Connected Corridors
Face-to-Face Meeting

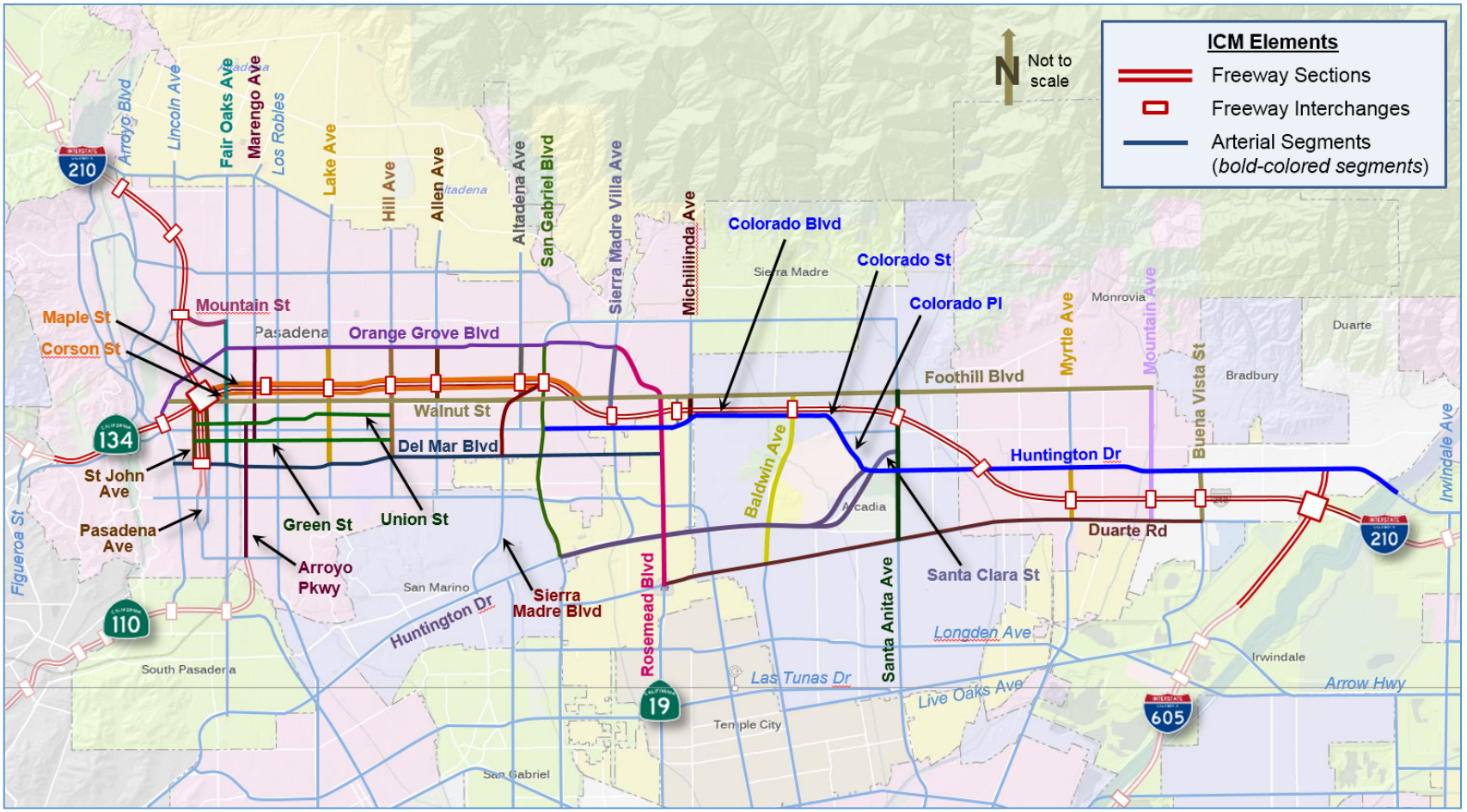
Tuesday, June 13th , 2017 – 1:30 – 3:30 pm
Caltrans D7 HQ – Downtown LA

June 13th, 2017

Agenda

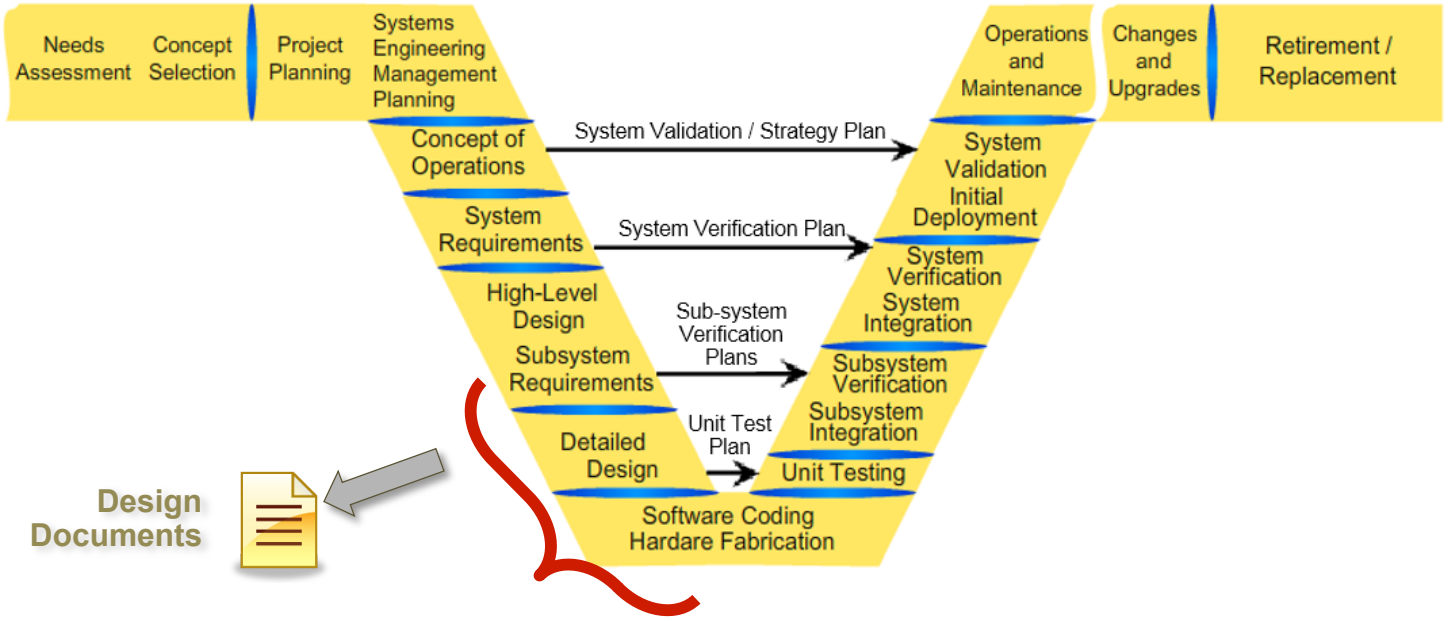
- Introductions
- Schedule Review
- Outreach
- High Level Design and Implementation
- Communications Network
- Data Quality and Estimation
- Modeling and Response Planning
- Action Items and Closing

