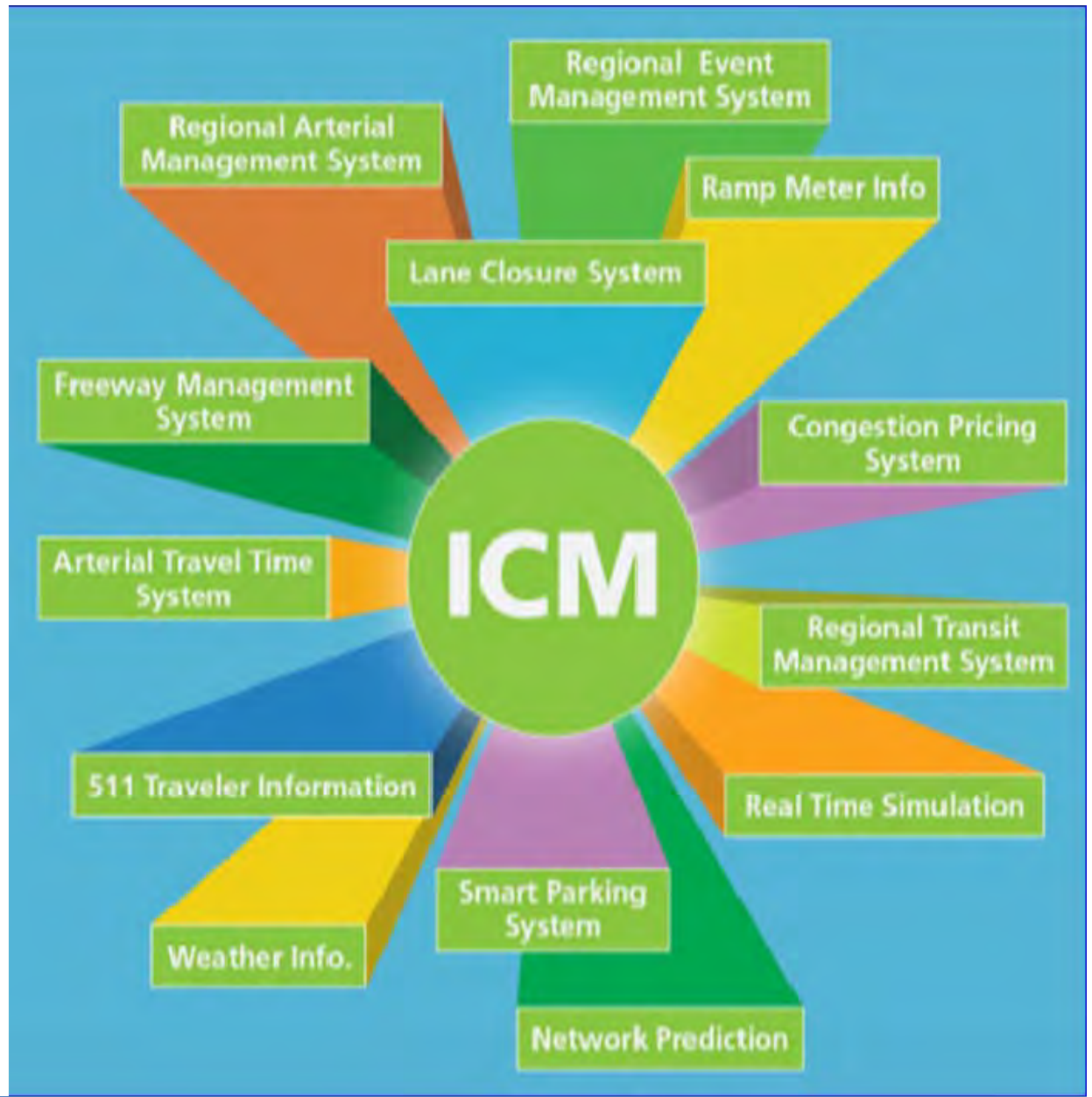


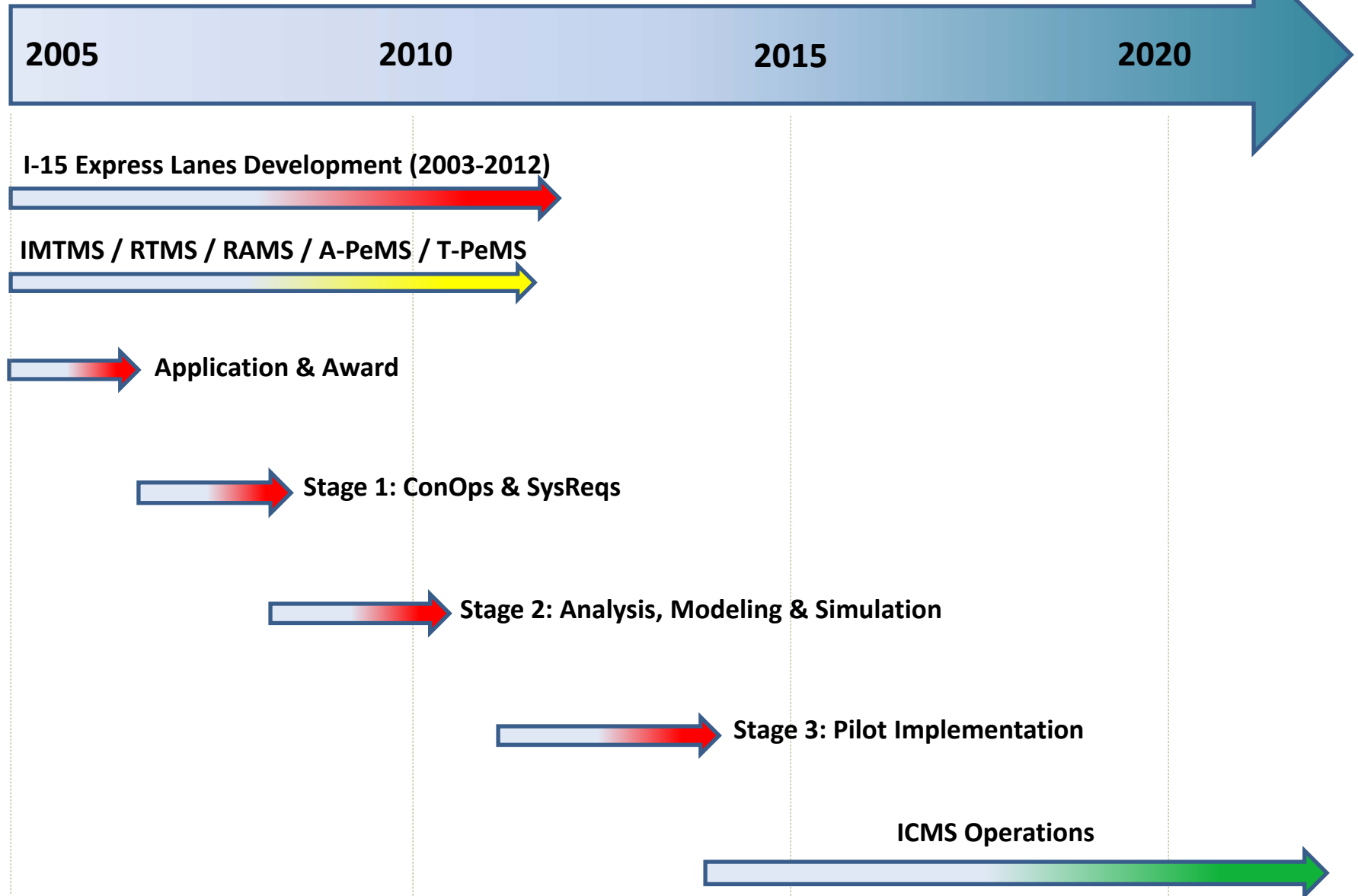
Integrated Corridor Management

Joint ITE Workshop
San Juan Capistrano, CA
March 8, 2019

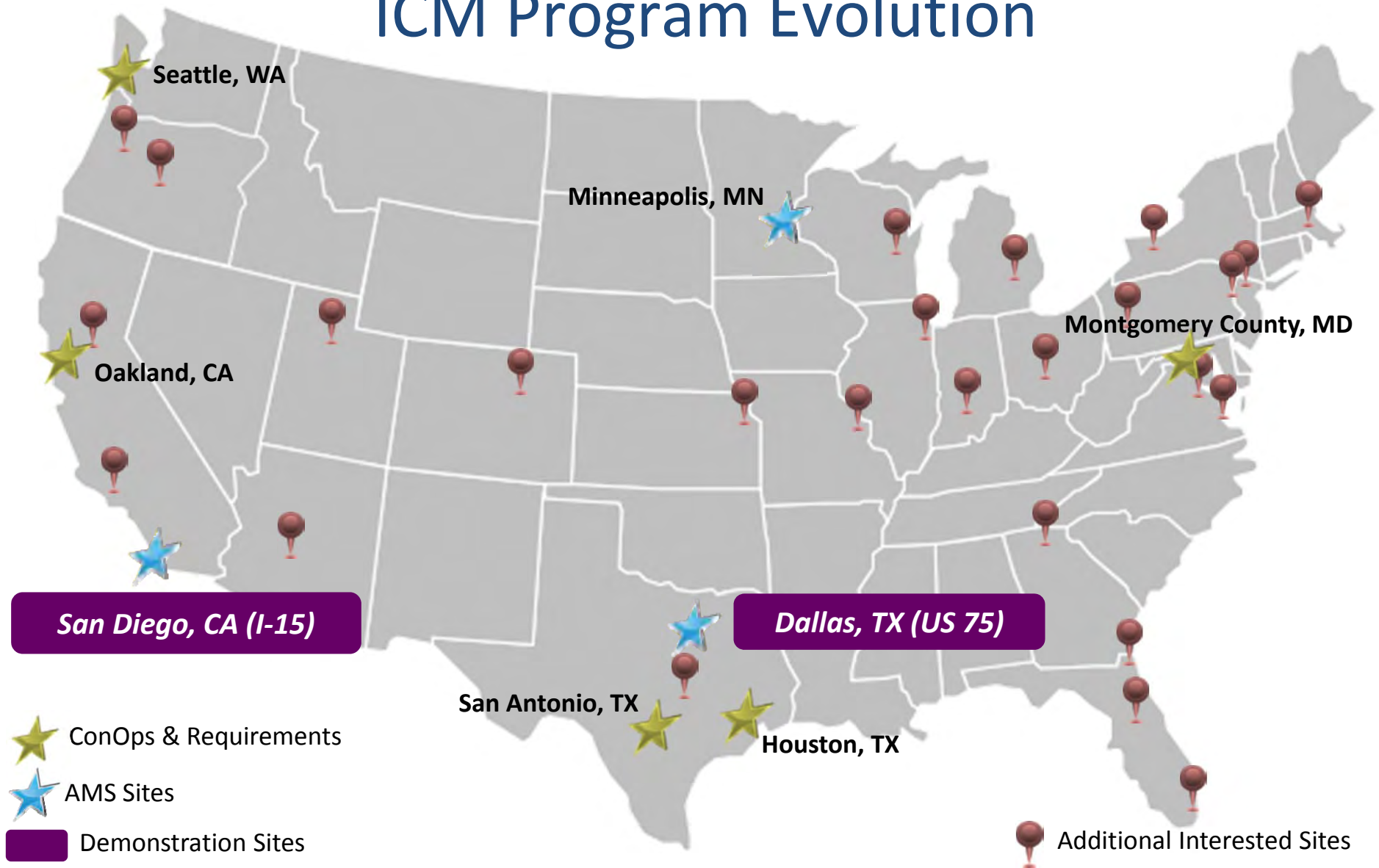
By Ellison Alegre, SANDAG



Integrated Corridor Management



ICM Program Evolution



Source: FHWA "Integrated Corridor Management" presentation

ICM In Review: Toolbox for managing transportation system

- Proactively Manage Congestion
- Provide Choices
- Maximize System Capacity
- Improve Coordination/ Interoperability
- Manage and Operate Across Modes and Agencies

Institutional
Integration

- **Commitment** - collaboration between various agencies, modes, and jurisdictions that transcends institutional boundaries

Operational
Integration

- **All inclusive customer focus** - Joint operational objectives and strategies to manage and balance the total capacity and demand of the corridor

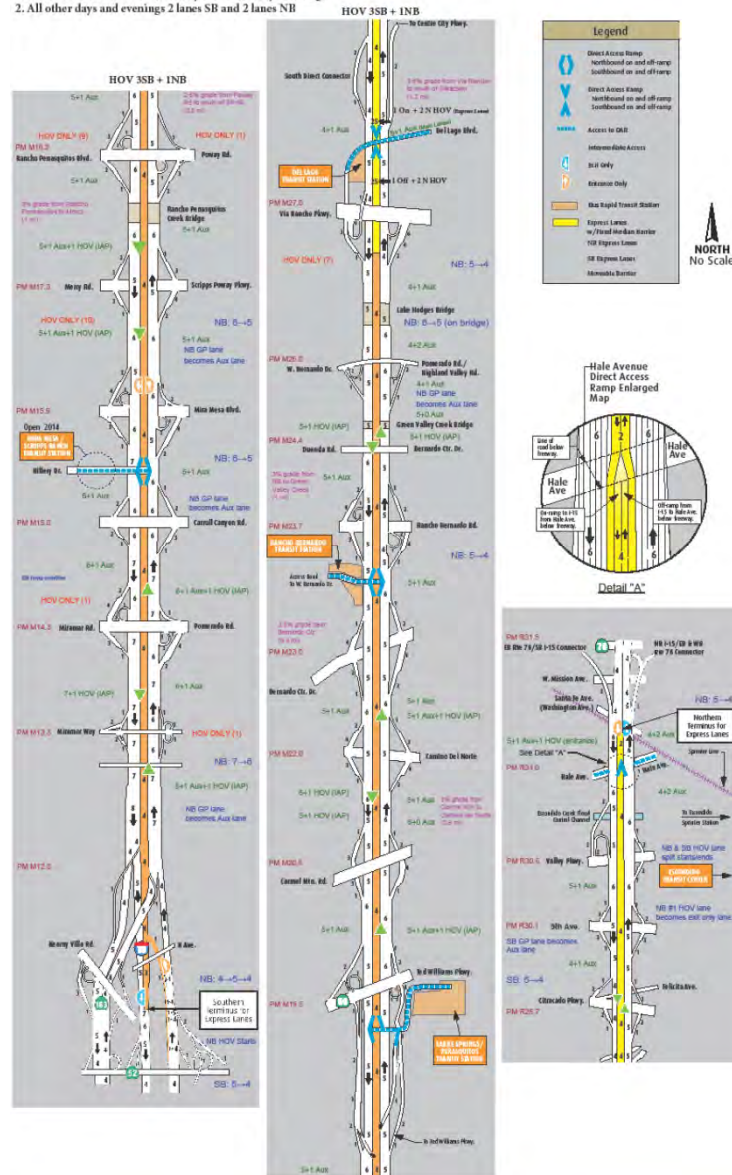
Technical
Integration

