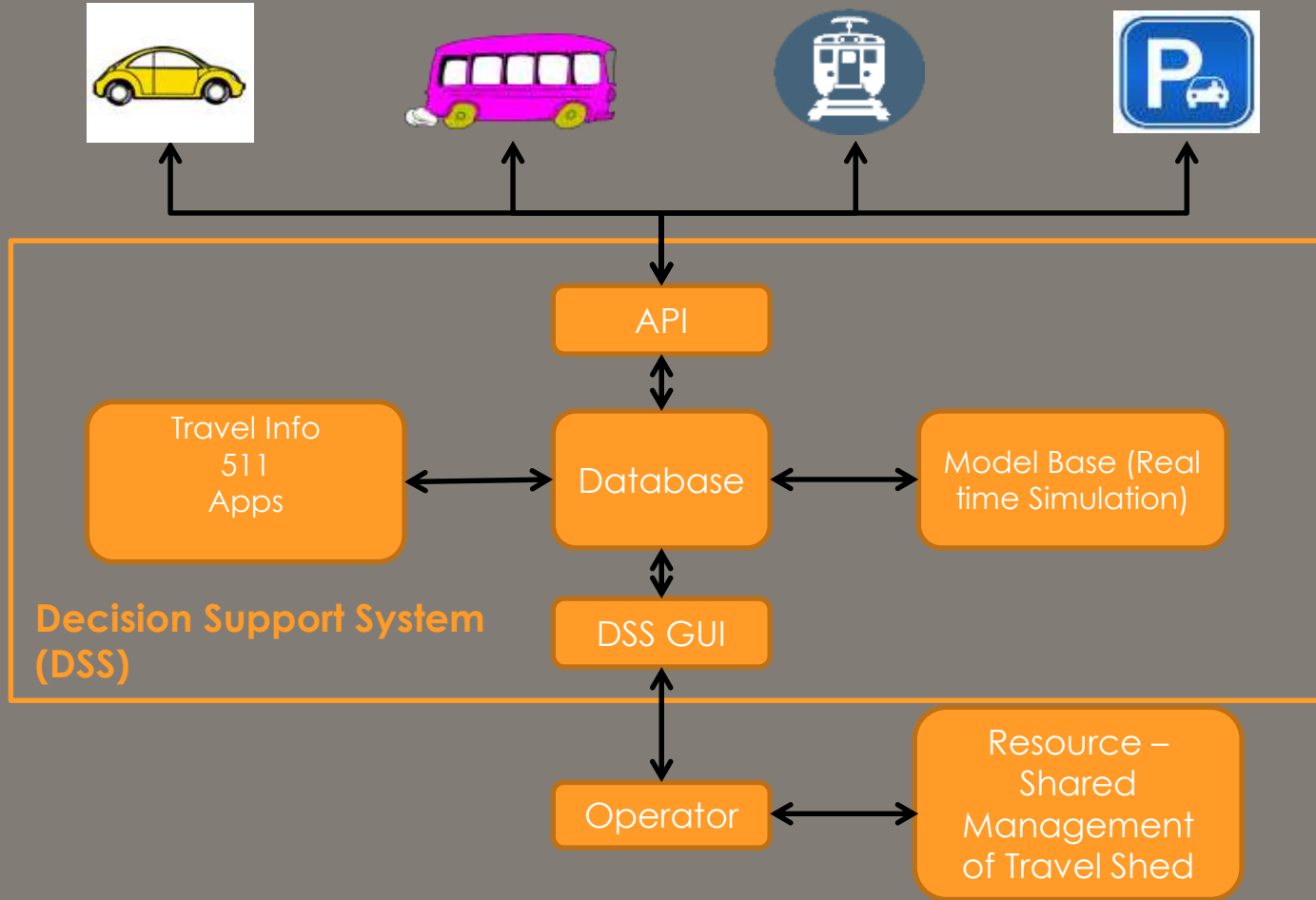
Dallas US-75 Corridor

Primary Corridor

Actionable Traveler Information

- New real-time 511 system
    - Incidents, Construction
    - Traffic speeds
    - LRT Volume and Vehicle Locations
    - Red Line park-and-ride utilization / parking availability
- My511 e-mail alerts
- ICM DMS messages
- Social media
- DART data feeds for third party application development

Coordinated timing and responsive signal control

Rerouting of traffic to Frontage Roads and Greenville Avenue

Real-time service adjustments to Red Line (capacity increases)

Smart Parking System & LRT Station Parking Expansion at Red Line park-and-ride facilities

Route/Mode Shift/Diversion
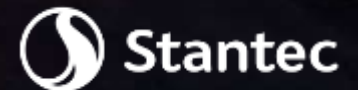
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I-80 SMART Corridor

What Is the I-80 SMART Corridor Project?

- Integrated network of technologies to enhance safety and improve travel time reliability
- Most sophisticated system of its kind in California
- Provides real-time information to drivers

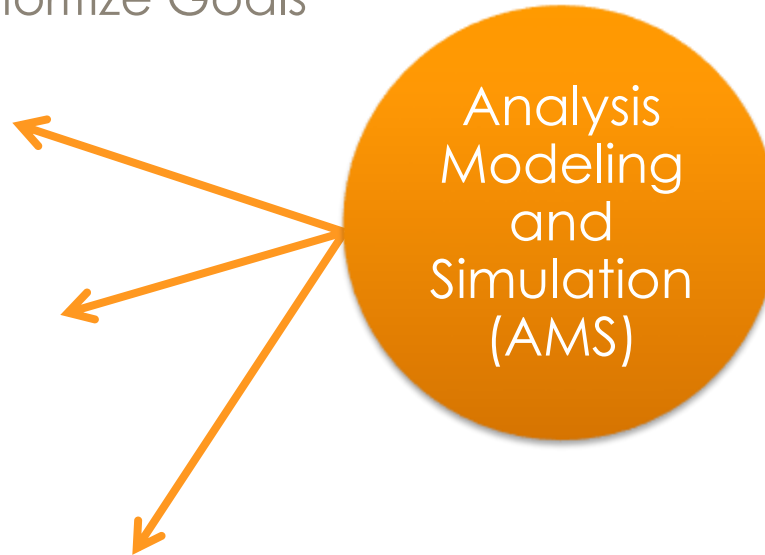smart corridor

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SR-4 ICM – A Corridor Vision

