



Accelerating solutions for highway safety, renewal, reliability, and capacity

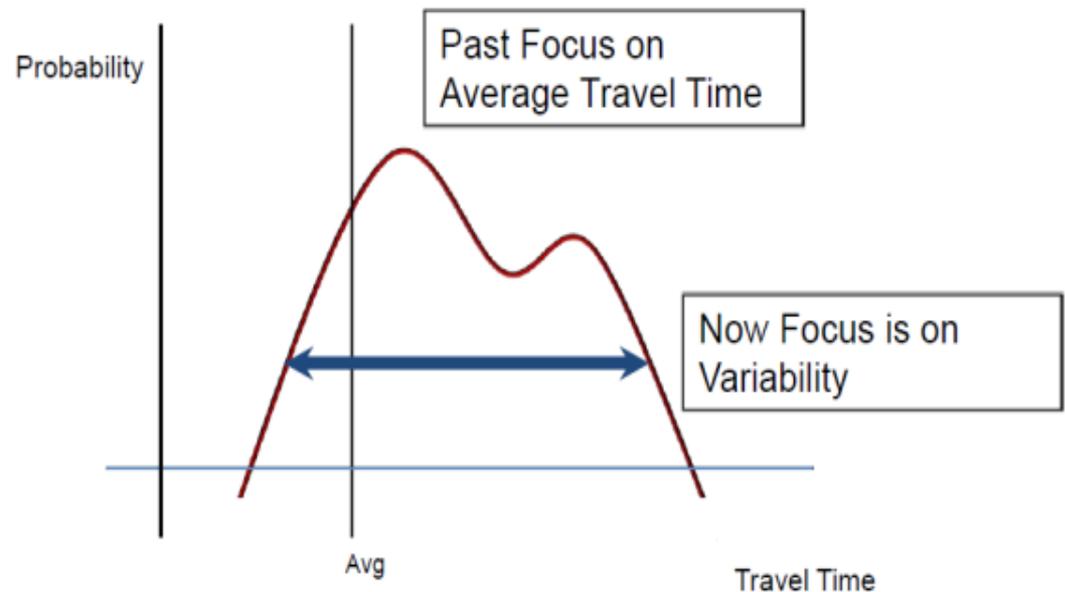
Regional Operations Forum

Traveler Information

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

“Reliability”

- Consistency or dependability in travel times
 - As measured from day to day, or across different times of day
- Less tolerance for unexpected delays
- Planning for travel variability has costs for users, including individuals, transit operators, freight and their end users



Technology Is Transforming Our World

- Rapid changes in availability of information
 - Internet connectivity, wireless communications, cloud computing
 - Information is available 24/7 on mobile devices
- Customers' perception that technology can improve efficiency of every organization
- The future – even more innovative technologies and a shorter shelf life
 - Connected / autonomous vehicles



What is TSMO?

Transportation Systems Management and Operations (TSMO, TSM&O)

Defined in MAP 21

- “Integrated strategies to optimize the performance of existing infrastructure through the implementation of multimodal and intermodal, cross-jurisdictional systems, services, and projects”
- Supported and enabled by Intelligent Transportation System (ITS) technologies



Why Traveler Information: Telling the “Story”

- Influence travel demand (how much, when, where)
- Effectively manage traffic that results
- Anticipate and respond to planned and unplanned events (traffic incidents, work zones, bad weather, special events)
- Provide travelers with high quality traffic and weather information
- Ensure that the unique needs of the freight community are considered and included in all of the above

U.S. DOT, FHWA Office of Operations, *The Operations Story*, Presentation



Traveler Information

- 511 Web and Voice
- Dynamic message signs (DMS)
- Radio and television traffic reports
- SmartPhone apps
- Social media tools
- Commercial traffic condition and prediction services



Example Benefits

- 511 customer satisfaction of 68% - 92%
- Route-specific travel time: 5% -13% in on-time performance



Planned Special Event Management

Agency collaboration and coordination is important to effective event management

- Planning and Protocols
- Implementation of Plan
- Event Activities
- Post Event Activities



Example Benefit:

- Travel time to a major racing facility in Phoenix was reduced by over 70% by applying event management strategies.