- **Sharing and distribution** - of information and system operations control functions to support the analysis and immediate response

Current Lane Configuration Diagrams

Proposed Barrier Operations for 2017

1. 3 lanes SB and 1 lane NB (Monday thru Thursday morning)
2. All other days and evenings 2 lanes SB and 2 lanes NB



ICM Corridor

- Unique facility in the U.S.
- “Freeway within a freeway”
- 20 miles long
- 10 general purpose lanes
- 4 reconfigurable lanes with 16 miles of moveable barrier
- **20** CMS, **49** Way-Finding Signs, **220** signals, **35** ramp meters, **15** CCTVs
- Multiple entry/exit points and Direct Access Ramps
- Integrated with new BRT service
- Smart Parking



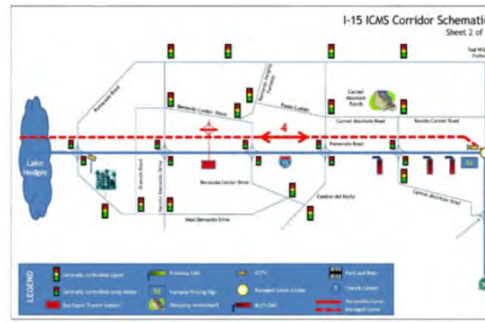
Why I-15 Corridor



- 1 Main Lanes
- 2 Express Lanes
- 3 DAR
- 4 BRT Stations
- 5 Arterial Network

*ICM is about management of a corridor.
Management implies more than monitoring.
Management implies planning for, and responding
to, what is happening across all networks.*