The Challenge

- **Manage and preserve** the $1.3 Billion investment made in roadway widening and new interchanges along the SR4 corridor
- SR-4 is the **4th worst commute** in the Bay Area
- SR-4 is **expected to degrade** to LOS F as travel demand and congestion continues to grow
- SR-4 is a **critical, regional corridor**
- Limited ability to expand freeway, arterials, or alternate routes
- Significant commuter corridor
- BART extension amplifies the opportunity for **multimodal solutions**
- **First ICM to ICM connection** in the US

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7 Phases of ICM lifecycle

1. Kickoff
2. Establish Goals and Prioritize Goals
3. Plan for Success
   1. PMP
   2. SEMP
   3. Con Ops
4. Develop and Design
   1. Architecture
   2. Requirements
   3. Detailed Design
5. Build and Test
6. Operate and Maintain
7. Retire/Replace/Upgrade

Analysis Modeling and Simulation (AMS)

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SR4 ICM System Management Concept

ICM Operations

ACTIONS

⇅

DECISION SUPPORT

⇅

INTEGRATED DATA

⇅

JOINT OPERATIONS, RESPONSE & ACTION PLANS

⇅

CORRIDOR NETWORKS: ROADWAY, TRANSIT, and FREIGHT

Where do agencies fall?

Active, but not Integrated

Active and Integrated

Active

Early in Active and/or
Integrated Operations

Integrated, but not Active

Integrated

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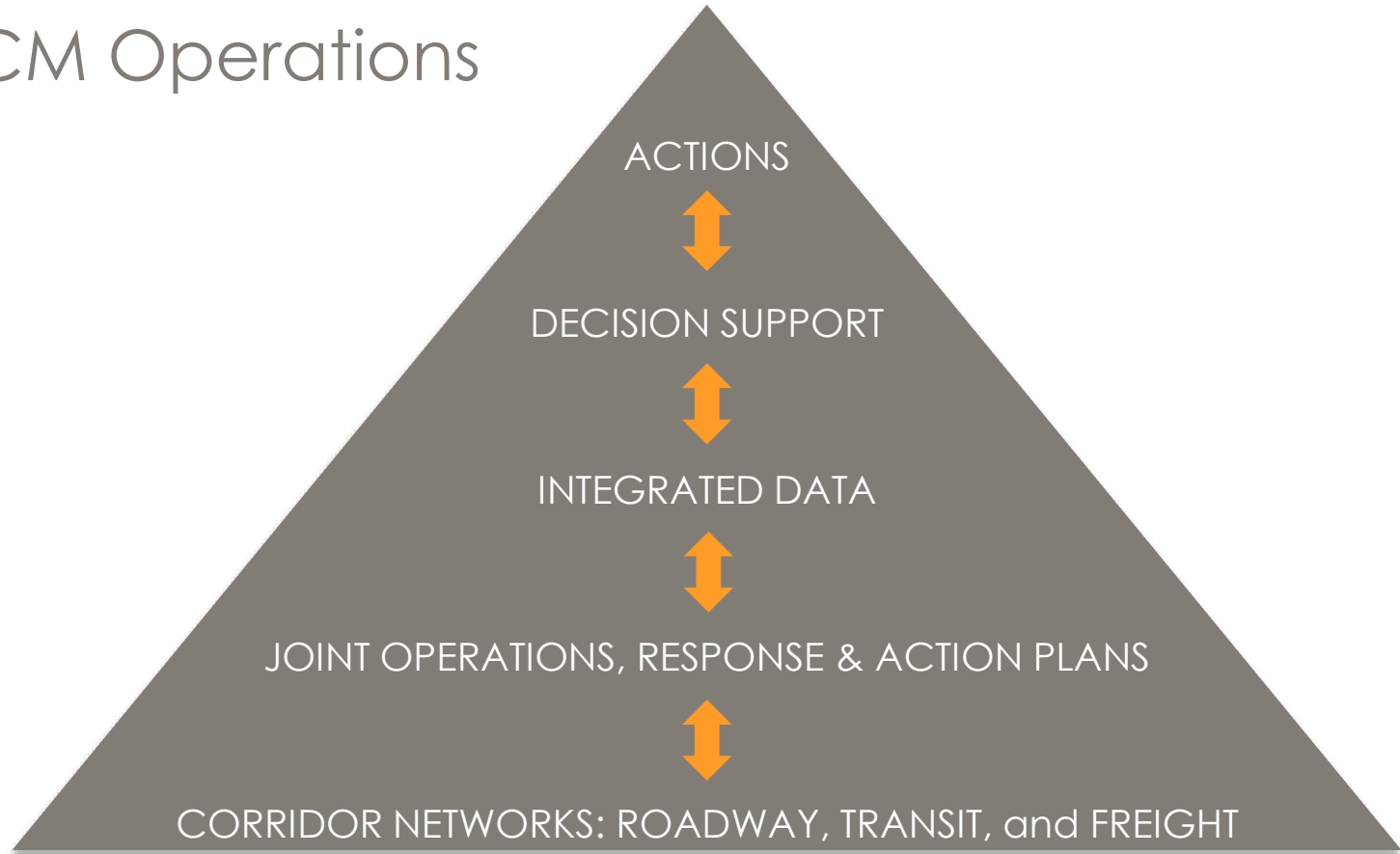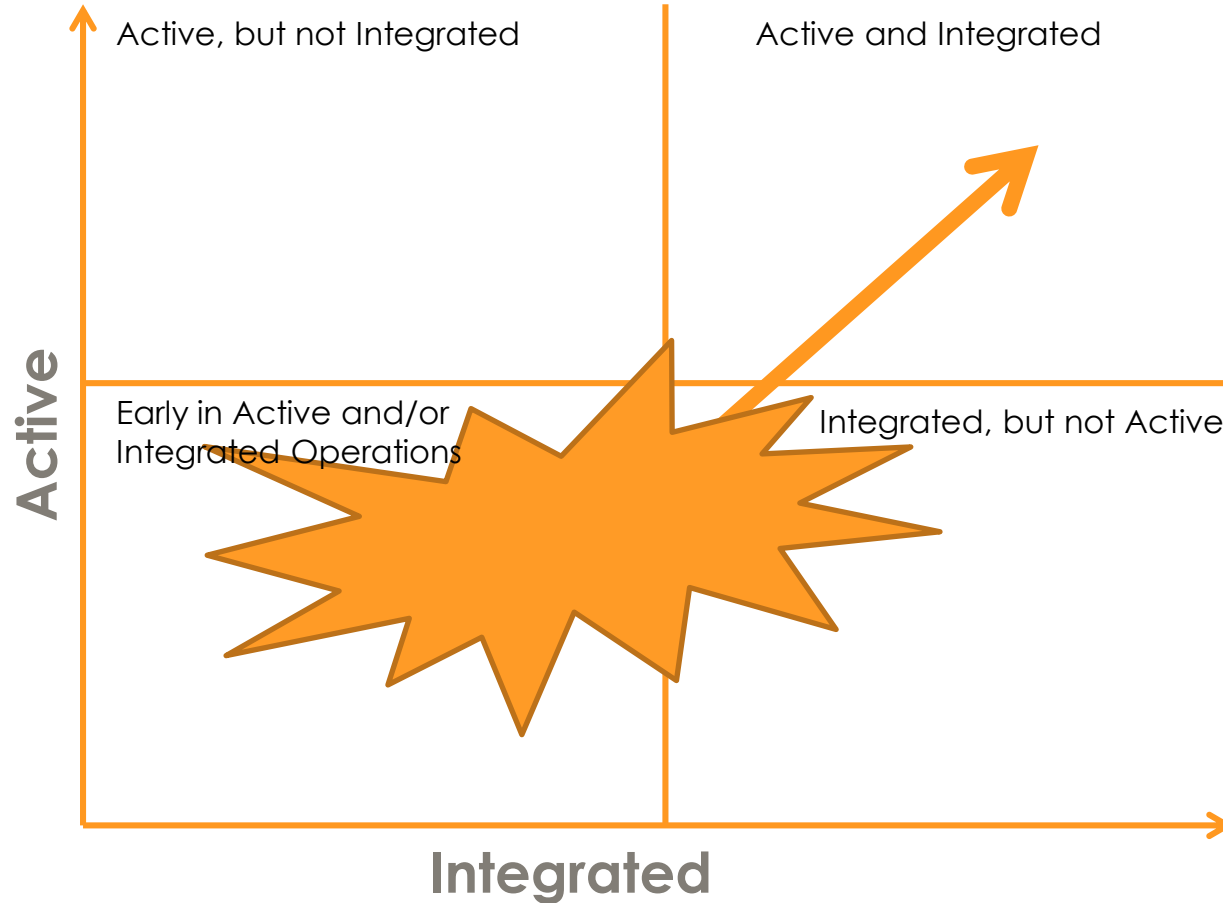
Background