Work Zone Management



Several strategies and technologies available

- Traveler information & portable DMS (delays, alternate routes)
- Variable speed limits
- Automated speed detectors, warning signs & enforcement
- Dynamic lane merge system
- Maintenance decision support

Demonstrated benefits include:

- Reduced crashes
- Reduced work zone traffic
- Reduced delays



Road Weather Management

Reduce the impact of adverse weather conditions on travelers

- Data collection
- Data assimilation and analysis
- Information dissemination

Example Benefits

- Low visibility warning system.
 - Crash rates during fog conditions reduced 70 – 100%
- Wet pavement detection & advisory system reduced crashes by 39%
- B/C ratio for automated wind advisory in Oregon = 4:1 and 22:1



Emerging TSMO Approaches

- Active Transportation and Demand Management
 - Dynamic management, control, and influence of travel demand, traffic demand, and traffic flow of transportation facilities
- Integrated Corridor Management
 - The integrated management of freeway, arterial, transit, and parking systems within a corridor
 - Management of the corridor as a system, rather than the more traditional approach of managing individual assets
- Connected Vehicle



Active Transportation and Demand Management (ATDM)

Broad operational philosophy – an integrated approach for dynamically and pro-actively managing and influencing travel demand and traffic flow

Uses a combination of the real-time operational strategies:

- Those previously noted
- Managed Lanes
- Active Traffic Management
- Integrated Corridor Management

• Dynamic pricing



ATDM Categories

Active Demand Management

- A suite of strategies intended to reduce or redistribute travel demand to alternate modes or routes.
- Examples: comparative multi-modal travel times, dynamic ride-sharing, pricing and incentive approaches.

Active Traffic Management

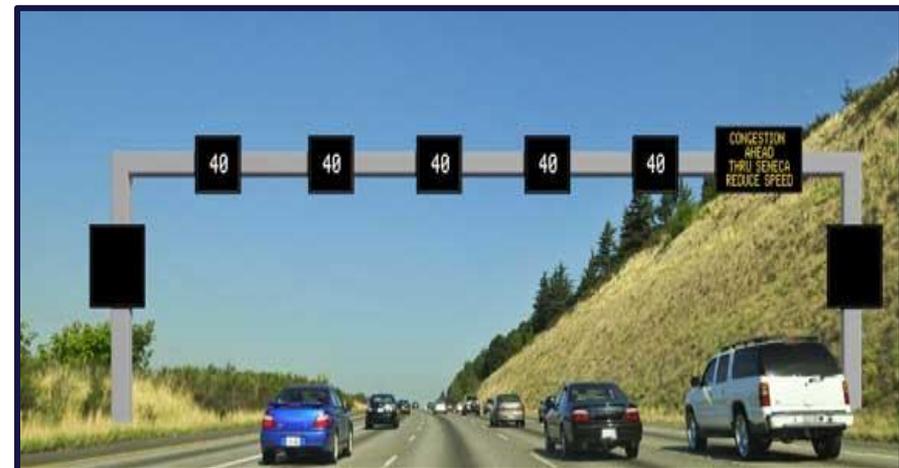
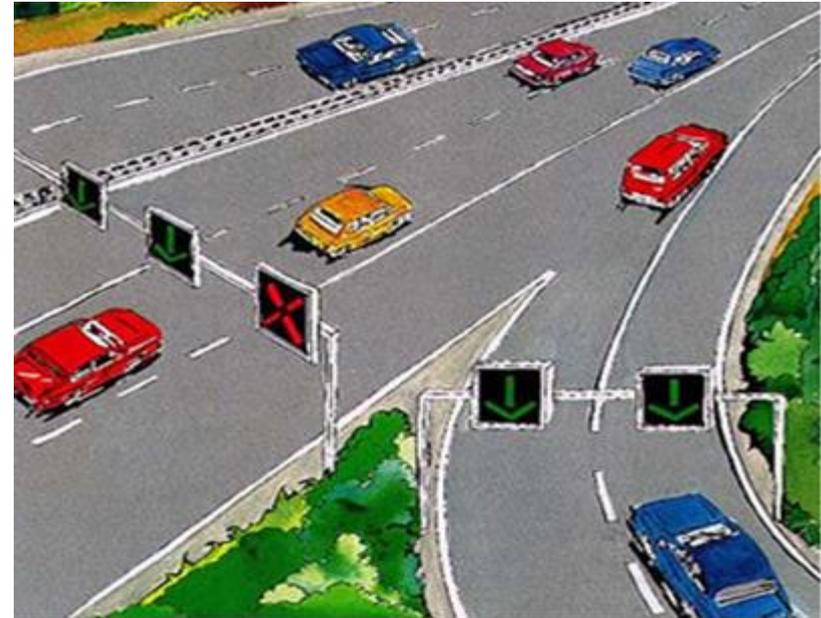
- A suite of strategies that actively manage traffic on a facility.
- Examples: variable speed limits, dynamic shoulder use, queue warning, lane control.

Active Parking Management

- A suite of strategies designed to affect the demand, distribution, availability, and management of parking.
- Examples: parking pricing, real-time parking availability and reservation systems.