Project need: Institutional



Multiple Modes

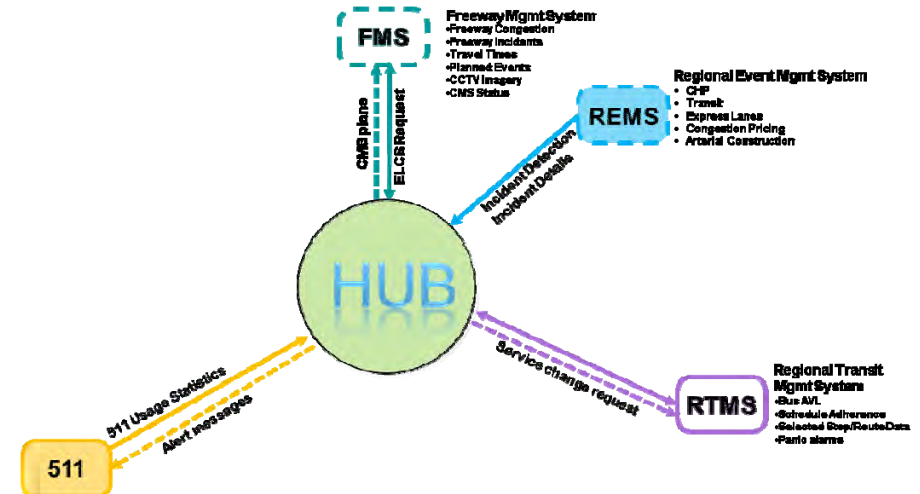
Multiple Jurisdictions

Core Understanding Only

Lack of Operational Visibility

Limited Procedural Awareness

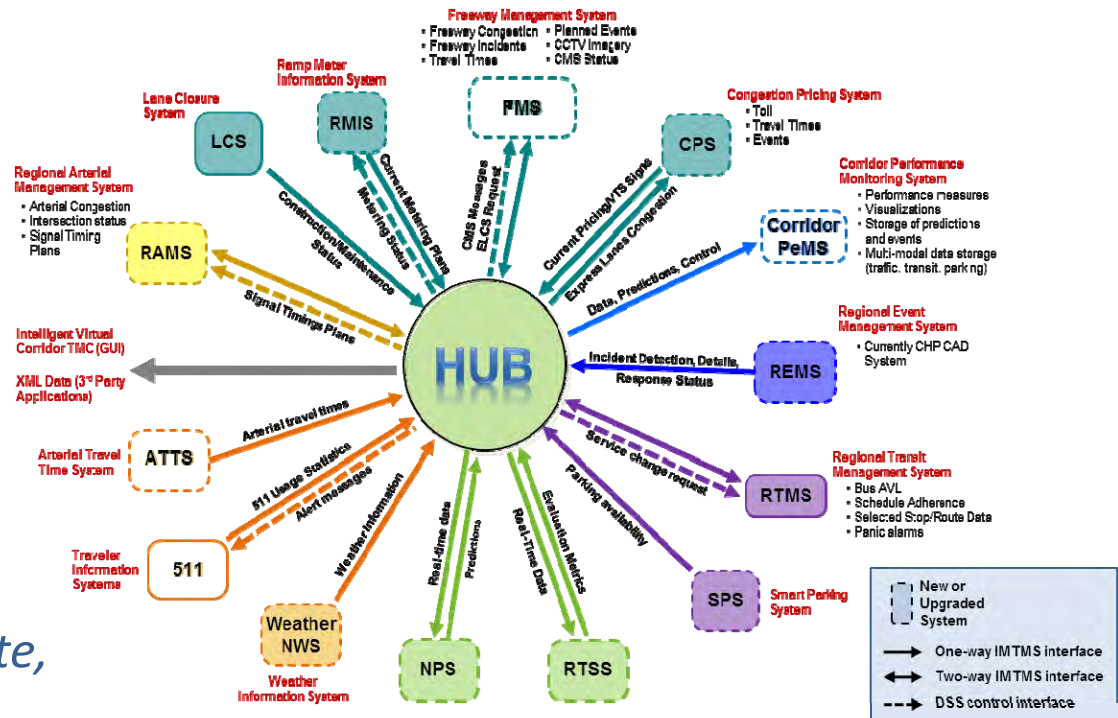
Desire to cooperate, but lacked vehicle



I-15 Integrated Corridor Management

Why ICM: Asset/Management System Rich *but* System Management and Operations Deficient

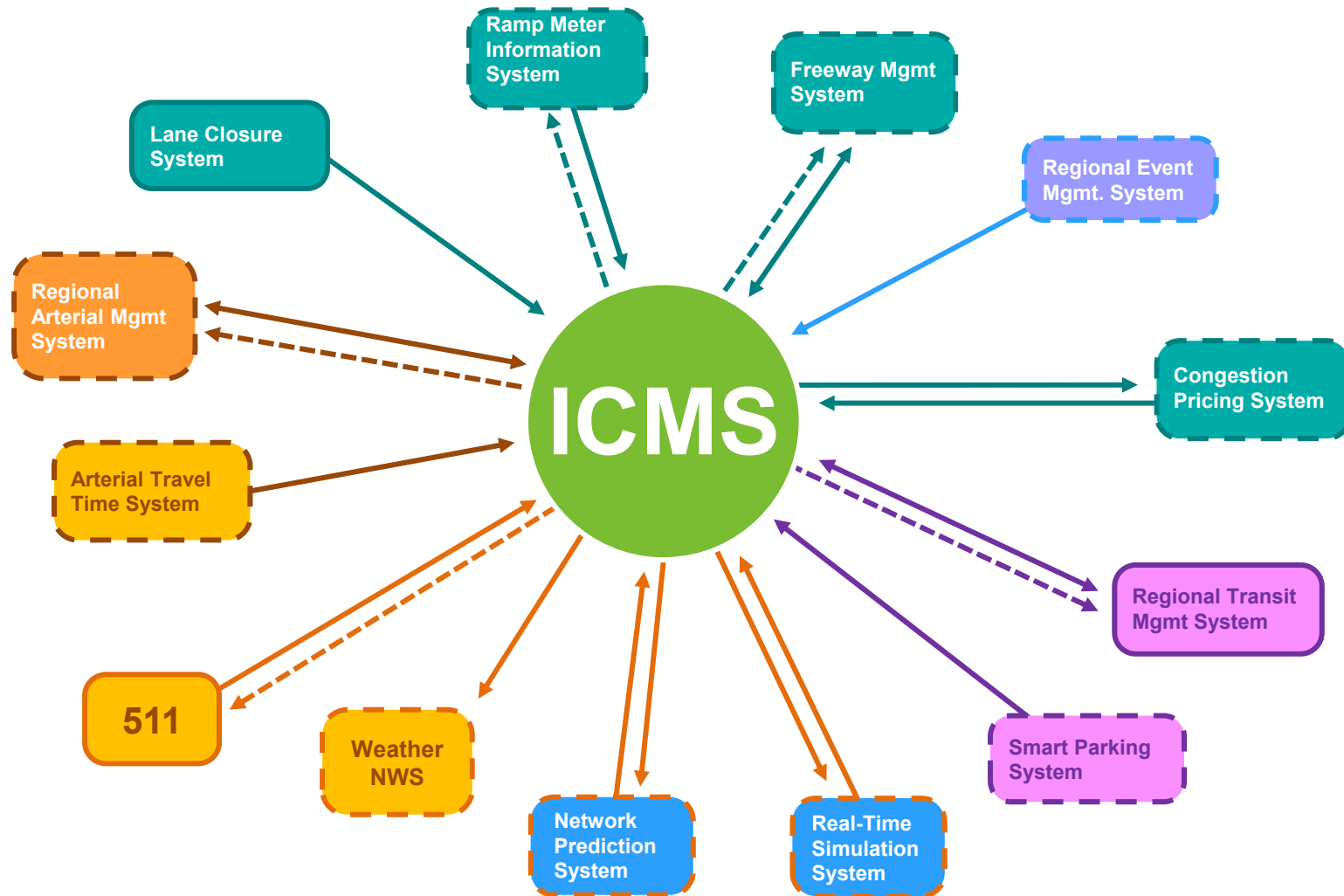
- Lacked decision quality
- Lacked procedural awareness
- Lacked repeatability
- Lacked standardized exchange
- Lacked knowledge of availability
- Lack of cross-boundary performance monitoring
- *Had desire to work and cooperate, but lacked vehicle*



What are I-15 ICM Strategies

- First to Implement Multi-Modal Active Traffic Management (ATM):
 - Active Decision Support System (First In Nation)
 - Coordinated congestion management
 - Freeway coordinated ramp metering
 - Actionable traveler information (en-route and pre-trip via changeable message signs (CMS), new 511 app, and other commercial sources)
 - Coordinated traffic signals with ramp meters (new traffic signal coordination timings, responsive traffic signal control)
 - Active arterial routing
 - Provides corridor awareness – Transit Operators

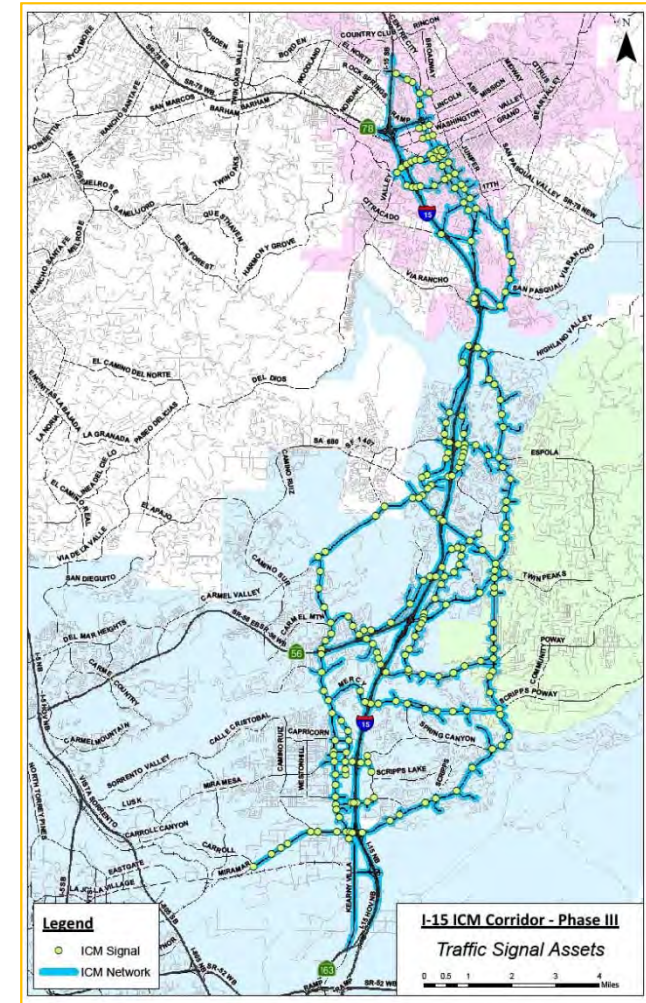
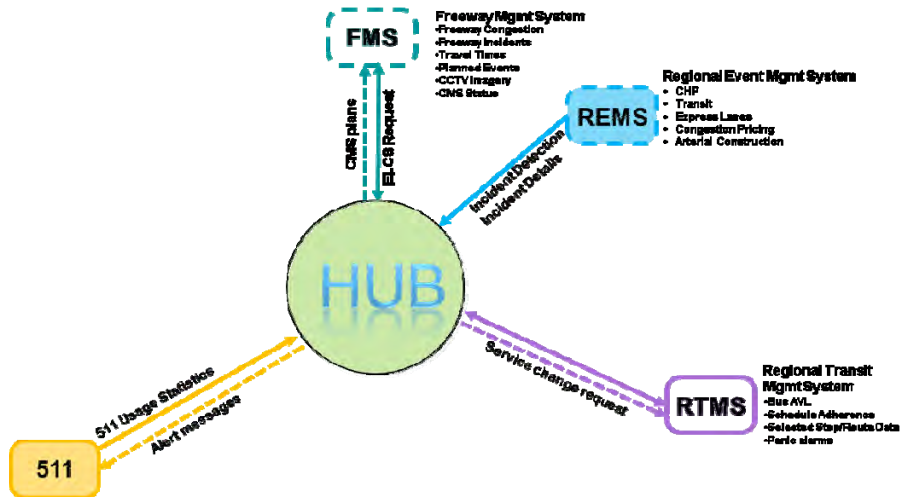
What are the ICM Management Assets:



What are the ICM Network Assets:



- Main Lanes
- Express Lanes
- DAR
- Transit
- Rapid Transit Station
- Arterial Network



What are the ICM Operational Assets:

Traveler Information	Traffic Signal Timing	Ramp Metering	Transit	Express Lanes
<ul style="list-style-type: none">• No change• Notify operators of event• Notify public of event on freeway• Notify public of event on arterial• Direct traffic to use alternative routes• Direct traffic to specific routes or transit usage	<ul style="list-style-type: none">• No action• Inbound Shoulder• Inbound Peak• Inbound Step Up• Inbound Flush• Outbound Shoulder• Outbound Peak• Outbound Step Up• Outbound Flush	<ul style="list-style-type: none">• No action• Meter Off• Max• Min	<ul style="list-style-type: none">• No change• Notify transit dispatcher of event• Provide transit dispatcher w/ recommended transit user message• Provide dead-head re-routing recommendation• Provide in-service re-routing recommendation• Recommend deployment of stand-by transit vehicles	<ul style="list-style-type: none">• No change• Open to all Vehicles• Northbound 3 Southbound 1• Southbound 3 Northbound 1• Closed to vehicles (segment)

ICM DSS: How Does Work?

Inventory + Prediction

1



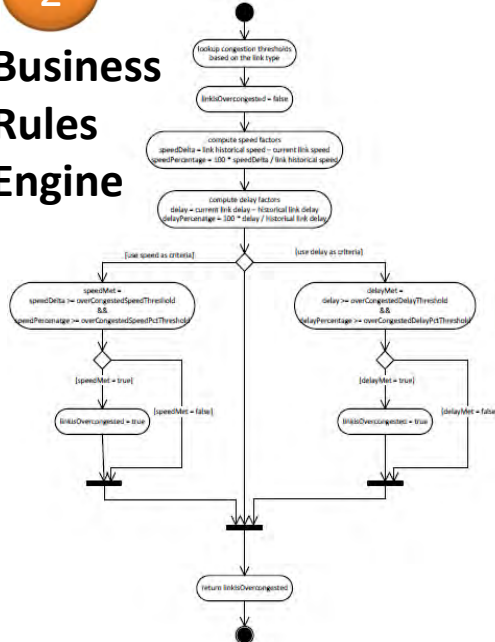
Event Response Suite

3



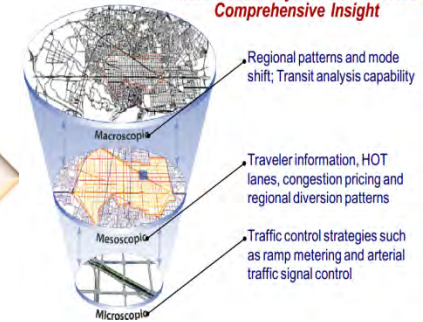
Business Rules Engine

2



Multi-level Analysis Tools Provide Comprehensive Insight

4



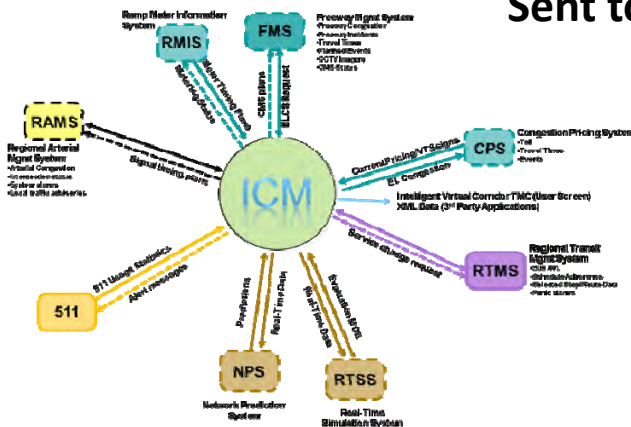
Corridor MOE

5

{0.00, -13.28, 11.14, 1.19, 7.81, 2.2}

Response Plan Sent to Field

6



I-15 Integrated Corridor Management

How Does ICM Work

Inventory + Prediction

1



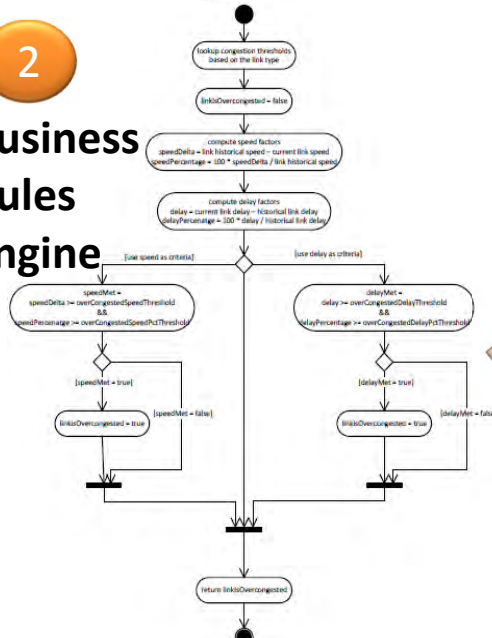
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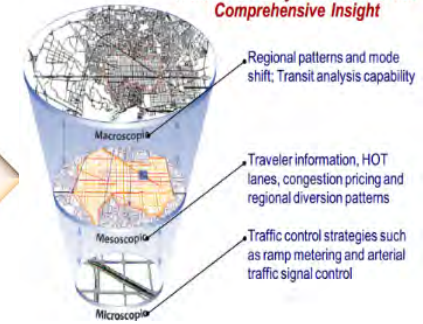
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Business Rules Engine



Multi-level Analysis Tools Provide Comprehensive Insight

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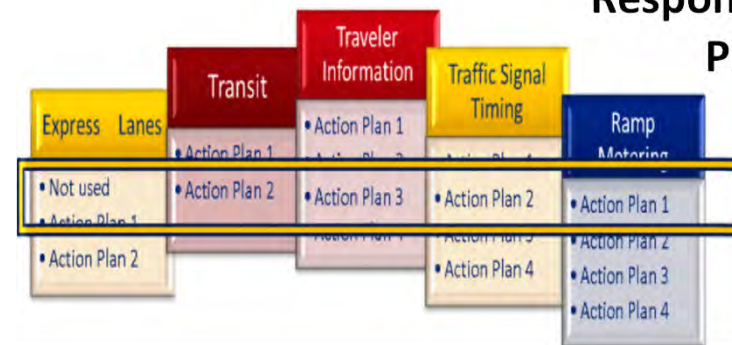
Corridor MOE