February 29 to March 4, 2016 Hourly
Speed/Accident/Obstructions

Selected Components

Traffic Management Strategy	Increased throughput	Increased capacity	Decrease in collision	Decrease in incident sensitivity	More uniform speeds	Decreased headways	More uniform driver behavior	Increased trip reliability	Delay onset of freeway breakdown	Reduction in traffic noise	Reduction in emissions	Reduction in fuel consumption	Will the strategy be included in the I-8 4 ICM Phase II?	Priority (based on vote)
Dynamic rerouting	•		•				•	•			•	•	Yes	1
Adaptive ramp metering	•		•		•			•	•		•	•	Yes	1
Advanced traveler information	•		•				•	•			•	•	Yes	1
Traffic signal synchronization	•				•	•		•		•	•	•	Yes	1
Centralized traffic signal management	•			•	•	•		•		•	•	•	Yes	1
Transit signal priority								•					Yes	1
Emergency vehicle pre-emption				•				•			•	•	Yes	1
Transportation – transit information sharing								•					Yes	1
Improved incident response	•			•	•	•							Yes	1
Decision Support System	•			•	•		•	•	•	•	•	•	Yes	1
First Mile/Last Mile/AV/CV	•		•	•	•	•	•	•	•	•	•	•	Yes	1
Bike related Improvements		•									•	•	Yes	1
Construction site management	•	•						•		•	•	•	Yes	1
Speed harmonization	•		•	•	•	•	•	•	•	•	•	•	Yes	2
Queue warning			•	•	•	•	•	•		•	•	•	Yes	2
Dynamic lane markings	•	•						•					Yes	2
Dynamic merge control	•	•	•		•			•	•	•	•	•	Yes	2
Junction control	•		•		•		•	•	•		•	•	Yes	2
High Occupancy Vehicle Lanes	•				•	•		•		•	•	•	Part of other projects	3
Freeway shoulder use	•	•						•	•				Part of other projects	3
Smart park								•			•	•	Part of Other projects	3
High Occupancy Toll Lanes	•				•	•		•	•	•	•	•	Part of other projects	3
Waterway	•	•	•	•	•	•	•			•			Part of other projects	3

Traffic Management Strategy	Increased throughput	Increased capacity	Decrease in collisions	Decrease in incident sensitivity	More uniform speeds	Decreased headways	More uniform driver behavior	Increased trip reliability	Delay onset of freeway breakdown	Reduction in traffic noise	Reduction in emissions	Reduction in fuel consumption	Will the strategy be included in the SR 4 ICM Phase II?	Priority (based on vote)
Automated speed enforcement			●	●	●		●	●			●	●	No	N/A
Dynamic truck restrictions	●	●			●		●	●			●	●	No	N/A
Reversible lanes	●												No	N/A
Road Widening	●	●				●			●				No	N/A
Traffic Signal Construction		●	●	●			●				●	●	No	N/A