ATDM Examples



Active Parking Management: SF Park

The screenshot shows the SFpark website interface. At the top, there is a navigation menu with links for 'The Project', 'How it Works', 'FAQ', 'Resources', 'News', and 'Contact Us'. The main content area features a map of San Francisco with various blockfaces highlighted in different colors (red, orange, yellow, green, blue) to represent different parking availability levels. A legend on the left side of the map indicates the color coding: High (red), Low (orange), and No Data (grey). On the right side, there is a 'Find Parking' section with a dropdown menu set to 'All pilot areas'. Below this, there are three numbered instructions: 1) Choose a pilot neighborhood above, 2) Click a blockface or garage icon for rates, and 3) Click \$ for a comparative pricing map. A table below the instructions shows the availability and pricing for different levels:

	Availability	Pricing
low	0-15%	\$0 - \$2.00 / hr
med	15-30%	\$2.01 - \$4.00 / hr
high	30%+	\$4.01+ / hr

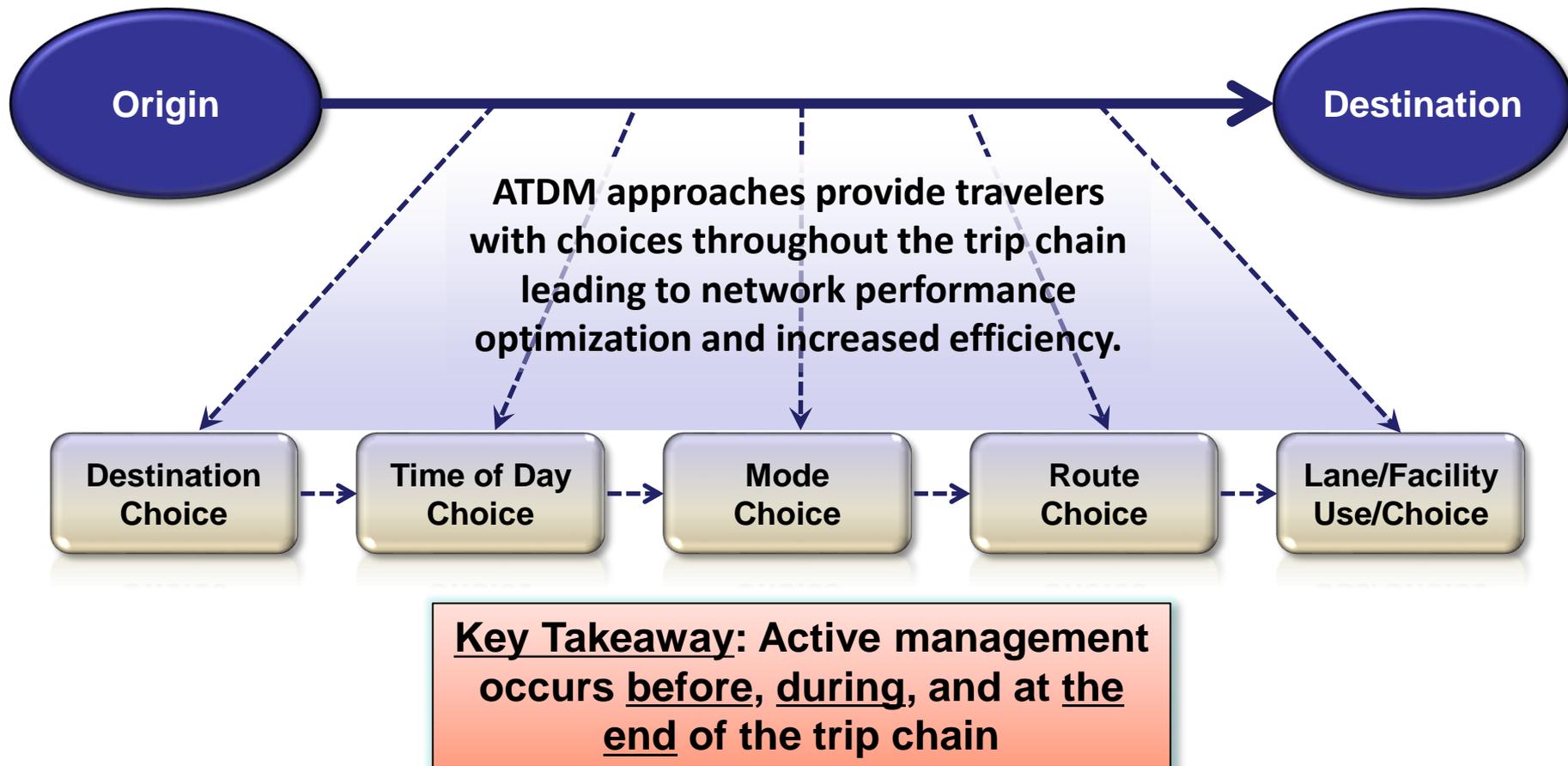
Below the table, there is a note: 'Use + and - to zoom in manually' and a link for 'Terms of Use'.