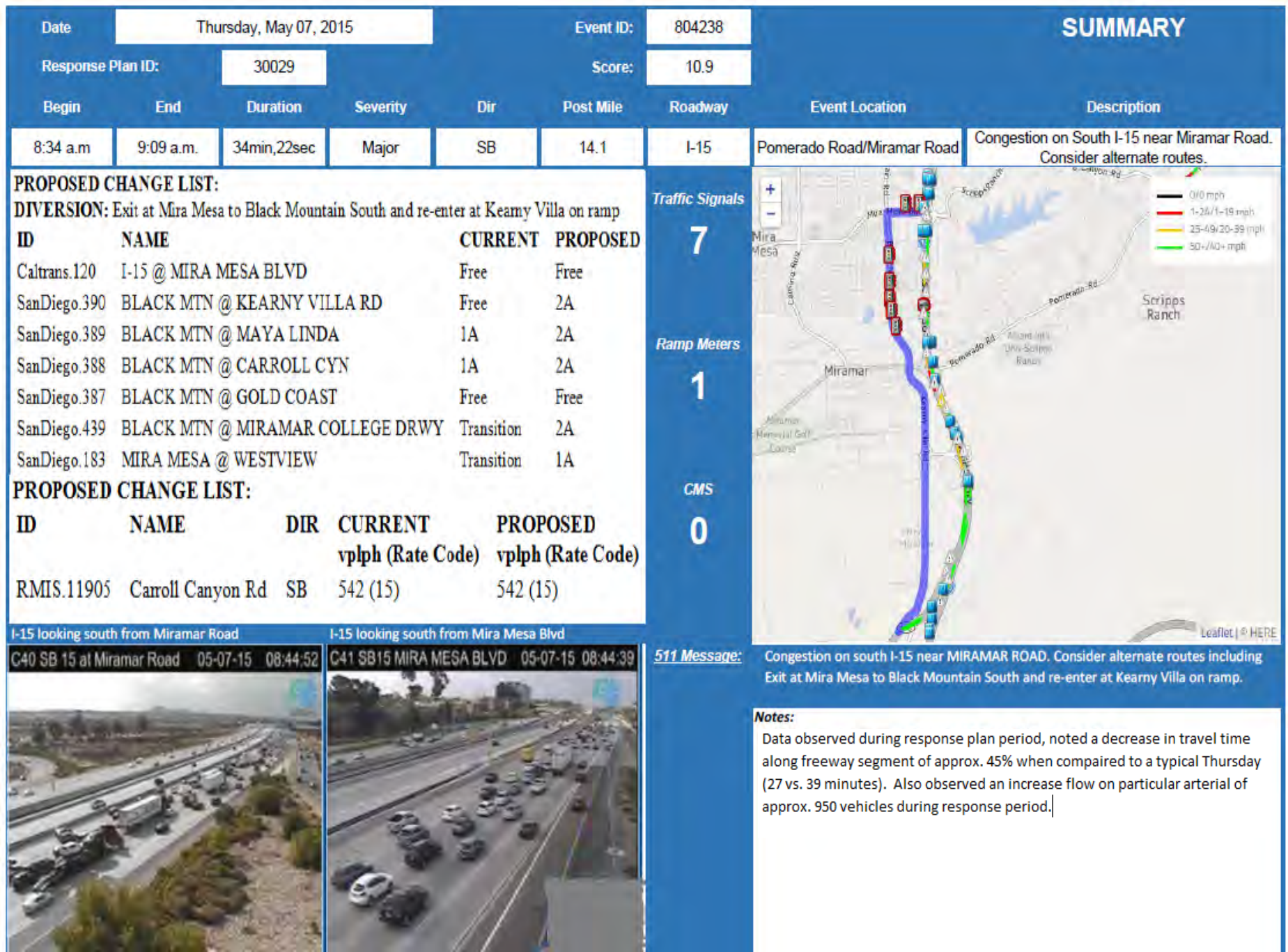
5

{0.00, -13.28, 11.14, 1.19, 7.81, 2.2}

Recommended Response Plan

6





DSS Response Plans

- The DSS has the ability to recommend up to **15 response plans at any given time**, giving operators more time to change any necessary field elements (e.g., implement recommended signal timing plans).

- 156 available routes for coordination
- 260 local arterial intersections
- 18 ramp metered interchanges
- 20 CMS
- 5 BRT stations
- 20 miles Express Lanes
- 30 miles traffic-responsive
- 511 message sets
- 14 available active arterial routes

= Billions of potential response plans

Vision to Implementation:

Institutional

MOUs



Management Framework

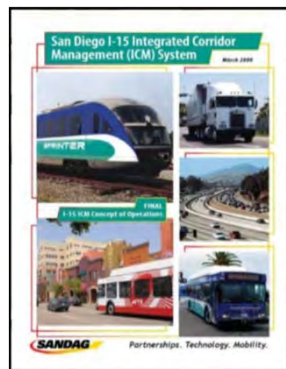


Technical Memorandum



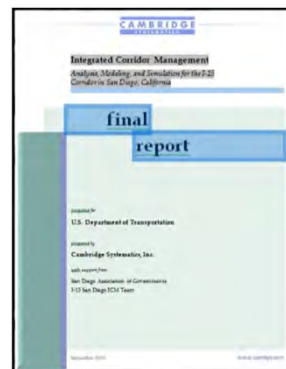
Common Vision – Management/Operations – Day to Day Operations