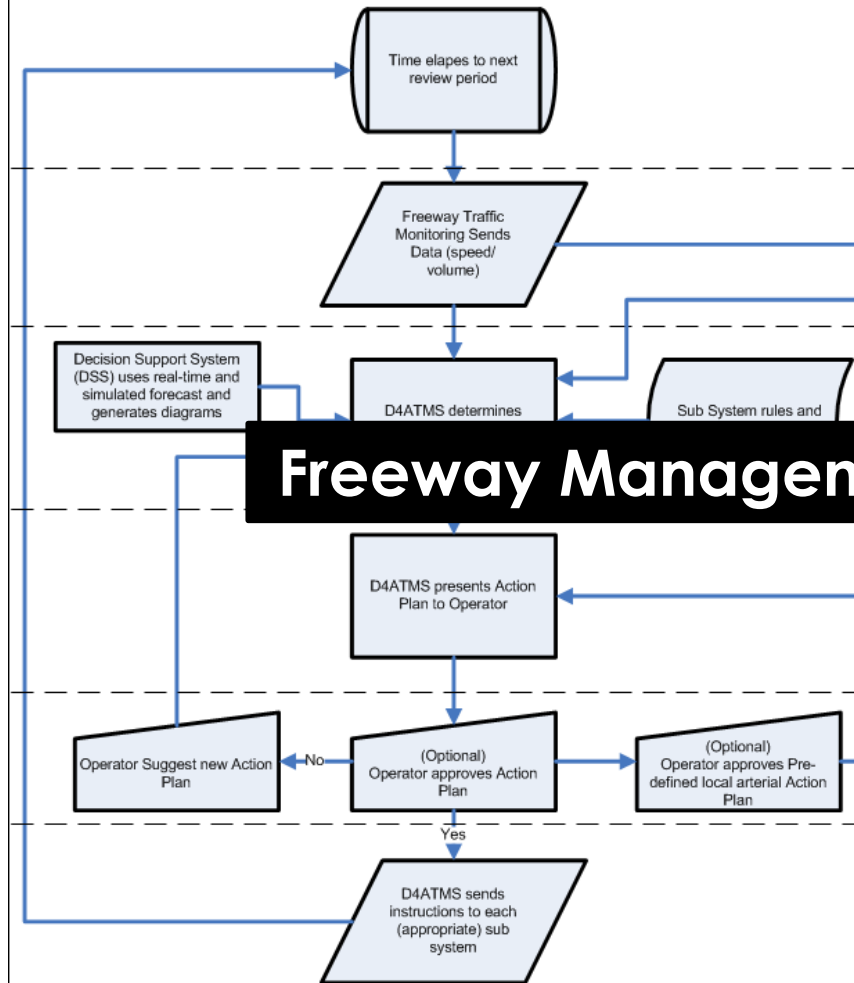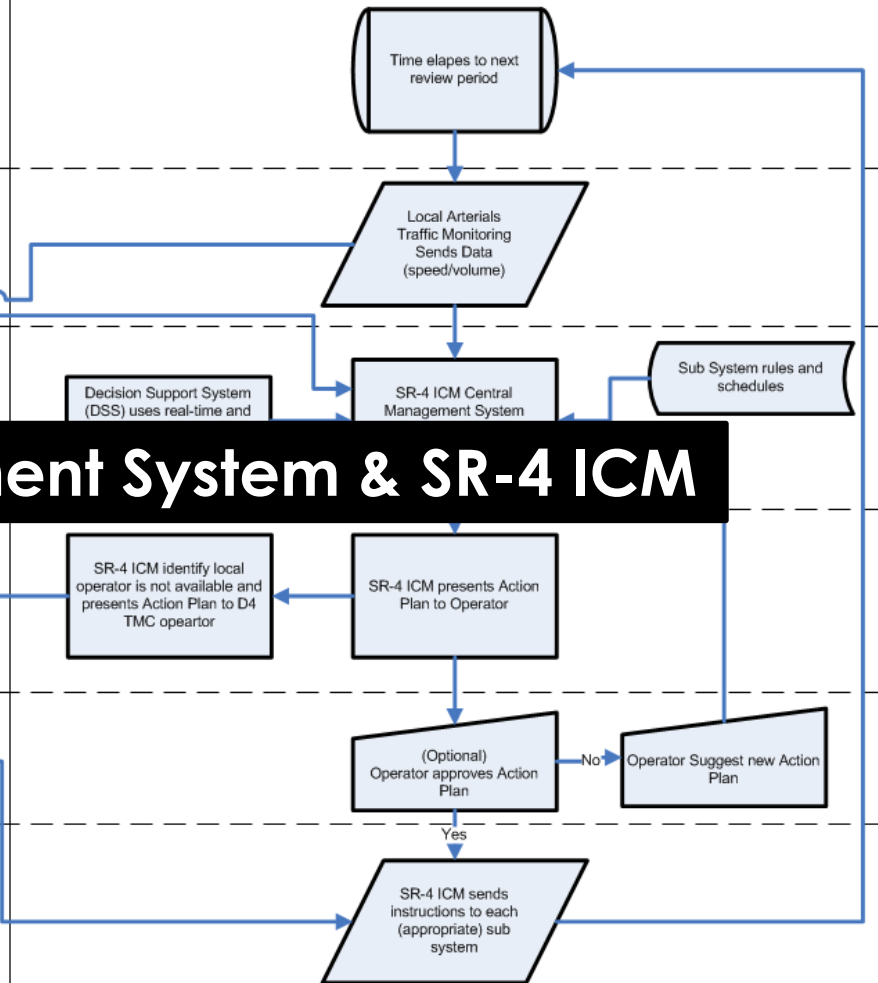|	
Operational Improvements/Hot Spot	• Shoulder lanes, Ramp widening, Aux lanes
ICM/ATM	• DSS, communication, instrumentation and Integration, ARM, Speed Harmonization
First-Mile/Last-Mile	• SAV, Mobility on Demand, Connection Protection
TDM	• Focus on shared rides (CBD, Schools, BART), Dynamic ride sharing, New transportation app, Dynamic Ride Match
Express Lanes/High Capacity Transit	• Converting existing HOV or Shoulder Use, High Capacity Transit Extension
Prepare the Corridor for High-Tech Future	• Sensor, DSRC, V2V and V2I
Public Private Partnership	• Private ferry operator, private buses, neighborhood shuttles