SFPark: Know Where the Parking is Video:

<http://youtu.be/9JVepZcA-GI>



Active Management Throughout the Trip Chain



Integrated Corridor Management

- Corridors offer opportunities to optimize the entire system
- ICM is the operational coordination of multiple transportation networks and cross-network links
 - Integrated traveler info
 - Operational efficiency of network junctions
 - Cross-network route & modal shifts
 - Capacity-demand relationship



Example Benefits

- ICM along I-15 in San Diego: estimated B/C ratio of 9.7:1
- Simulation of ICM: B/C ratios of 7.1:1 to 25.1:1



Connected Vehicles and the Future

- Vehicles “reading” the roadway and one another
- Collisions reduced; reliability improved
- Smarter operational decisions (possibly predictive)

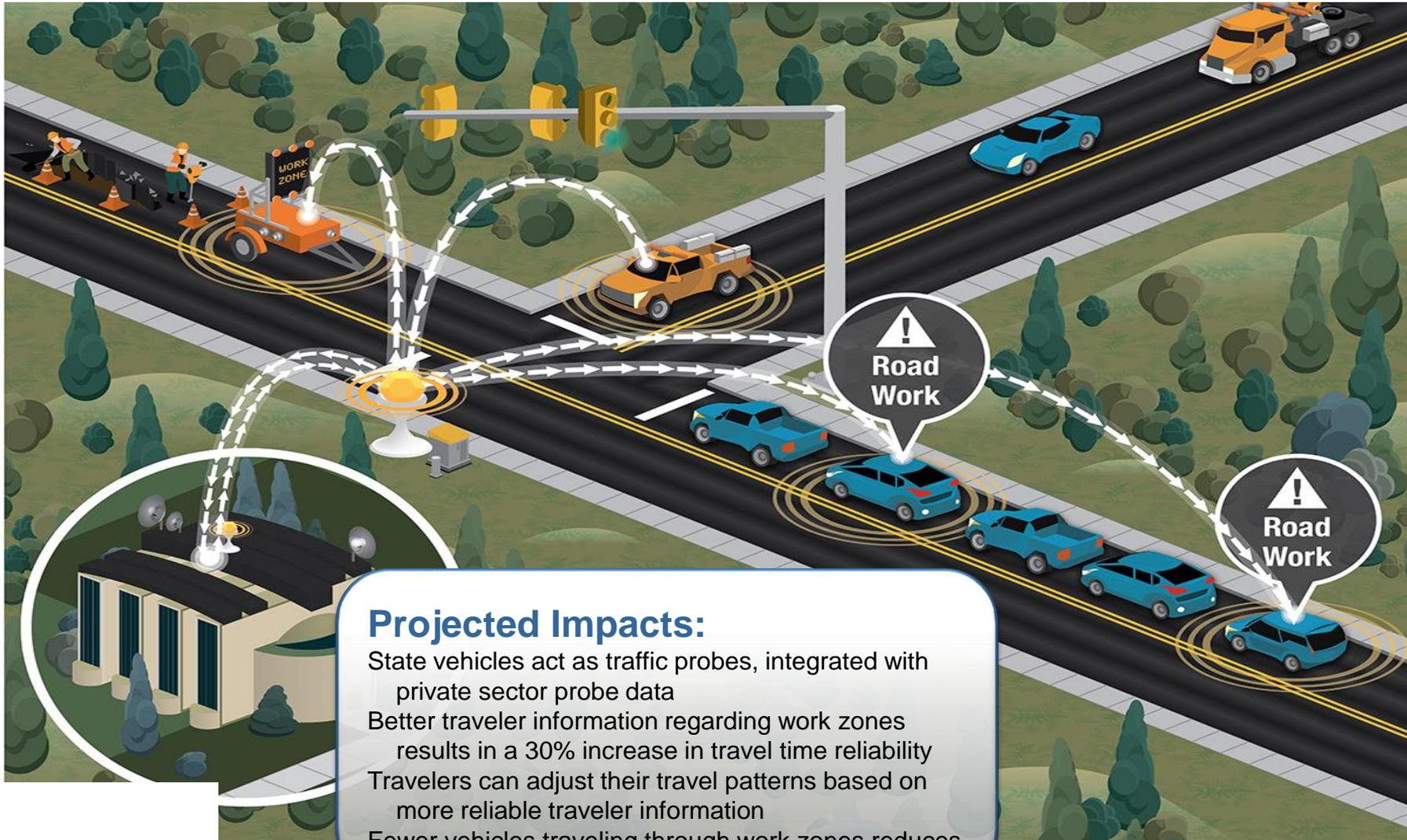


The Future?