Stage 1



Concept Development and Draft
Reqs. – Partnership Commitment

Phase 2

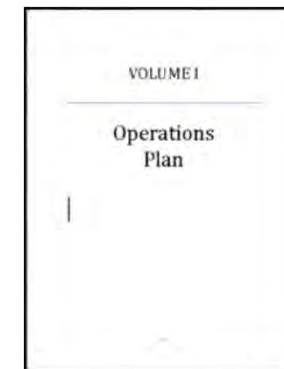


Stage 3



Implementing Vision

Deployment



Corridor Management and
Operations in Practice

Beyond



I-15 Integrated Corridor Management

What is Happening Now

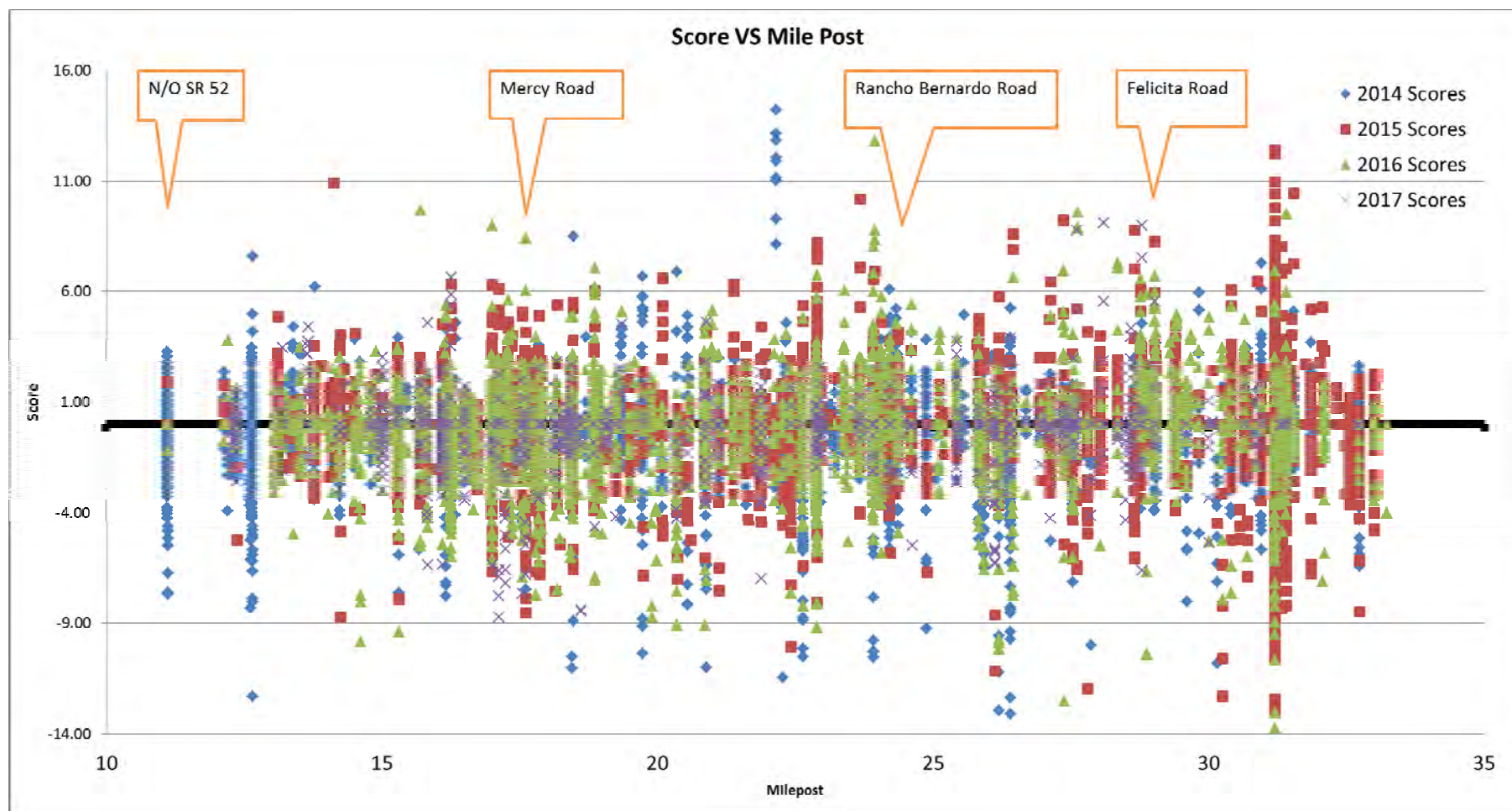
□ Operational review meetings

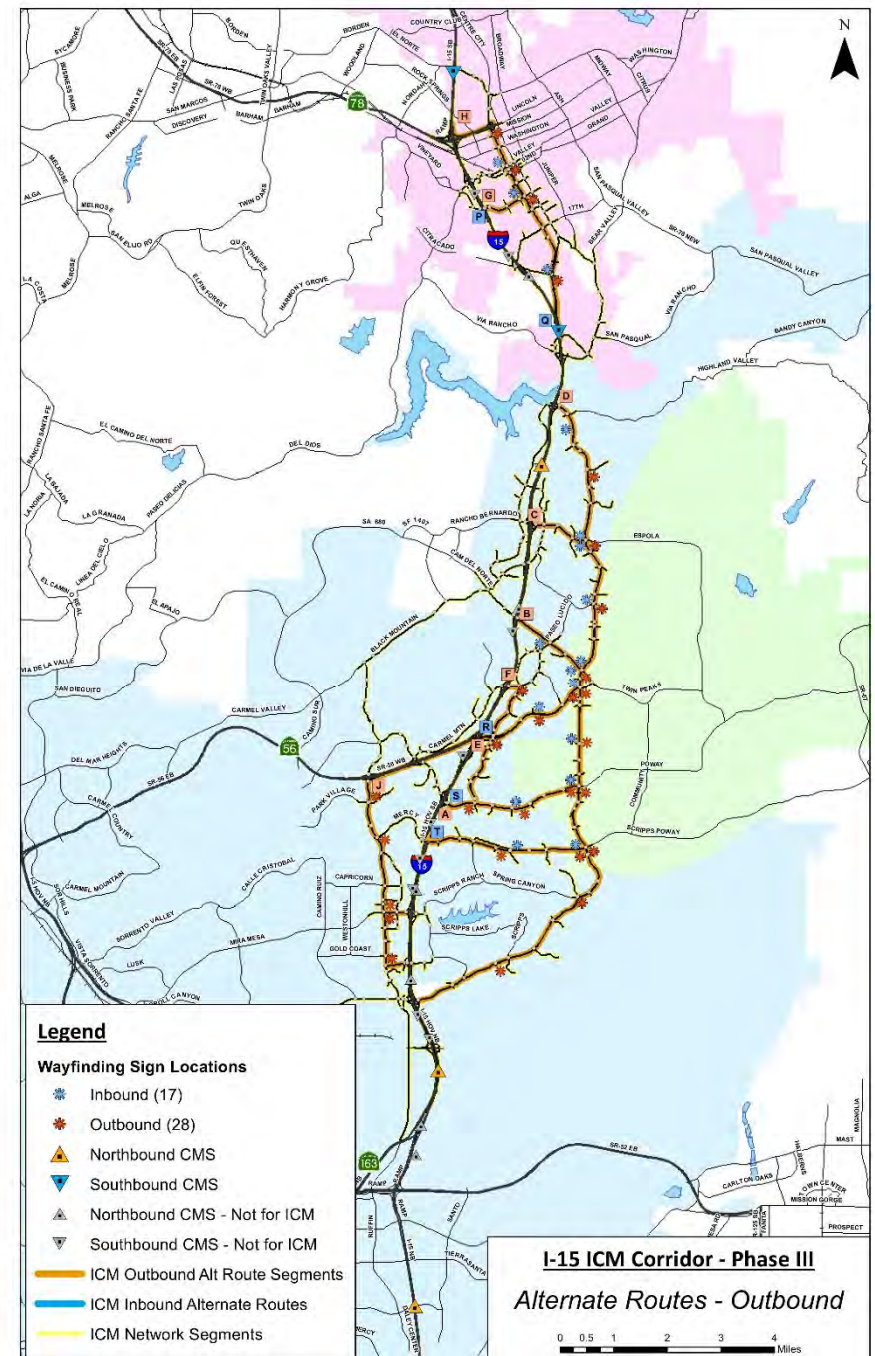
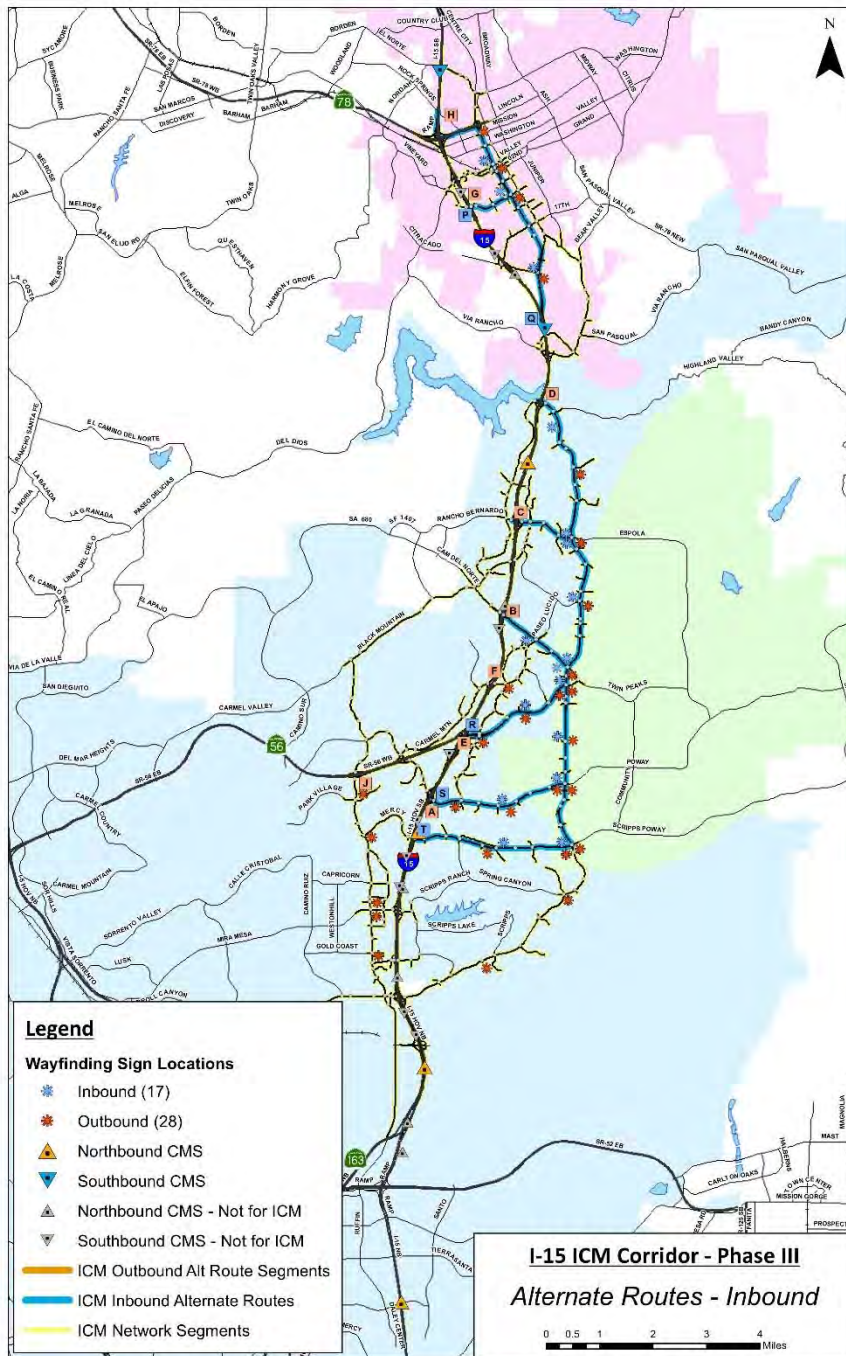
- ▣ Venue to check in and review system operations
 - Events and response plans occurring in past period
 - Performance statistics associated with events
 - Expectations regarding event identification and appropriate responses
 - Corridor configuration parameters (particularly congestion score, congestion event finder, congestion thresholds)
- ▣ Aim to foster an on-going process for discussing, reviewing, assessing, and ultimately modifying ICM system settings and response plans

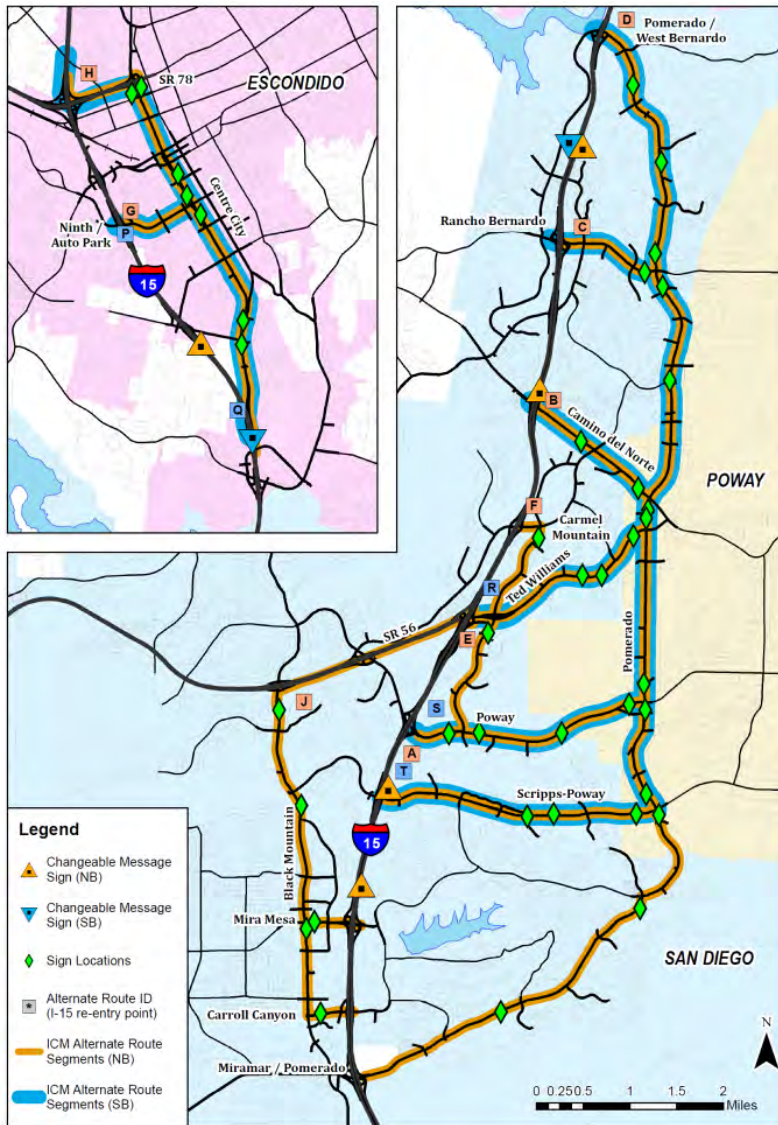


ICM Highlights: System Operations Continues

- Over 28K Response Plans
- Over 2 million Events
- Continued Work with I-15 ICM Team for ICM System Monitoring (System Performance and System Enhancements):
 - Established System Procedures for Major Event
 - Signal Subsystem Transition
 - Ramp Metering 2070 Firmware
 - DSS Modeling Upgrades
 - Assessment of Corridor Score Algorithm – Recently Implemented New Response Plan Triggering Threshold/MOE
 - On-going system maintenance