Freeway Management System & SR-4 ICM
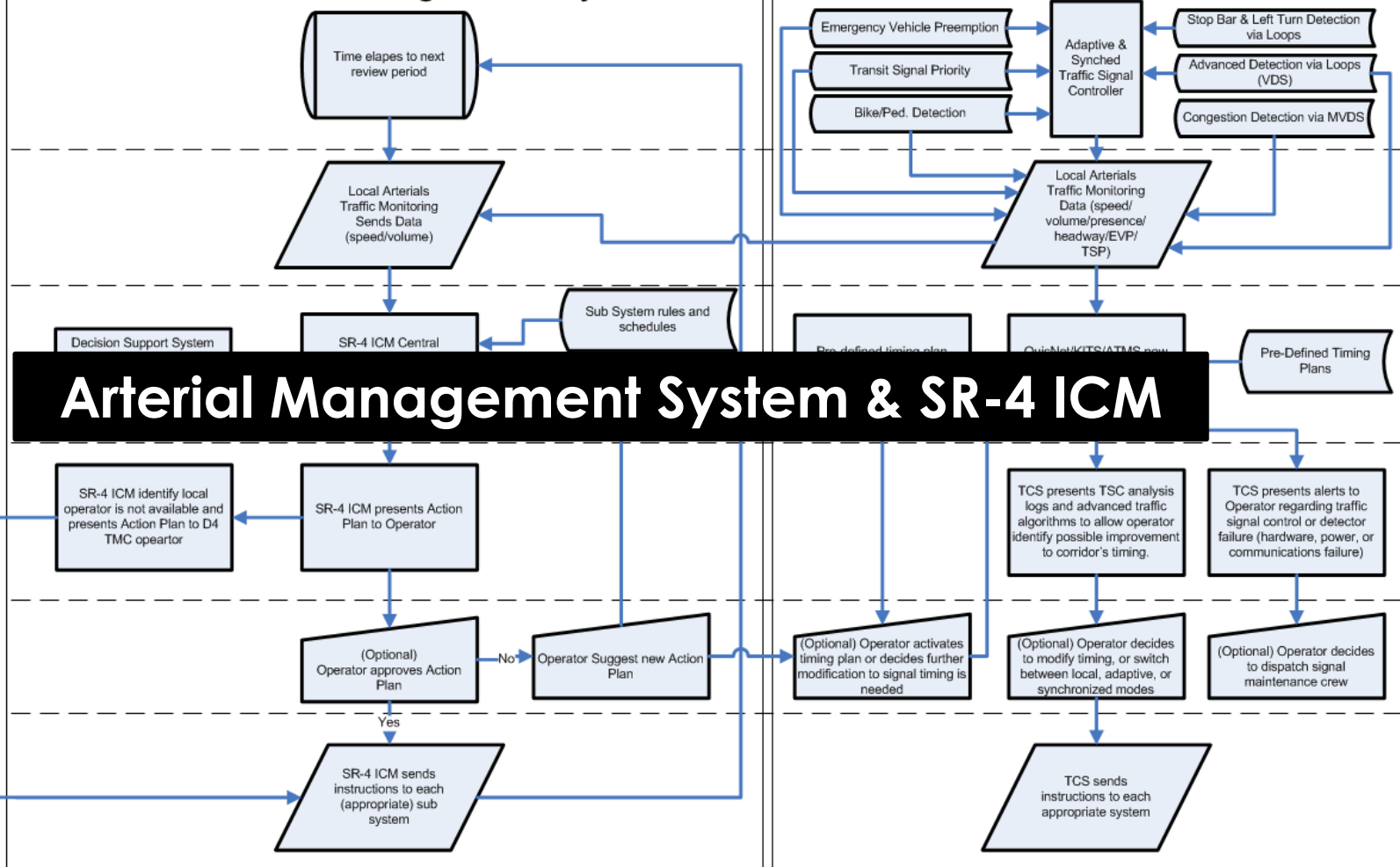
Regional TMC D4 ATMS

SR-4 ICM Central Management System

Arterial Management Systems

Arterial Management System & SR-4 ICM

Time elapes to next review period

Emergency Vehicle Preemption

Transit Signal Priority

Bike/Ped. Detection

Adaptive & Synched Traffic Signal Controller

Stop Bar & Left Turn Detection via Loops

Advanced Detection via Loops (VDS)

Congestion Detection via MVDS

Local Arterials Traffic Monitoring Sends Data (speed/volume)

Local Arterials Traffic Monitoring Data (speed/volume/presence/headway/EVP/TSP)

Decision Support System

SR-4 ICM Central

Sub System rules and schedules

Pre-defined timing plan

QuicNet/KITS/ATMS now

Pre-Defined Timing Plans

D4ATMS presents Action Plan to Operator

SR-4 ICM identify local operator is not available and presents Action Plan to D4 TMC opeartor

SR-4 ICM presents Action Plan to Operator

TCS presents TSC analysis logs and advanced traffic algorithms to allow operator identify possible improvement to corridor's timing.