- Technology transformation changes mobility
- What might be the impact of autonomous vehicles?
- DOT role in supporting development



[FHWA] Vehicle-to-Infrastructure (V2I) Communications (Example)



V2I Safety

Red Light Violation Warning
Curve Speed Warning
Stop Sign Gap Assist
Spot Weather Impact Warning
Reduced Speed/Work Zone Warning
Pedestrian in Signalized Crosswalk
Warning (Transit)

V2V Safety

Emergency Electronic Brake Lights
(EEBL)
Forward Collision Warning (FCW)
Intersection Movement Assist (IMA)
Left Turn Assist (LTA)
Blind Spot/Lane Change Warning
(BSW/LCW)
Do Not Pass Warning (DNPW)
Vehicle Turning Right in Front of Bus
Warning (Transit)

Agency Data

Probe-based Pavement Maintenance
Probe-enabled Traffic Monitoring
Vehicle Classification-based Traffic
Studies
CV-enabled Turning Movement &
Intersection Analysis
CV-enabled Origin-Destination Studies
Work Zone Traveler Information

Environment

Eco-Approach and Departure at
Signalized Intersections
Eco-Traffic Signal Timing
Eco-Traffic Signal Priority
Connected Eco-Driving
Wireless Inductive/Resonance
Charging
Eco-Lanes Management
Eco-Speed Harmonization
Eco-Cooperative Adaptive Cruise
Control
Eco-Traveler Information
Eco-Ramp Metering
Low Emissions Zone Management
AFV Charging / Fueling
Information
Eco-Smart Parking
Dynamic Eco-Routing (light
vehicle, transit, freight)
Eco-ICM Decision Support System

Road Weather

Motorist Advisories and Warnings
(MAW)
Enhanced MDSS
Vehicle Data Translator (VDT)
Weather Response Traffic
Information (WxTINFO)

Mobility

Advanced Traveler Information System
Intelligent Traffic Signal System
(I-SIG)
Signal Priority (transit, freight)
Mobile Accessible Pedestrian Signal
System (PED-SIG)
Emergency Vehicle Preemption (PREEMPT)
Dynamic Speed Harmonization (SPD-
HARM)
Queue Warning (Q-WARN)
Cooperative Adaptive Cruise Control
(CACC)
Incident Scene Pre-Arrival Staging
Guidance for Emergency Responders
(RESP-STG)
Incident Scene Work Zone Alerts for Drivers
and Workers (INC-ZONE)
Emergency Communications and
Evacuation (EVAC)
Connection Protection (T-CONNECT)
Dynamic Transit Operations (T-DISP)
Dynamic Ridesharing (D-RIDE)
Freight-Specific Dynamic Travel Planning
and Performance
Drayage Optimization

Smart Roadside

Wireless Inspection
Smart Truck Parking



Managing Demand with Traveler Information



- New Partnerships
- Financial Levers
 - Incentives
 - Pricing
- Travel Options (Shared Mobility)
- Real time Info
 - Change Route, Mode, Departure Time, Destination
 - Parking, Travel time, in vehicle navigation, transit and Park and rind info, parking availability,
 - Access and parking management
- Demand during reconstruction
- Pre Trip Influence
- Apps

Managing Demand with Traveler Information

- 511 System in the U.S. – San Francisco
 - Over 30 deployments in U.S.
- Large-scale deployment of TravInfo
 - Traffic conditions
 - Airport traffic
 - Driving times (vs. rail on 101)
 - Travel time prediction
 - Transit trip planner
 - Transit schedules and maps
 - Ridesharing – on-line matching
 - Bicycle maps and tips

35% say they change plans with info



Your Bay Area travel guide.