Decision Point Signs



Confirmation Signs



<https://www.youtube.com/watch?v=CsA3OaHpND4>

Performance Since ICM activation (April 2014- Feb 2019)

- System is triggered: 1-2 times a month
- Automatic adjustment of signals and ramp meters
- Decrease in travel times: 3-9%
- Increase in Travel Speed: 2-10%
- Diversion to the Arterials (passive): 9-20%
- Expect % Diversion to go up with Active Re-routing

On-Going/Next Steps ICM Efforts

- Continued Work with I-15 ICM Team for ICM System Monitoring (System Performance and System Enhancements) –
- Strategic Planning Efforts for future ICMs
- Development of Regional Transportation System Management and Operations (TMS&O) Strategy

Lessons Learned supported:

- Establishment of the I-15 Corridor Management Team (CMT)
- Completion of 805 ATDM Concept Opts.
- Initiation of 805 TSMO Plan - March

ICM : Toolbox for managing transportation system

- Proactively Manage Congestion
- Provide Choices
- Maximize System Capacity
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Institutional Integration

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Operational Integration

- **All inclusive customer focus** - Joint operational objectives and strategies to manage and balance the total capacity and demand of the corridor

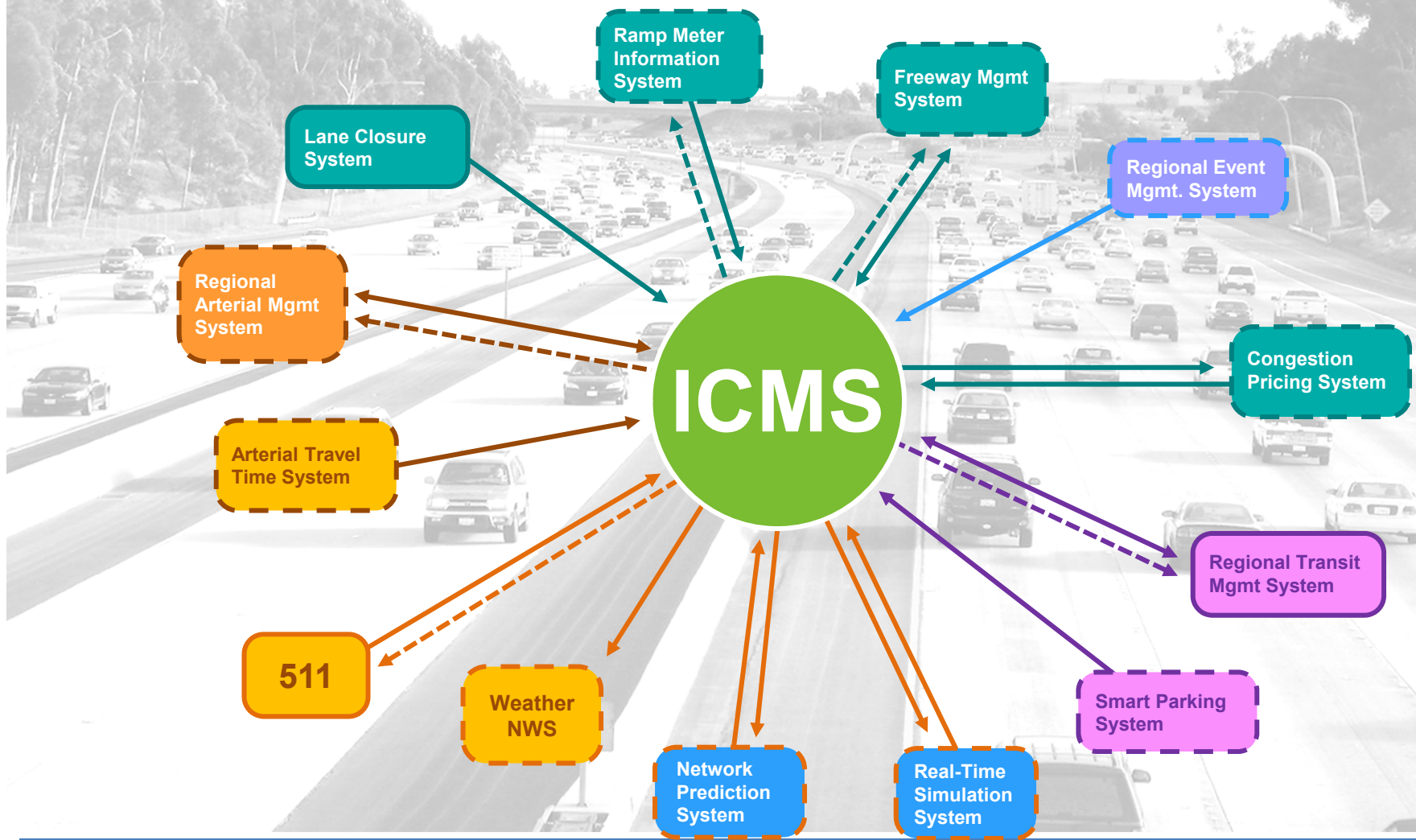
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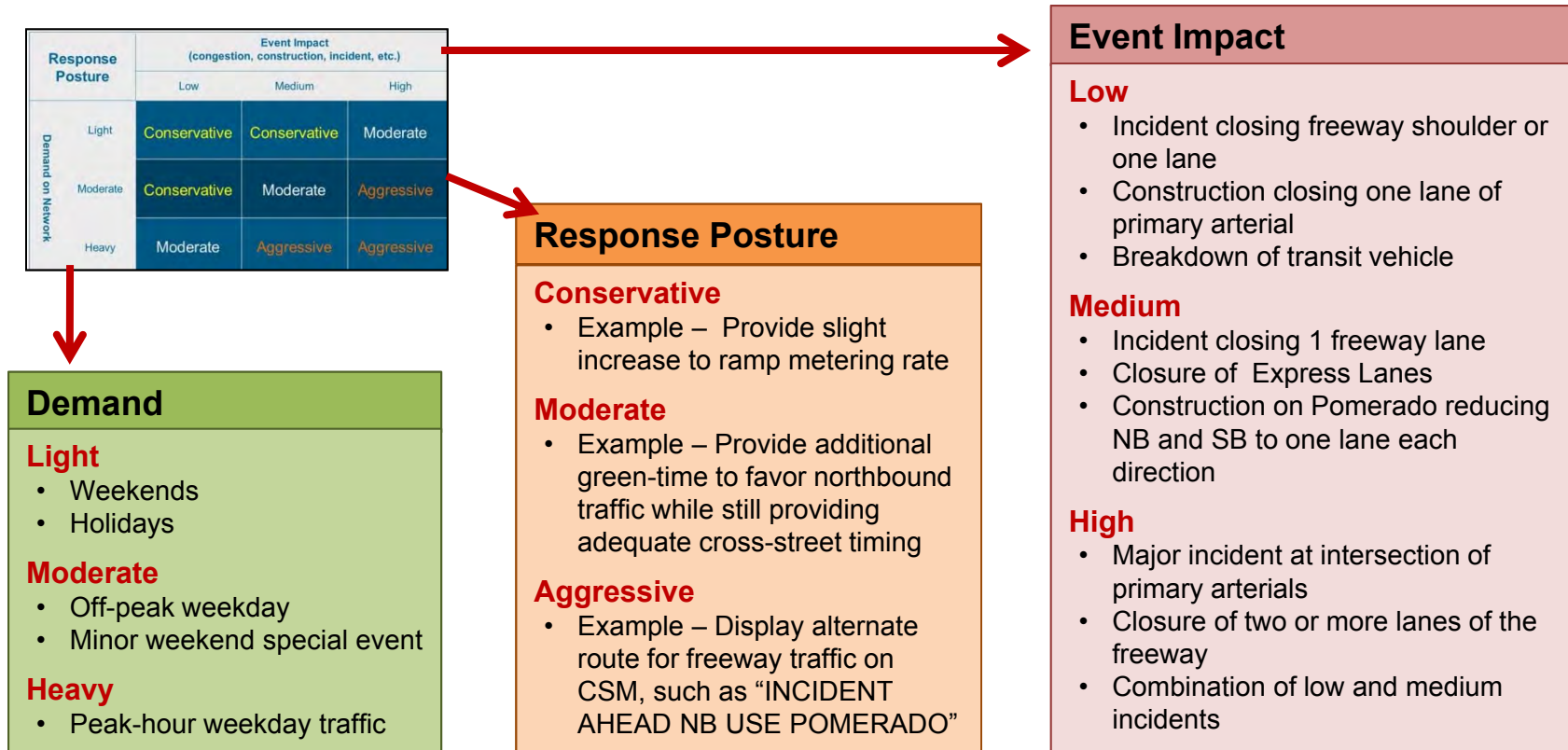
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- Coordinated traffic signals with ramp meters (new traffic signal coordination timings, responsive traffic signal control)
- Active arterial routing
- Provides corridor awareness – Transit Operators

Project Need: Technical integration



Project Need: Operational



I-15 Integrated Corridor Management

ICM Operational Assets

Traveler Information

- No change
- Notify operators of event
- Notify public of event on freeway
- Notify public of event on arterial
- Direct traffic to use alternative routes
- Direct traffic to specific routes or transit usage

Traffic Signal Timing

- No action
- Inbound Shoulder
- Inbound Peak
- Inbound Step Up
- Inbound Flush
- Outbound Shoulder
- Outbound Peak
- Outbound Step Up
- Outbound Flush