Our Corridor: The I-210

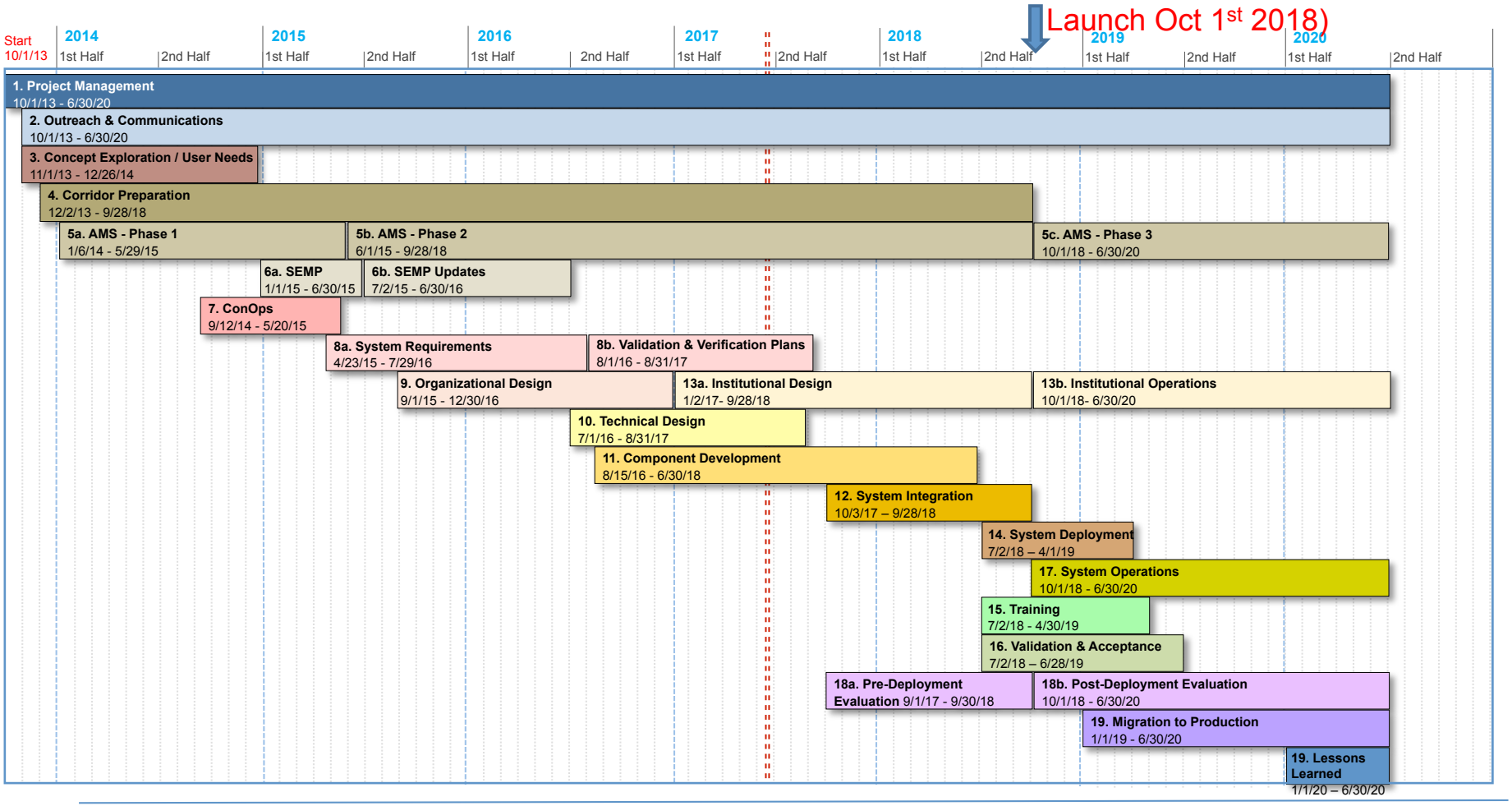


Systems Engineering Next Steps

- **Design Documents – How will the requirements be met**
- **Hardware and Software – Building the system**



Schedule



Caltrans Metro SGVCOG Foothill Transit

6

Outreach and Communications

Outreach

- **Project Charter Amendment**
  - Ready to send to stakeholders with 511 and RIITS added
    - Waiting until after ATCMTD Letters of Support have been received
- **Duarte Council presentation (need to schedule)**
- **Spring Connected Newsletter – distributed!**
- **MOU – Outline sent to stakeholders; awaiting comments**
- **ATCMTD federal grant – Updated 2016 application; sent to D7 (need to submit on June 12th by noon PST)**
  - Funding: Requesting $5.4M
  - Thank you for the Letters of Support!!

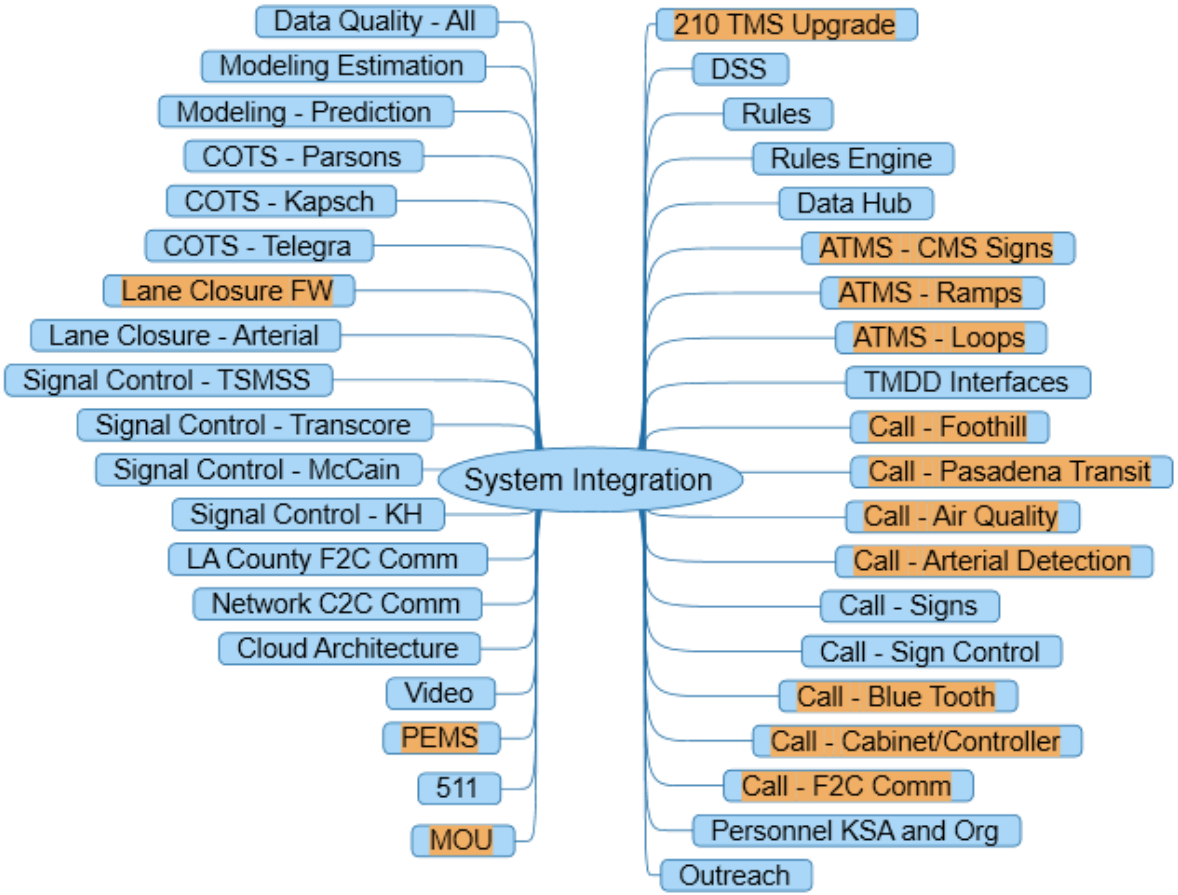
SB1 Discussion

- **It is time for us to develop a strategy for acquiring new funding coming out of Sacramento**