Metropolitan Transportation Communication

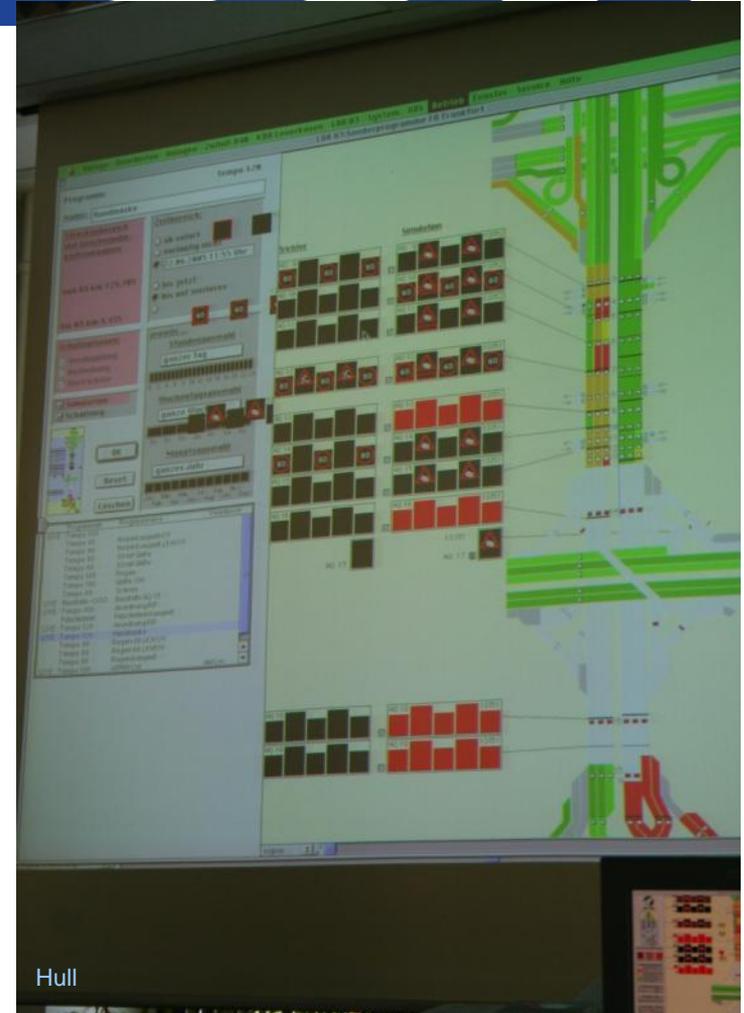
Source: MTC

Queue Warning

- Inform motorists of reason for slower speeds
- Includes congestion, accident and construction
- Integrated into overhead system