Ramp Metering

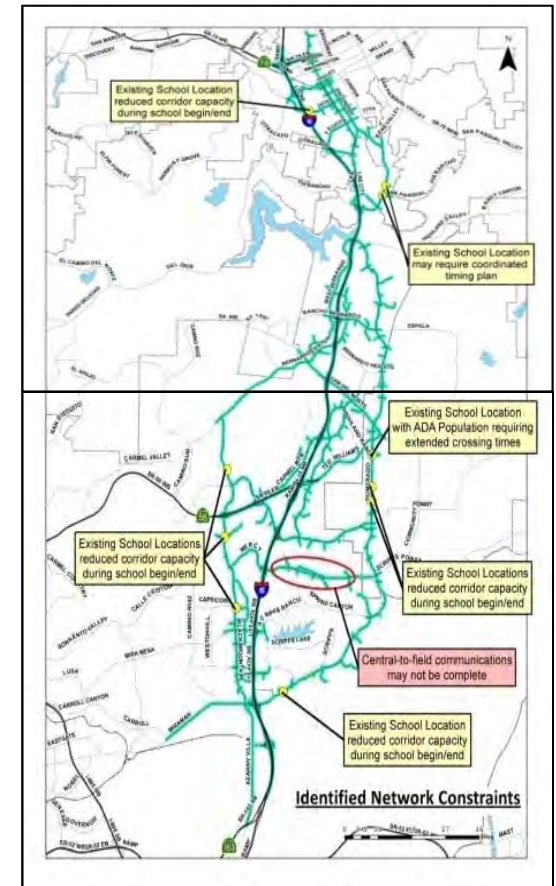
- No action
- Meter Off
- Max
- Min

Transit

- No change
- Notify transit dispatcher of event
- Provide transit dispatcher w/ recommended transit user message
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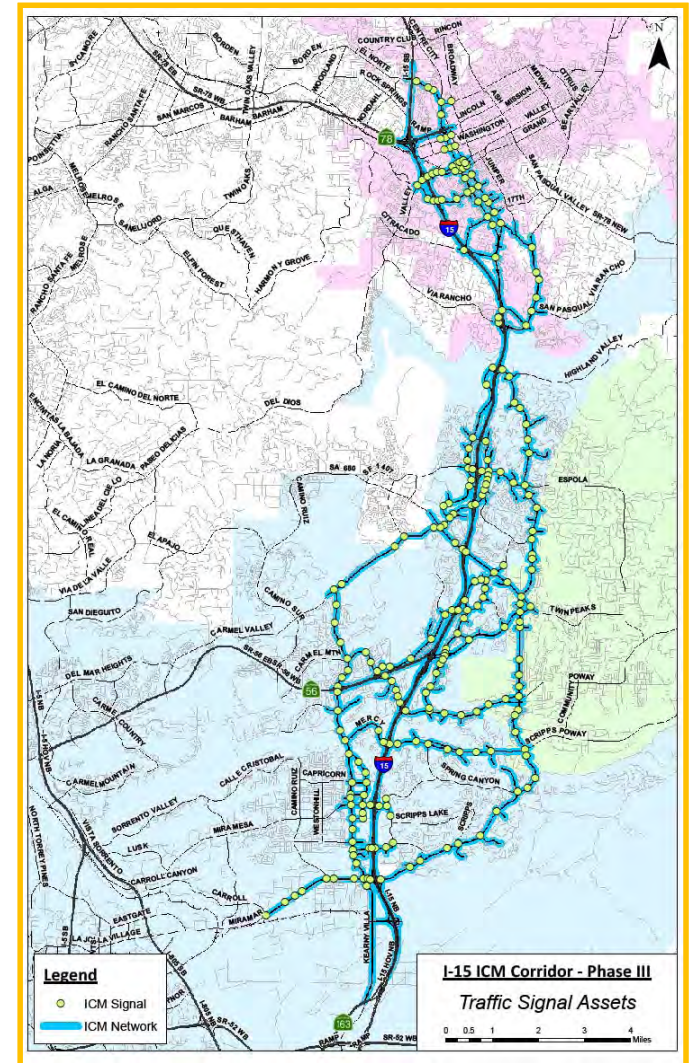
Express Lanes

- No change
- Open to all Vehicles
- Northbound 3 Southbound 1
- Southbound 3 Northbound 1
- Closed to vehicles (segment)



I-15 Integrated Corridor Management

ICM System Assets






Integrated Corridor Management Concept

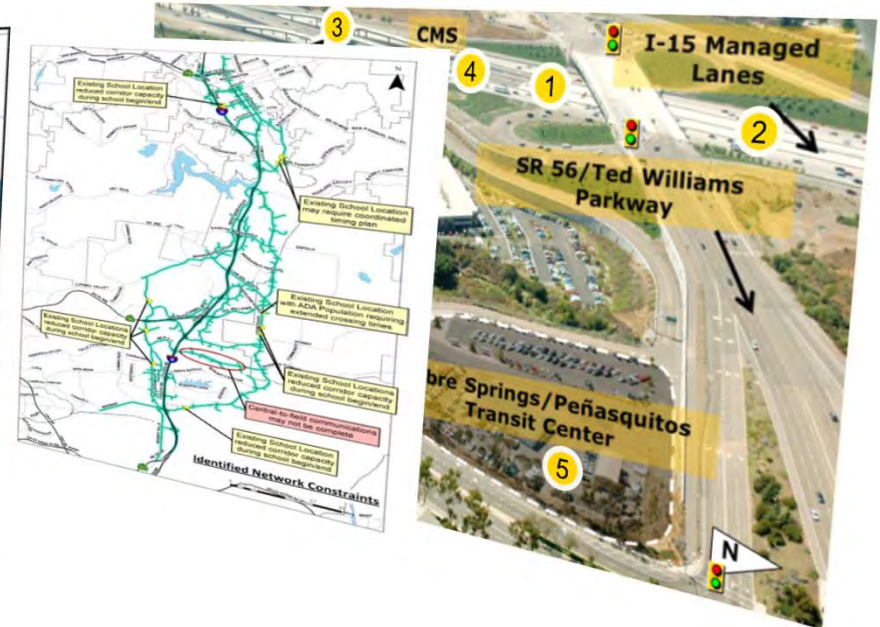
- | | | |
|-----------------------|--------------------------------------|------------------------------|
| 1 Smart Intersections | 4 Multi-modal transit station | 7 Active traffic management |
| 2 Smart ramp meters | 5 Active arterial routing | 8 Dynamic parking management |
| 3 Real-time transit | 6 Congestion pricing – managed lanes | 9 Incident management |

SANDAG sandag.org/lcm

Vision To Implementation



Response Posture	Event Impact (congestion, construction, incident, etc.)		
	Low	Medium	High
Light	Conservative	Conservative	Moderate
Moderate	Conservative	Moderate	Aggressive
Heavy	Moderate	Aggressive	Aggressive



- Propose who and what would be involved
- Discuss approach for responding to recurring & non-recurring congestion
- Identify *performance* measures for operations.
- Drive Common Operational Multi-Agency Philosophy

Vision to Implementation: Institutional

MOUs



Management Framework

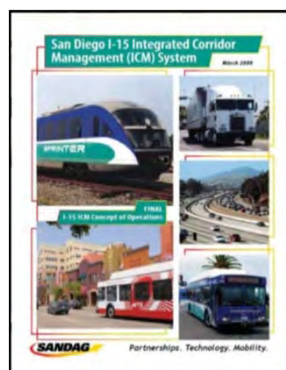


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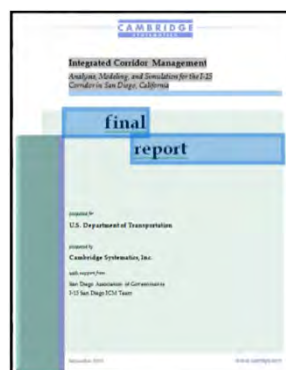


Common Vision – Management/Operations – Day to Day Operations

Stage 1



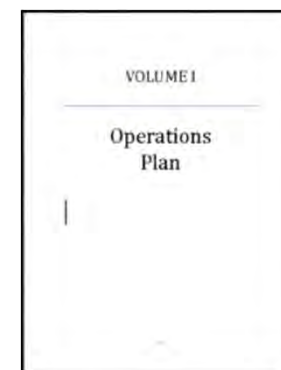
Phase 2



Stage 3



Deployment



Beyond

Concept Development and Draft
Reqs. – Partnership Commitment

Implementing Vision

Corridor Management and Operations in Practice



I-15 Integrated Corridor Management

What is Happening Now

- Continued Work with I-15 ICM Team for ICM System Monitoring (System Performance and System Enhancements) –
- Strategic Planning Efforts for future ICMs via ATDM Program
- Development of Regional Transportation System Management and Operations (TMS&O) Strategy

Lessons Learned supported:

- Establishment of the I-15 Corridor Management Team (CMT)
- Completion of I-805 ATDM Concept Ops & I-805 TSMO Plan



Lessons Learned from I-15 ICM

Federal Pilot Project (2006-2013)

- Importance of Con Ops
 - Set expectations, vision, goals
 - Lack of set roadmap to take highly conceptual strategy to actual implementation
- Importance of “executive-level” project sponsor/champion
 - Focus on technical complexity and overall project implementation
 - Breaking new ground in multi-modal operations / Degree of uncertainty/ learning as we go

Lessons Learned from I-15 ICM

ICMS Operations (2013-current)

- A LOT data / Data rich & Information Poor
- Continuous level of engagement with Caltrans and local agencies (Trust-building)
- ICM is about People, Processes and tools