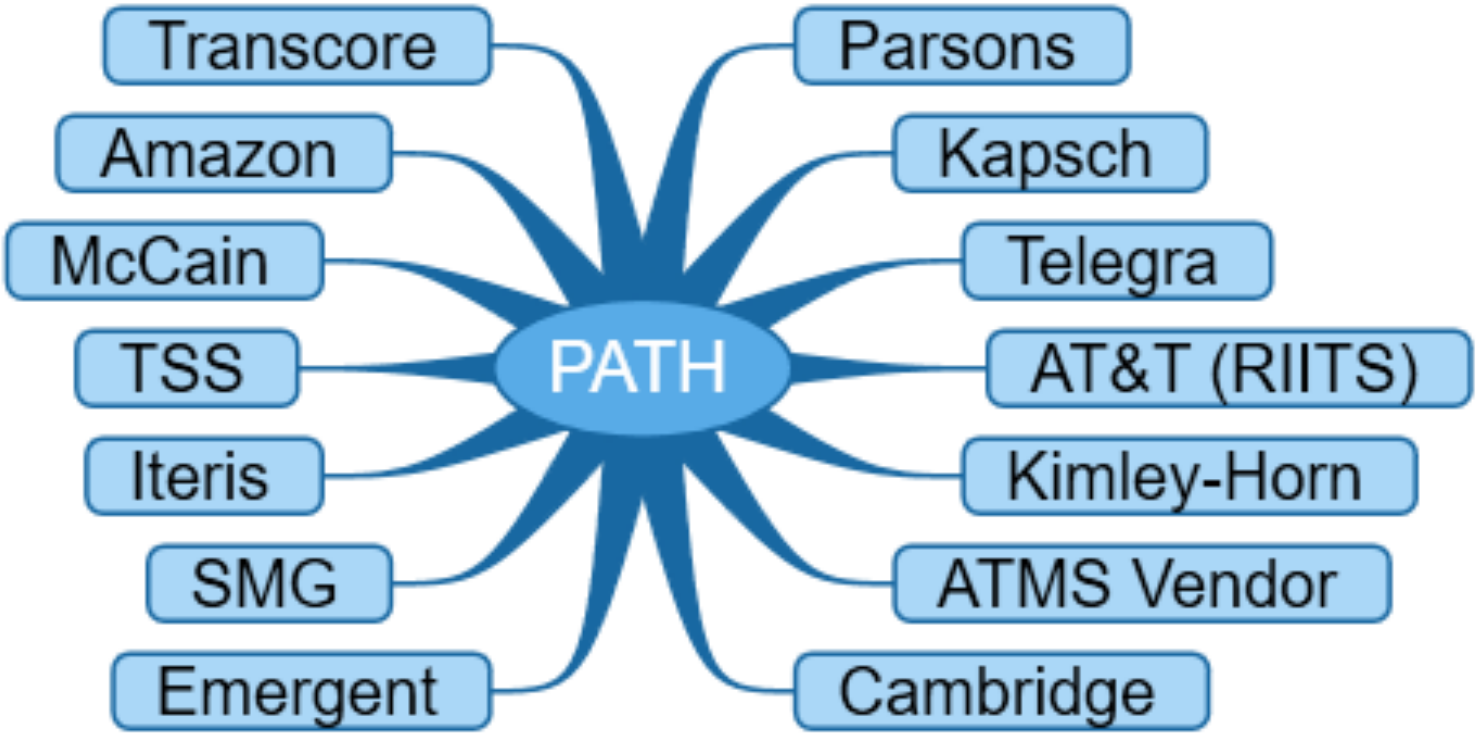
Risks - Summarized

- **Significant Risks**
  - Call for Projects on time completion
  - Wayfinding signs
  - Overall integration of a large system composed of hardware, software and personnel
- **Secondary Risks**
  - Caltrans contract administration (ATMS, Video, PEMS, PATH)
  - Construction on the I-210
  - C2C Purchasing and installation
  - Organizational readiness
  - Integration of purple box (Corridor Management Subsystem) systems
  - Network Communication
  - Corridor wide data quality
  - Final MOU - General stakeholder communication frequency and content
  - Challenges in some aspect of software development
  - Travelers following reroutes

Integration – Subsystems and Subefforts

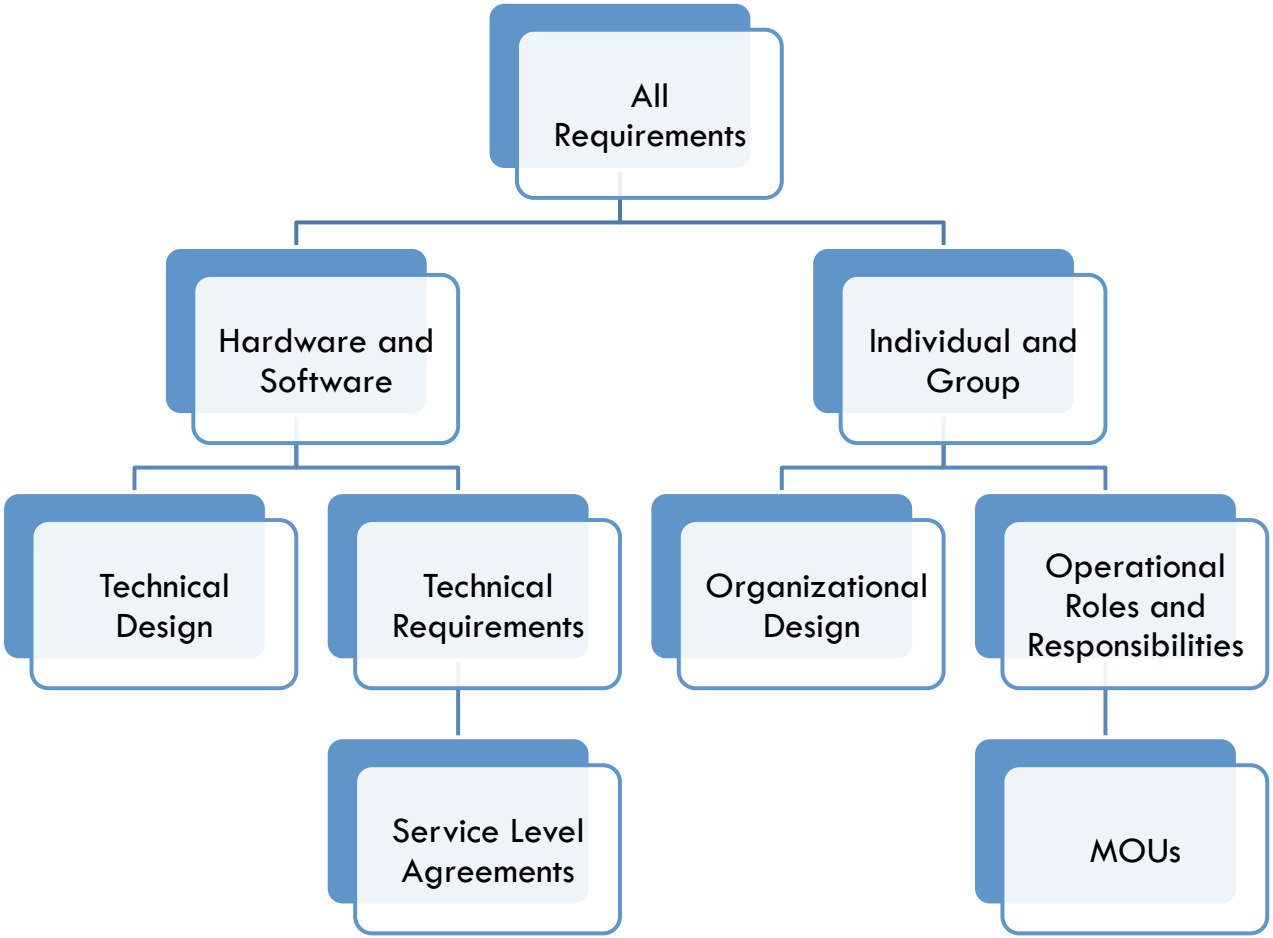


Integration - Subcontractors



Technical Design

Design


All Requirements
Hardware and Software
Individual and Group
Technical Design
Technical Requirements
Organizational Design
Operational Roles and Responsibilities
Service Level Agreements
MOUs