TCS presents alerts to Operator regarding traffic signal control or detector failure (hardware, power, or communications failure)

No

(Optional) Operator approves Action Plan

(Optional) Operator approves Action Plan

No

Operator Suggest new Action Plan

(Optional) Operator activates timing plan or decides further modification to signal timing is needed

(Optional) Operator decides to modify timing, or switch between local, adaptive, or synchronized modes

(Optional) Operator decides to dispatch signal maintenance crew

Yes

(Optional) Operator approves Pre-defined local arterial Action Plan

SR-4 ICM sends instructions to each (appropriate) sub system

TCS sends instructions to each appropriate system

Regional TMC D4 ATMS

SR-4 ICM Central Management System

Transit Management Systems

Time elapses to next review period

Local Arterials Traffic Monitoring Sends Data

Automated Vehicle Location

CCTV

Automatic Passenger Counter (APC)

VMS/CMS

Ticket Vending Machine

Fare Collection System

Local Transit Data

Sub System rules and schedules

Decision Support System (DSS) uses real-time and

SR-4 ICM Central Management System

SR-4 ICM presents possible delays along major transit

Transit Management System (CAD/AVL/Scheduling

Pre-Defined Routes & Schedules

Transit Management System & SR-4 ICM

D4ATMS presents Action Plan to Operator

SR-4 ICM identify local operator is not available and presents Action Plan to D4 TMC opeartor

SR-4 ICM presents Action Plan to Operator

SR-4 ICM presents information & data related to Transit Signal Priority (TSP) to Transit operator

Transit Management System presents Transit related data to transit dispatch/schedulers/ and operators.

No

(Optional) Operator approves Action Plan

(Optional) Operator approves Action Plan

No

Operator Suggest new Action Plan

(Optional) Operator approves or decides further modification is needed

(Optional) Operator may decides to update schedules to get priority along the route

(Optional) Dispatcher may decide to take actions and inform drivers through CAD.

Yes

(Optional) Operator approves Pre-defined local arterial Action Plan

SR-4 ICM sends instructions to each (appropriate) sub system

Transit Management System sends instructions to each (appropriate) sub system

First/Last Mile Solution:

GOMENTUM STATION

CONTRA COSTA transportation authority

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BART Bay Area Rapid Transit

BR

EASY MILE

BAY AREA AIR QUALITY MANAGEMENT DISTRICT
A HEALTHY BREATHING ENVIRONMENT FOR EVERY BAY AREA RESIDENT

First Transit

Adding:

The County Connection

SAN FRANCISCO COUNTY TRANSPORTATION AUTHORITY

Wheels

BESTMILE
THE MISSING LINK

Notable Project: Shared Autonomous Vehicles

Watch our video:
bit.ly/FirstandLastMile

Solving the First/Last Mile Challenge:

43% Transit

57% auto

93% auto

7% transit

CONTRA COSTA
transportation
authority

Completing Mass Transit
via SAV* Shuttles
in 2020

* SAV = Shared Autonomous Vehicle

2 Vehicles
2.5 Miles long
1 Mile wide

1 Vehicle
1 Mile long
0.5 Miles wide

Contra Costa Transit

Amtrak Stations

Transit Centers (Contra Costa)

BART Lines/Stations

AC Transit Routes

WestCAT Routes

County Connection Routes

TriDelta Transit Routes

1 SAV can...

SAV lifecycle = only 2 years

Replace

12 conventional vehicles

Serve
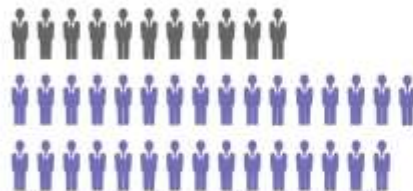
31-41 persons a day

Eliminate
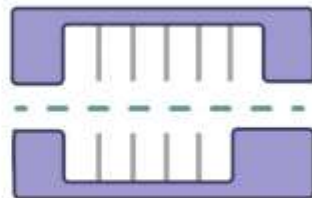
11 parking spaces

11% increase in passenger's overall travel distance with pooling

Source: D. J. Fagnant, K. M. Kockelman (2014), The travel and environmental implications of shared autonomous vehicles, using agent-based model scenarios , Transportation Research Part C: Emerging Technologies, 40, March 2014.

$1.60/mi.

Total Cost of a Conventional Vehicle (including time value) vs. SAVs

$0.41/mi.

Source: L.D. Burns, W.C. Jordon, B.A. Scarborough (2013), "Transforming personal mobility", Earth Island Institute, Columbia University, 2013.

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Participate - Track and Monitor

Concord Naval Weapons Station

Selected as 1 of 10
USDOT-Designated Automated Vehicle Proving Grounds

GO**MENTUM** STATION

#1
Largest secure testbed in North America

5,000+ acres
with 2,100 acres available for testing

20+ miles
of paved roadways with a 7-mile long spine road for high speed testing

What is GoMentum Station?

A Platform for Transforming the Future

GoMENTUM STATION

Platform

Largest Test Bed

Collaboration/ Facilitation

Center for Innovation

Testing & Research

CV Applications

Leading the World in Redefining Mobility

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Questions

Thank you!

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EXTRAS

The Vision

Build a CV/AV center at GoMentum Station to converge innovation and commercialization of CV applications and AV technologies at the largest test bed in the world