www.chielie.nl



CCTV camera

Lighting Columns

MS4 driver
Information panel

Fixed direction
signing

CEC cabinet

Lane specific
signals

Emergency
Roadside Telephone

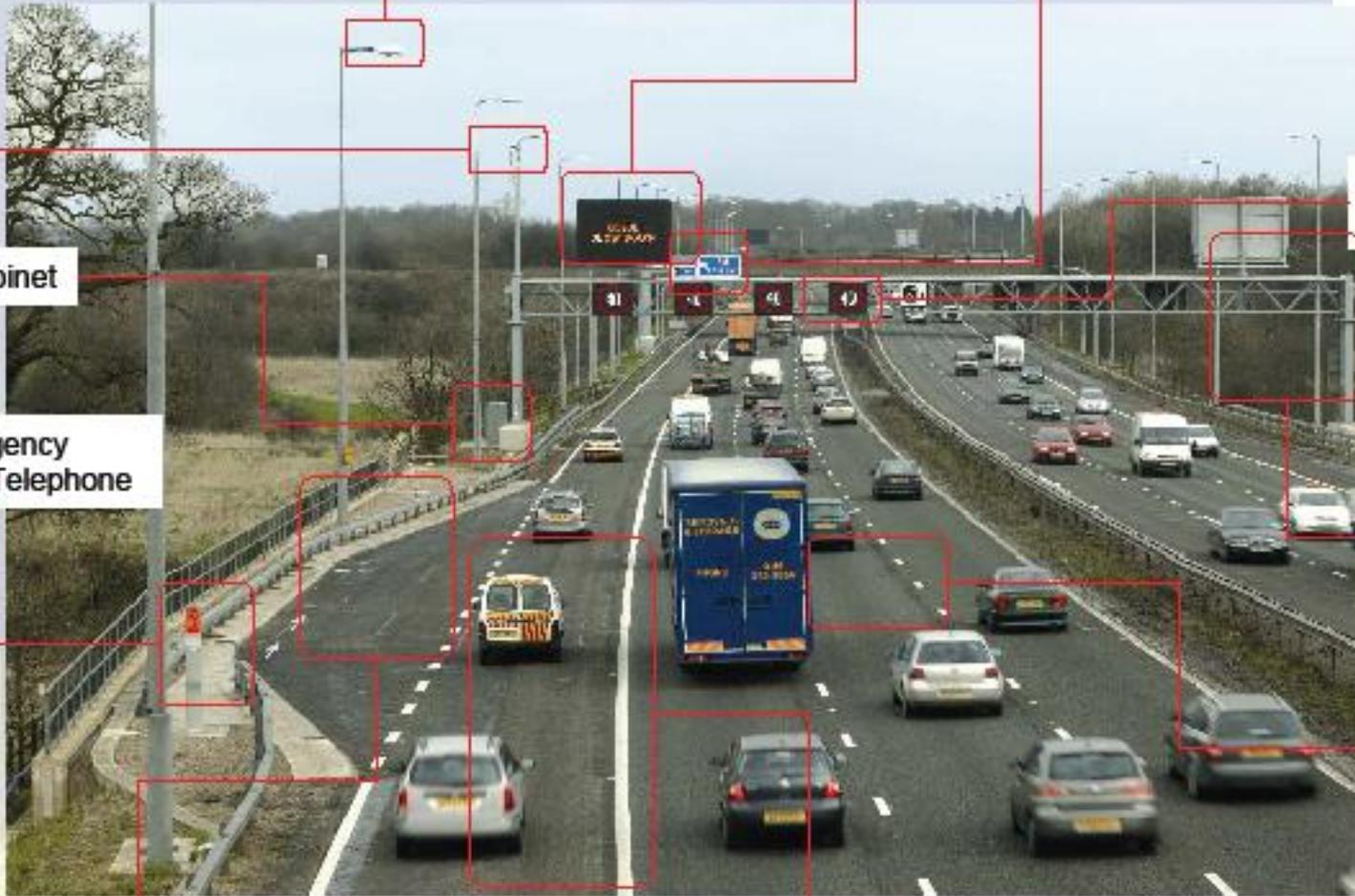
Lightweight
Gantries

MIDAS

Emergency Refuge

Hard Shoulder
running

Continue

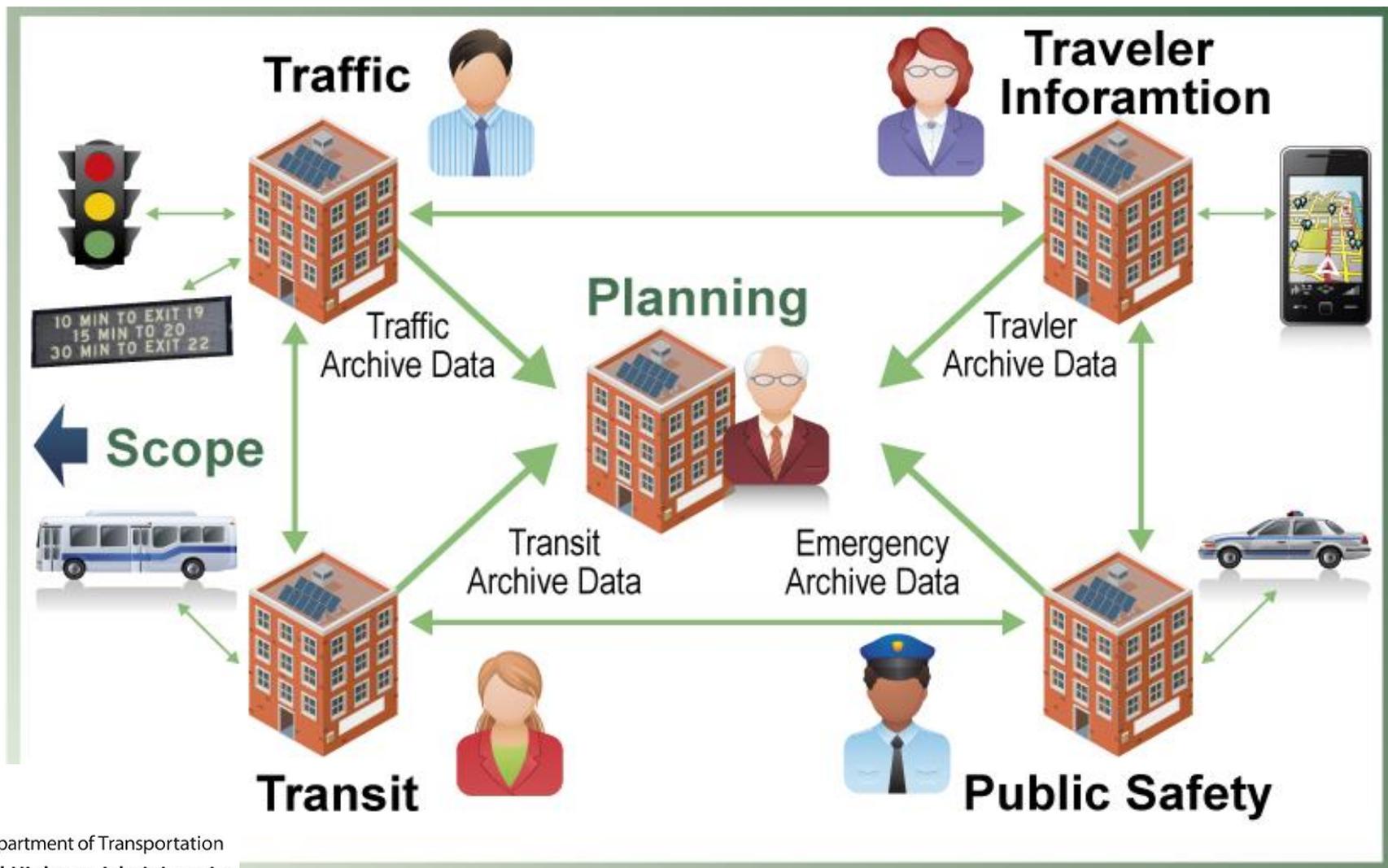