Design Document – In Progress

PARTNERS FOR ADVANCED TRANSPORTATION TECHNOLOGY
INSTITUTE OF TRANSPORTATION STUDIES
UNIVERSITY OF CALIFORNIA, BERKELEY

Connected Corridors: I-210 Pilot
Integrated Corridor Management System

Core System High-Level Design

June 9, 2017

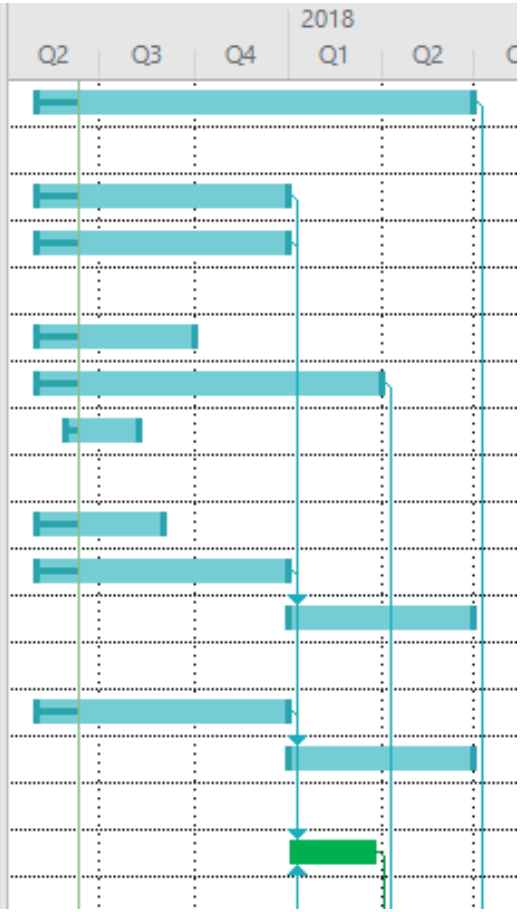
Partners for Advanced Transportation Technology works with researchers, practitioners, and industry to implement transportation research and innovation, including products and services that improve the efficiency, safety, and security of the transportation system.

Requirements Mapped to Subsystems

RP-3.23	**The ICM Core System shall include a function to develop multiple potential response plans in response to a given incident or event.**	**Decision Support**
RP-3.23.1	The ICM Core System shall be able to develop multiple response plans as a response to an incident or event.	DSS
RP-3.25	**The ICM Environment shall inform transit field supervisors as soon as possible of the response actions being considered to help them make decisions regarding potential transit service adjustments.**	**Corridor Managemt**
RP-3.25.1	Following the development of a response plan, the ICM Core System shall disseminate the following information to transit field supervisors: • Location of incident • Time incident occurred • Expected duration of incident • Agency responsible for managing the incident • Recommended detour(s) for the passenger cars • Recommended detour(s) for buses • Messages to be passed along regarding the incident or detour	CMS
RP-3.25.2	Following the identification of a medium or major incident, the ICM Core System shall inform transit field supervisors of recommended detour(s) for buses within the zone of influence of the incident.	CMS
RP-3.25.3	Transit field supervisors shall use information from the response actions to make potential transit service adjustments.	Institutional Job Tasks
RP-3.26	**The ICM Core System shall evaluate all developed valid response plans.**	**Decision Support**
RP-3.26.1	The ICM Core System shall always consider a "do nothing" scenario (scenario in which no action is taken) as one of the potential response plans to be evaluated.	DSS
RP-3.26.2	The ICM Core System shall evaluate all response plans developed by Decision Support.	DSS

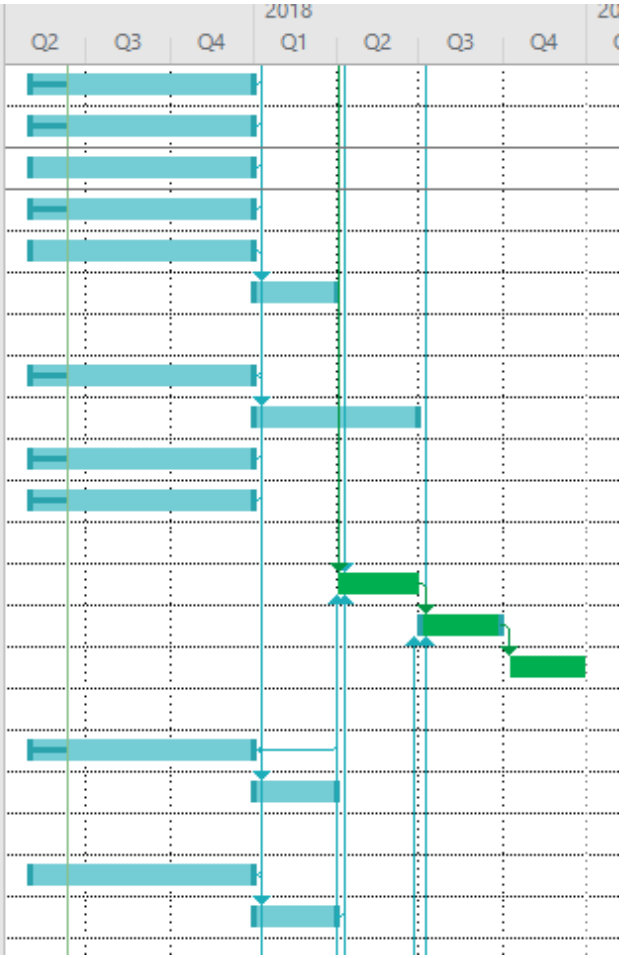
Gantt Chart – 1 of 3

	Assist	Responsible	Task Name
3		Cal, PATH	Personnel/Orgs
4			
5	Cal	PATH	Cloud Architecture
6	All	PATH	Network Communication
7			
8		Cal	Freeway SHOPP
9	All	Cal	Call For Projects
10	All	PATH	CFP - Sign Design
11			
12		PATH	Internal Data Hub Path
13		PATH	Data Hub Interfaces
14	Cal	PATH	Data Hub Internals
15			
16		PATH	Choose COTS
17		PATH,COTS	First Cots Integration
18			
19		PATH, All	Integrate with Data Hub
20			