Established October, 2014

Selected as 1 of 10
USDOT-Designated Automated Vehicle Proving Grounds

$130,000,000,000
Lost productivity per year due to congestion

45,000
Annual roadway fatalities In North America

More Resilient Cities

Sustainable – Less, smaller & safer cars

Affordable – Less capital construction

Equitable – Fair access to all

Accommodating – Provide capacity

Influencing – Enhances transit

Disruptive – Employment

Diverse – multimodal and mixed-use

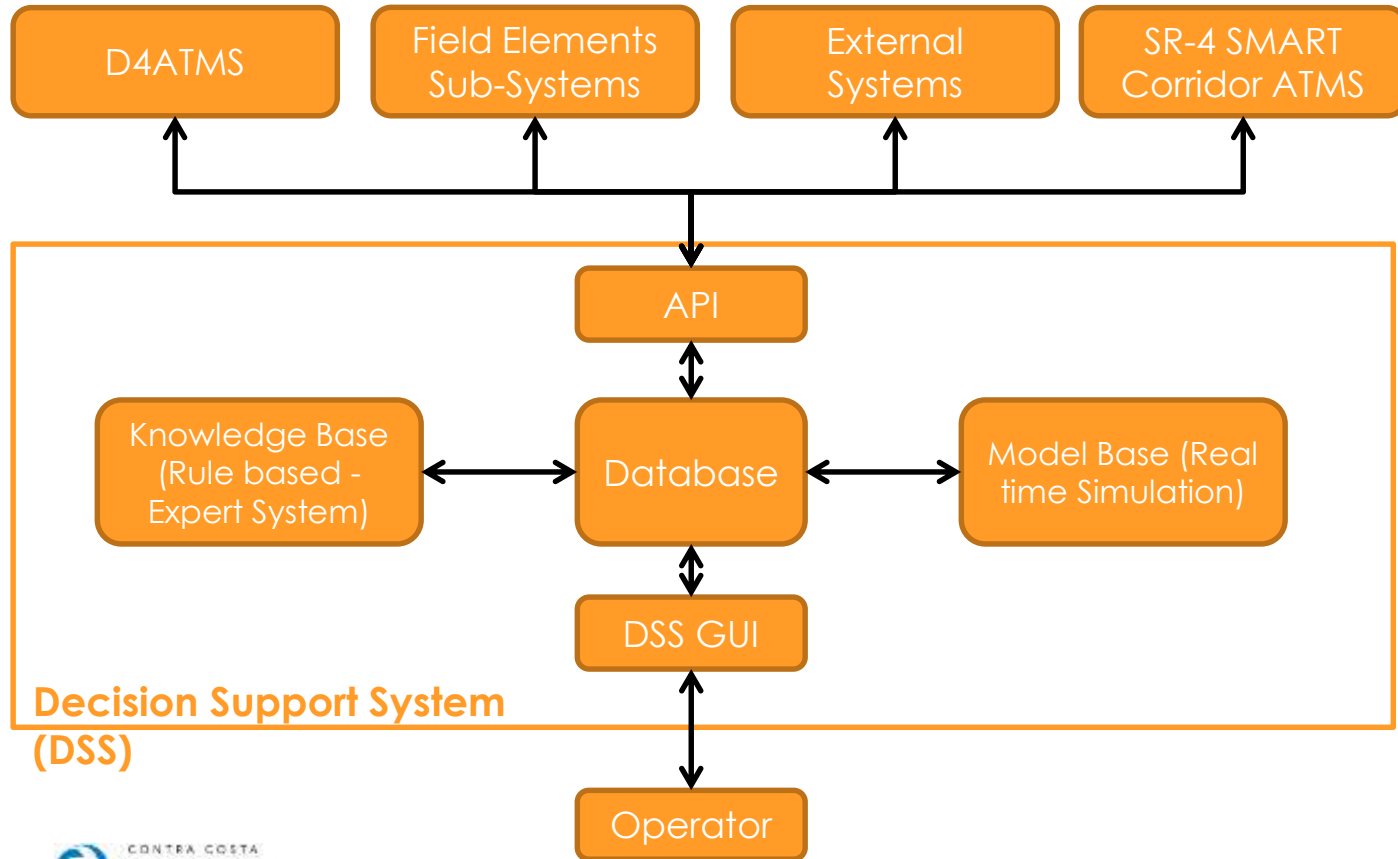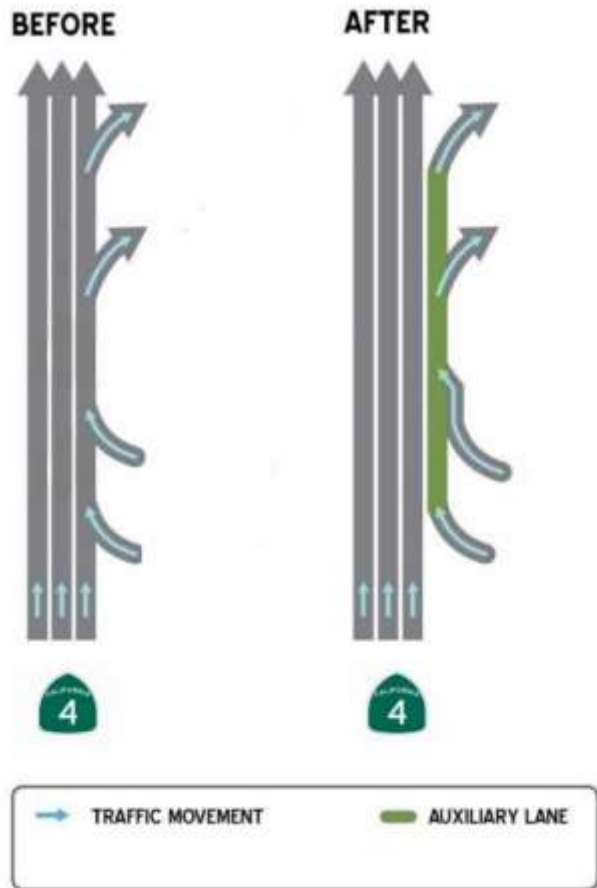# GoMentum Station CV/AV Macro Environment

Influencers

- AMs/OEMS
- Insurance Carriers
- State DOTs
- Fleet Mgmt.
- MPOs
- USDOT
- DMV
- Media
- Tech Leaders
- NHTSA
- FCC

Issues

- Standards
- Inst. & Societal
- Liability
- Older Driver
- Certification
- Equity
- Privacy
- Safety
- Licensing
- Bandwidth Deficit

Applications

- D-RIDE
- IMA
- FCW
- EVAC
- EEBL
- LTA
- CACC
- BSW/LCW
- DNPW
- T-DISP
- Q-WARN
- SPD HARM
- I-SIG
- VDT
- PRE EMPT

Technology

- Wireless Comm
- Mobility
- 3D Mapping
- DSRC
- 5G & WIFI
- Sensors
- Fuel Cells
- Solar
- GPS
- Telematics
- Analytics
- Internet of Things
- Lidar
- Cloud
- Radar
- Big Data
- Apps