ITS Architecture

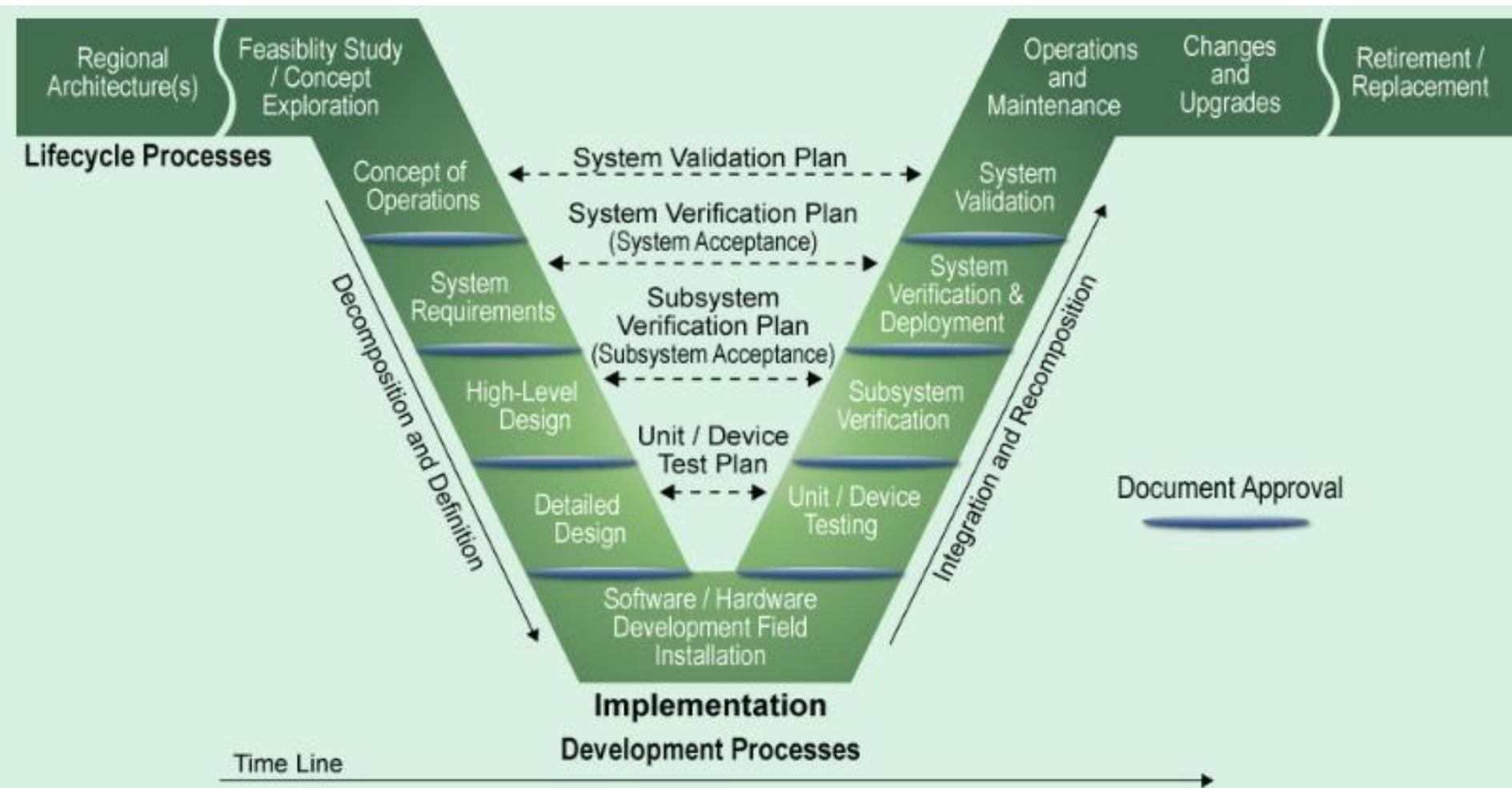
A framework for ensuring institutional agreement and technical integration for the implementation of ITS projects in a particular region



ITS Architectures are a Framework for Integration



Systems Engineering “V” Diagram



ITS Architecture to Support Project Development





Questions