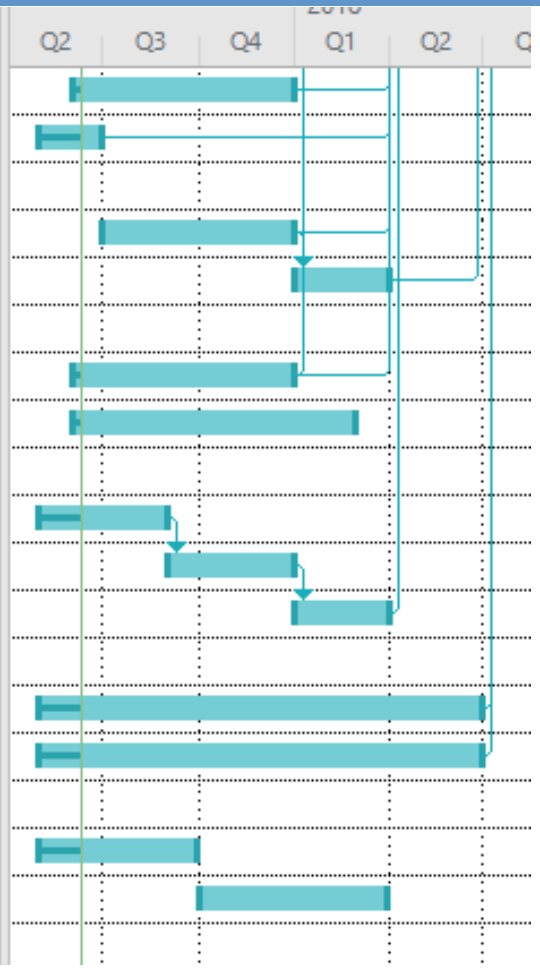
Gantt Chart – 2 of 3

	Assist	Responsible	Task Name
21	PATH	Cal	Arterial Closures
22	RIITS,511	511	PATH
23	RIITS	Cal	Transit
24	RIITS	PATH	RIITS Video
25	PATH	Cal	PEMS Interfaces
26	PATH	Cal	PEMS
27			
28	PATH	Cal	ATMS Interfaces
29		Cal	ATMS Functional
30	RIITS	PATH	Environmental
31	Cty, City	PATH	Travel Time
32			
33	All	PATH	Integrate System
34	All	PATH	Test System
35	All	PATH	Launch System
36			
37		PATH	C2C Interfaces
38	All	PATH	C2C Working
39			
40	PATH	PATH	Sign Control Interface
41		PATH	Sign Control Completed

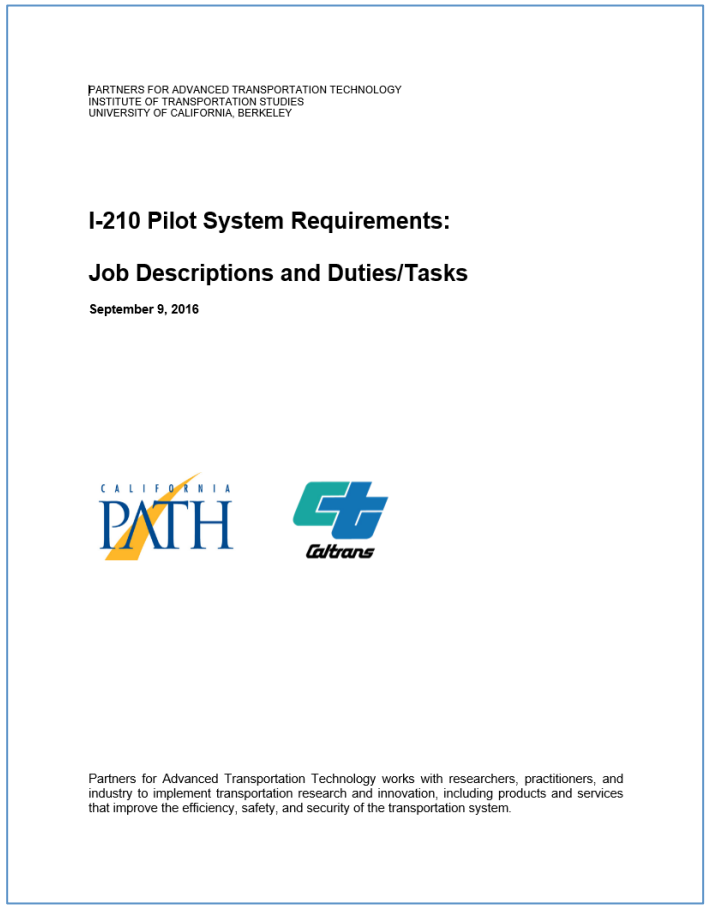


Gantt Chart – 3 of 3

	Assist	Responsible	Task Name
44	City/Cnty	PATH	City Data
45	PATH	Cal	Caltrans' Data
46			
47		PATH	Estimation Interfaces
48	PATH	PATH	Estimation Working
49			
50		PATH	Prediction Interfaces
51		PATH	Prediction Working
52			
53		PATH	Rules Engine Beta
54		PATH	Rules Engine Interfaces
55		PATH	Rules Engine Working
56			
57	All	PATH	Rules
58	All	PATH	Response Plans
59			
60	PATH	Cal	PATH Contract Update
61	PATH	Cal	Next PATH Contract
62			



Job Descriptions and Duties/Tasks



PARTNERS FOR ADVANCED TRANSPORTATION TECHNOLOGY
INSTITUTE OF TRANSPORTATION STUDIES
UNIVERSITY OF CALIFORNIA, BERKELEY

I-210 Pilot System Requirements:

Job Descriptions and Duties/Tasks

September 9, 2016

Partners for Advanced Transportation Technology works with researchers, practitioners, and industry to implement transportation research and innovation, including products and services that improve the efficiency, safety, and security of the transportation system.

- Corridor Champions
- Corridor Manager
- Corridor Technical Manager
- Corridor Data Analyst
- Traffic Engineers
- Data Analysts
- Software Engineers
- Electrical Engineers
- Database Administrators
- Stakeholders
- Maintenance Staff
- Information Technology Support
- Information Technology Security
- TMC/TCS Operators
- Transit Field Supervisors
- Public Information Officers
- First Responders
- Outreach and Communications Manager

Mapping Knowledge to Summary Requirements

- PATH is preparing Ks (knowledge) for Caltrans items in the summary list (for HQ)
  - Base items are from the Kimley Horn report
  - Items in blue are suggested additions by PATH

ICM Core System Functions	
Caltrans shall be responsible for operating and maintaining the ICM Core Software and Hardware System: • Security • Maintenance • Working with stakeholders to implement upgrades	• Knowledge of the basic principles of Caltrans' System Management philosophy and integrated corridor management concepts and strategies (K4) • Broad knowledge of evolving real-time transportation information systems (K7) • Knowledge of electrical systems, as applied to automated traffic surveillance and control (K8) • Knowledge and experience in the field of computer networking and electronic communications (K9) • Knowledge of Caltrans' organization, department policies and financial constraints and procedures (K10) • Knowledge of communications network design as it relates to ITS infrastructure (K14) • Knowledge of systems and applications used to monitor and analyze transportation data (K18) • Basic knowledge of personal computer usage and its applications (K21) • Knowledge of stakeholder agencies' processes and systems (K28) • Advanced outreach and communications knowledge (KP2) • Knowledge of corridor ITS software (KP6) • Knowledge of corridor ITS hardware (KP7) • Knowledge of industry-standard system security best practices, including tools, functions, processes, protocols (KP21)

Proof Of Concept – COTS (Purple Box)

- **3 Companies have responded positively**
  - Kapsch
  - Parsons
  - Telegra
- **Selections made by end of June**
- **Probably all three**
- **This reduces one of our risks**

Proof of Concept Dates

- June 2017 – Choose vendors who will participate in pilot
- August 2017 – Complete agreements with vendors as needed
- Sept 2017 – Begin integration planning with vendors
- Nov 2017 – Begin integration of vendor COTS products
- Oct 2018 – Launch pilot utilizing COTS software of first vendor
- Feb 2019 – Complete Integration of second vendors COTS software
- May 2019 – Complete Integration of third vendors COTS software