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GOMENTUM STATION

Background

- Shoulder Lanes

- Ramp Widening

- Auxiliary Lanes

- Adaptive Ramp Metering

- Instrumentation and Integration

- Speed Harmonization

- Communication

- Decision Support Systems

Congested Traffic
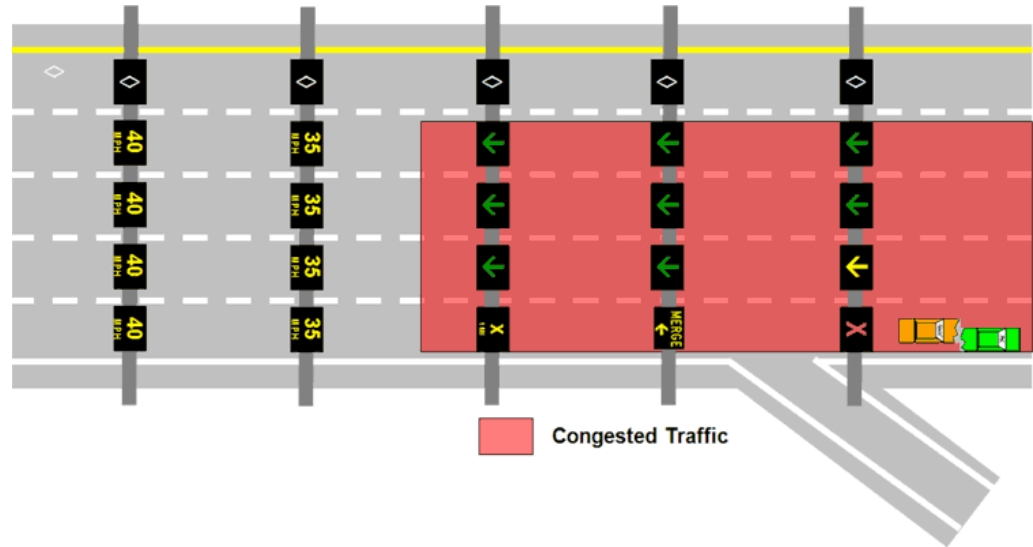
First Mile / Last Mile

- Self Automated Vehicles

- Mobility on Demand

- Connection Protection

First Mile

Transit

Last Mile

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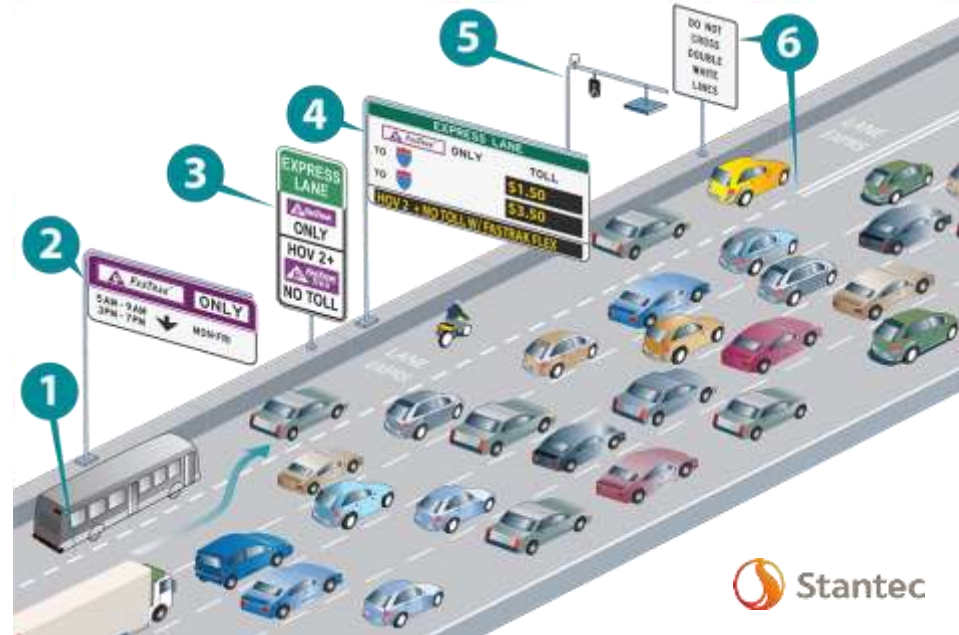- Focus on shared rides (CBD, Schools, BART)

- Dynamic Ride Sharing

- New Transportation Apps

- Dynamic Ride Match

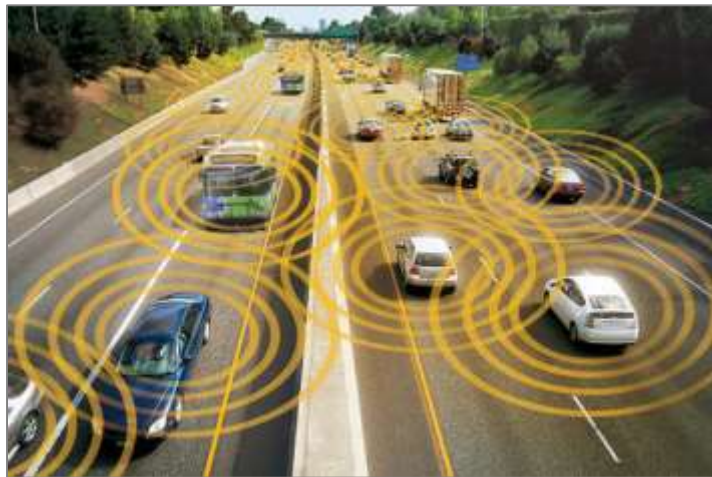
FREE BIKE RACKS

SCHOOLPOOL

511 RIDESHARE

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- Converting existing HOV or Shoulder Use

- High Capacity Transit Extension

- Sensors

- Dedicated Short Range Communication

- Vehicle to Vehicle

- Vehicle to Infrastructure

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Public / Private Partnership

- Private Ferry Operator

- Private Buses

- Neighborhood Shuttles

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