- The anticipated schedule for Caltrans procurement is:
-
- May 2018 – Caltrans will begin internal procurement process
- Oct 2019 – Procurement document released
- April 2020 – COTS vendor chosen
- July 2020 – Complete contractual negotiations
- Nov 2020 – Install production software

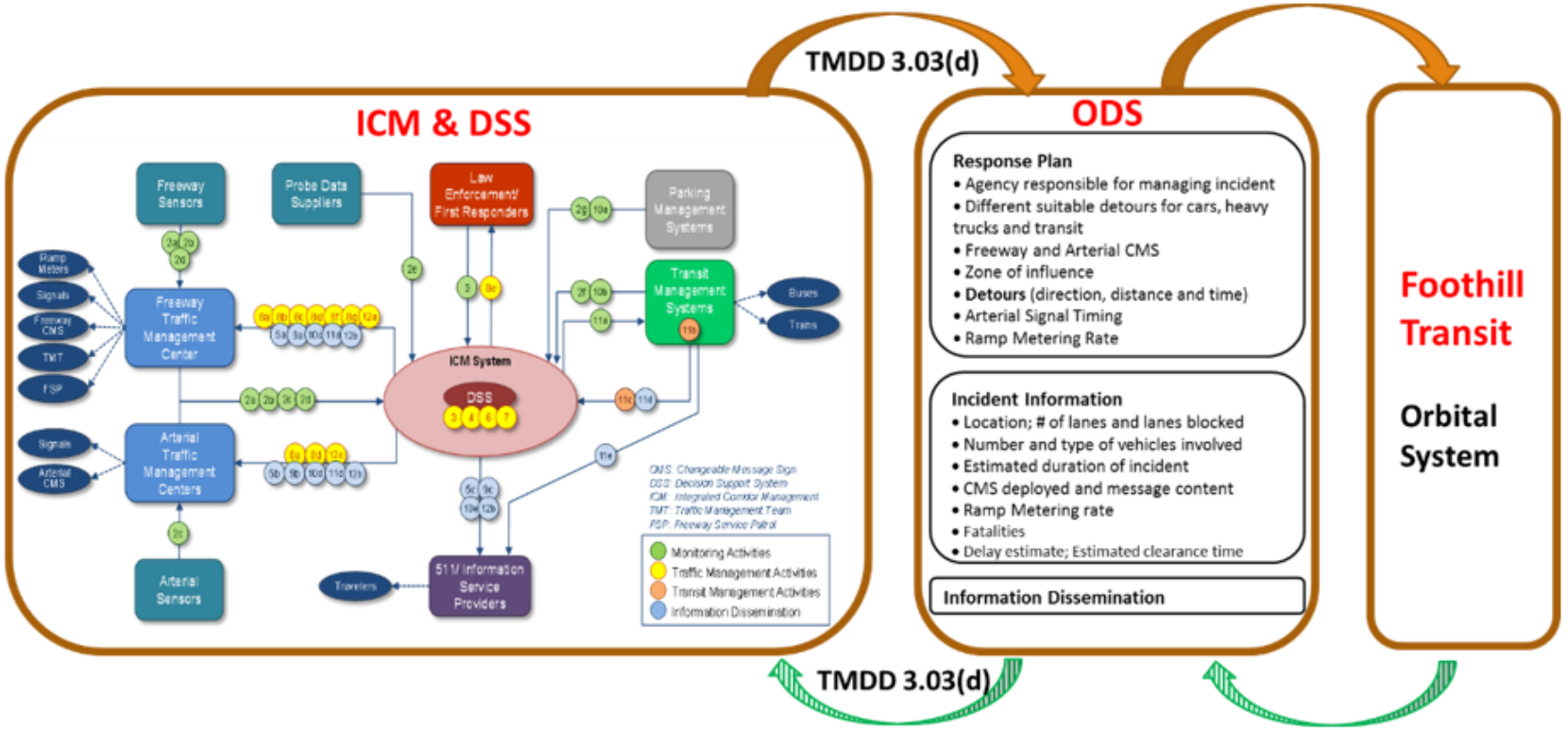
Metro Call for Projects

- **Contract Status**
  - We have a present for Steve
- **Final Equipment List**
  - Strong focus by PATH on sign types, locations, power and communications
- **Procurement**
  - Planning on using a Service Contract to deliver project elements
  - Awaiting word from DPAC

Arterial Signs

- PATH and Iteris met with Pasadena, Arcadia and LA County to discuss signs
- Pasadena and Arcadia would like signs that measure X by X and are full Matrix - PATH is getting quotes – This may be cost prohibitive
- Stakeholders have reviewed sign locations and there are likely to be few changes in overall locations
- Detailed sign location studies have begun to determine exact locations, possible use of existing poles, power and communication
- Current plan is to place signs near sensors at stop lines
- Josh Seeherman from PATH and Erlan Gomez from Iteris are working on this

Allen – Foothill Transit and Cal Poly



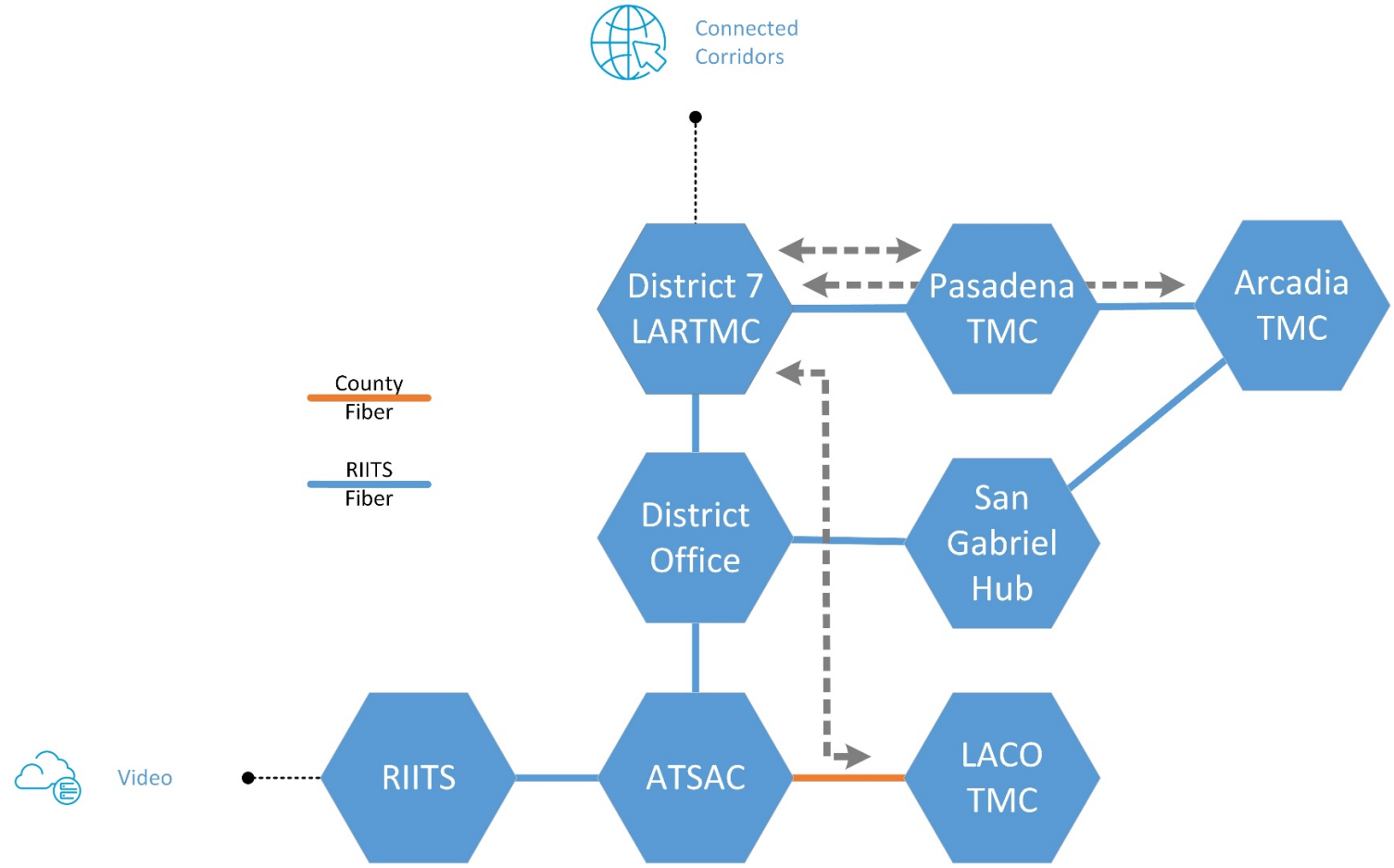
Network Communication

Jesus and Erlan

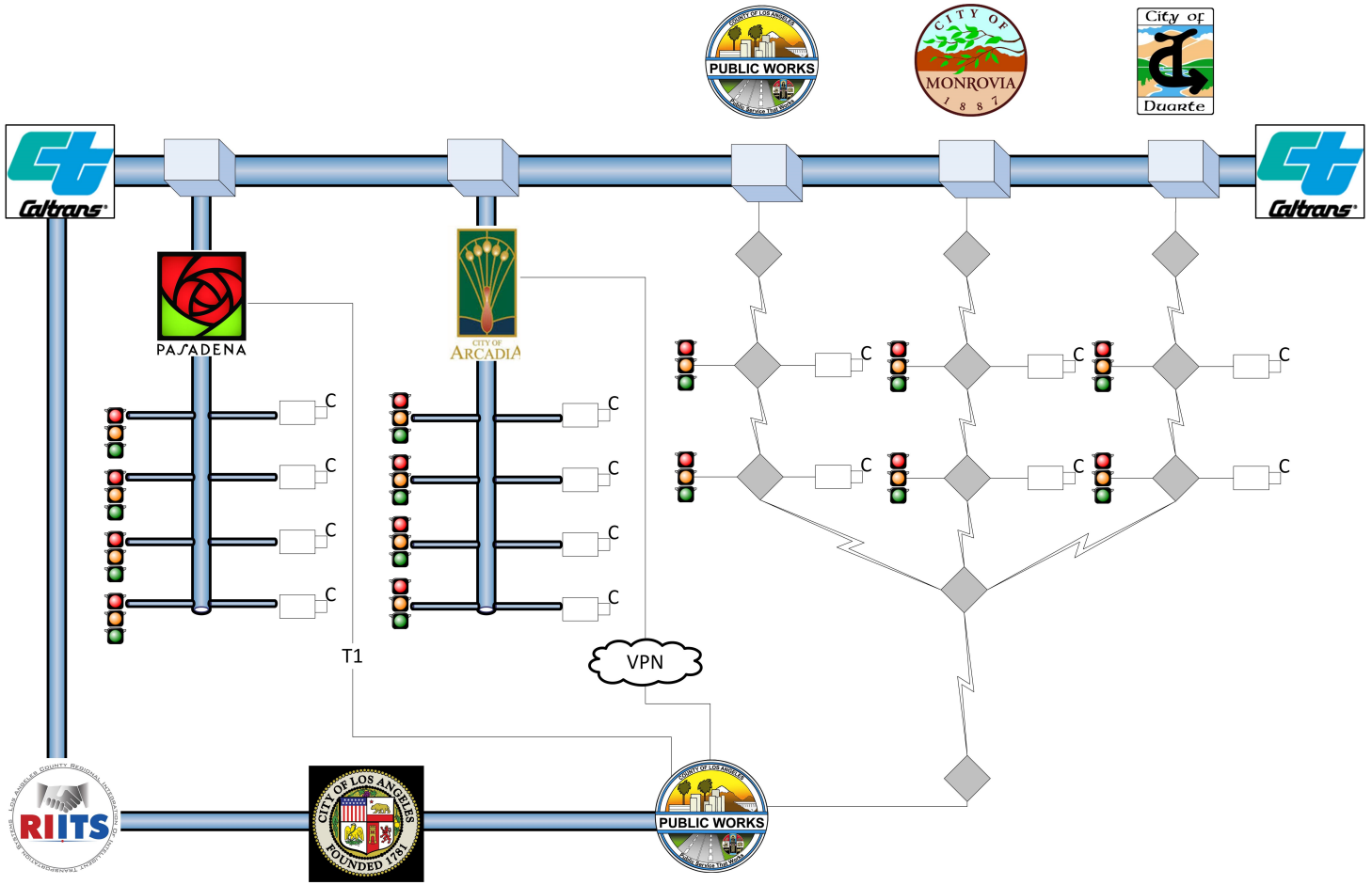
Network Communications

- CC Stakeholders wanted to upgrade their regional communication speed, bandwidth and reliability as part of the CC project
- Caltrans offered to connect cities and county to their new I-210 fiber as part of the 210 upgrade. They offered two strands.
- RIITS offered to manage the fiber and provide needed hardware, software, management, and maintenance
- There have been several meetings with stakeholders and plans are underway. There is a need for design decisions based on stakeholder input.
- RIITS hired AT&T (Jesus) and PATH hired Iteris (Erlan). Two weeks ago we met and began working together as a team
- Over the last two weeks we have met with Caltrans, Pasadena, Arcadia, and LA County

Physical Connectivity between Agencies



Communication Schematic



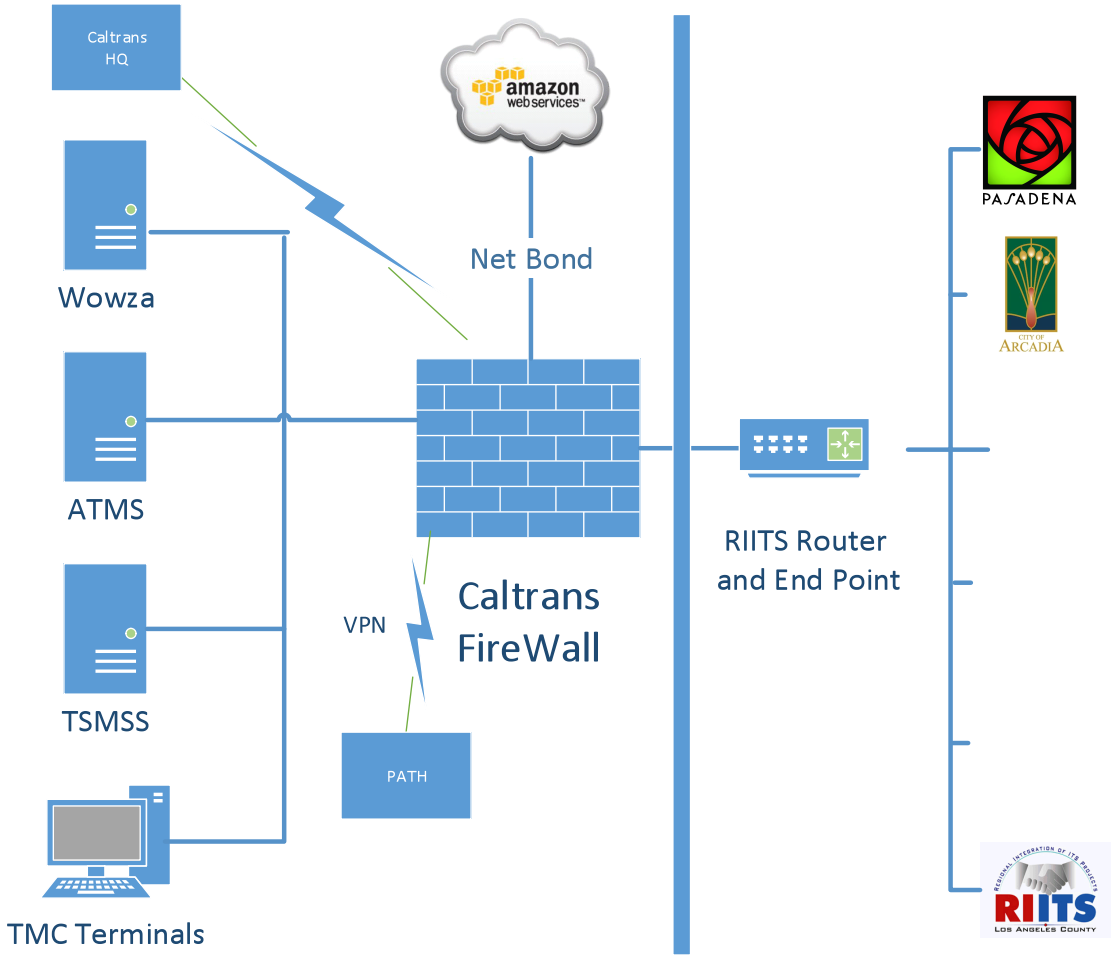
Services Required

- **Three types of data will be distributed over the network**
  - Standard C2C
  - Video Streaming
  - HTTPS for the CC Corridor Management Subsystem access
- **Bandwidth**
  - Concern about bandwidth in re video, however
  - Current video requirements indicate that resolution is low and not likely to be an issue
  - We will be doing a detailed analysis

Caltrans

- **Has agreed to provide two strands of fiber along the I-210 to serve as the communications backbone between the participating agencies and Caltrans**
- **These strands are terminated at the LARTMC which is where the network will be integrated onto the Caltrans' network**
  - The integration will occur through Caltrans firewall for security purposes
  - Access to the ICM Cloud will be established through the firewall as well
- **Caltrans will manage the Amazon cloud and it will be located behind the Caltrans firewall**

D7 Internal Network



Pasadena

- **Will have access to Caltrans network at two locations**
  - Fair Oaks & Maple
  - Allen & Maple
- **Will provide dark fiber strands between the locations and their TMC**
  - Will need a minimum of 4 strands between each Caltrans fiber drop and TMC
  - Patch cables will be required to link the Caltrans fiber onto the City's fiber
- **RIITS can then add communication equipment (OADM) at Pasadena's TMC**
  - Pasadena has agreed to provide rack space within their TMC for the network equipment
  - A firewall or other secure alternative will be required between the City's network and the shared Caltrans network
- **Pasadena will have access to the network from their TMC.**
  - Any additional routing between the Pasadena TMC and other Pasadena departments will be the responsibility of the City's IT department.

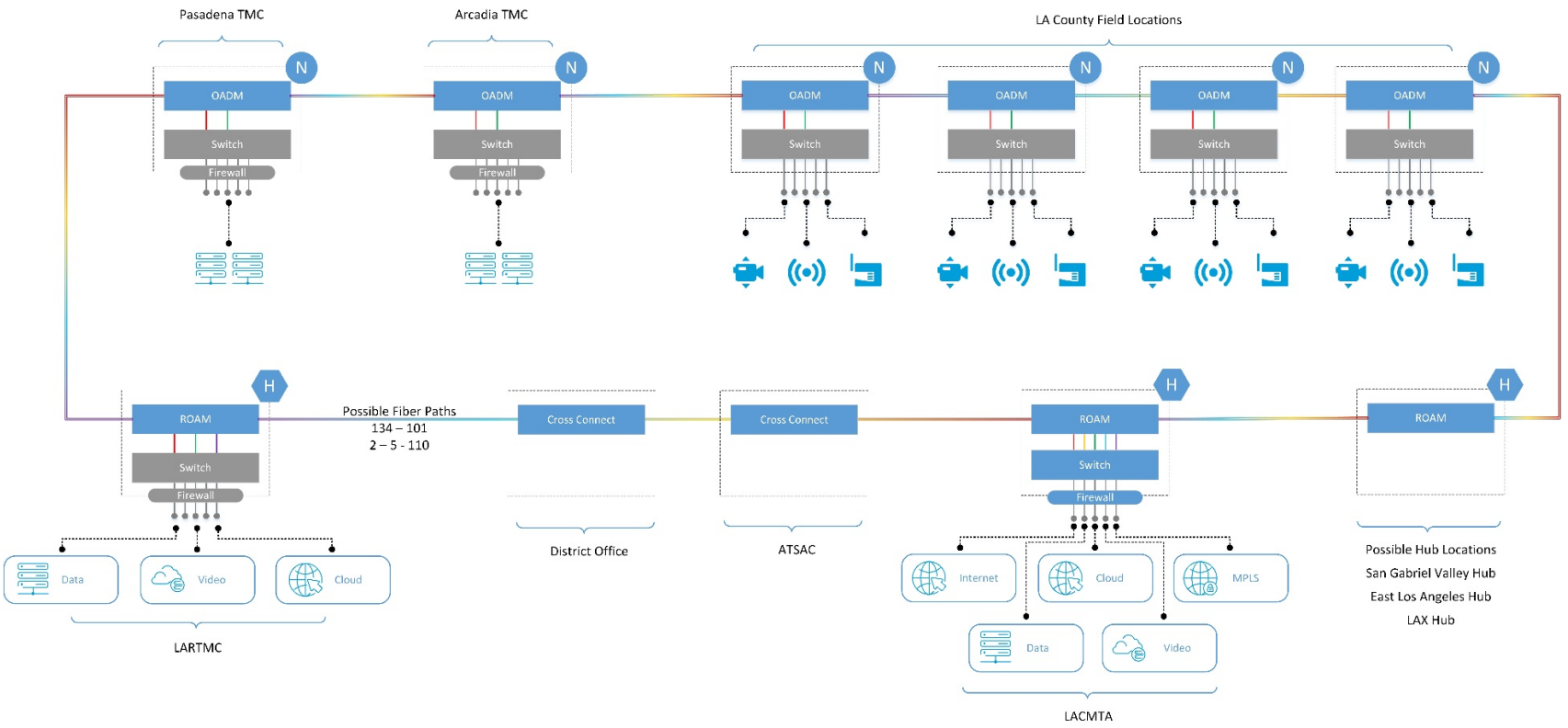
Arcadia

- Will have access to Caltrans fiber at one location:
  - Santa Anita & I-210
- City would like to request a second access point at:
  - Baldwin & I-210
- Will provide dark fiber strands between the locations and their TMC
  - Will need a minimum of 4 strands between each Caltrans fiber drop and the TMC
  - Patch cables will be required to link the Caltrans fiber onto the City's fiber
- RIITS can then add communication equipment (**OADM**) at Arcadia's TMC
  - Arcadia has agreed to provide rack space within their TMC for the network equipment
  - A firewall or other secure alternative will be required between the City's network and the shared Caltrans network
- Arcadia will have access to the network from their TMC.
  - Any additional routing between the Arcadia TMC and other Arcadia departments will be the responsibility of the City's IT department.

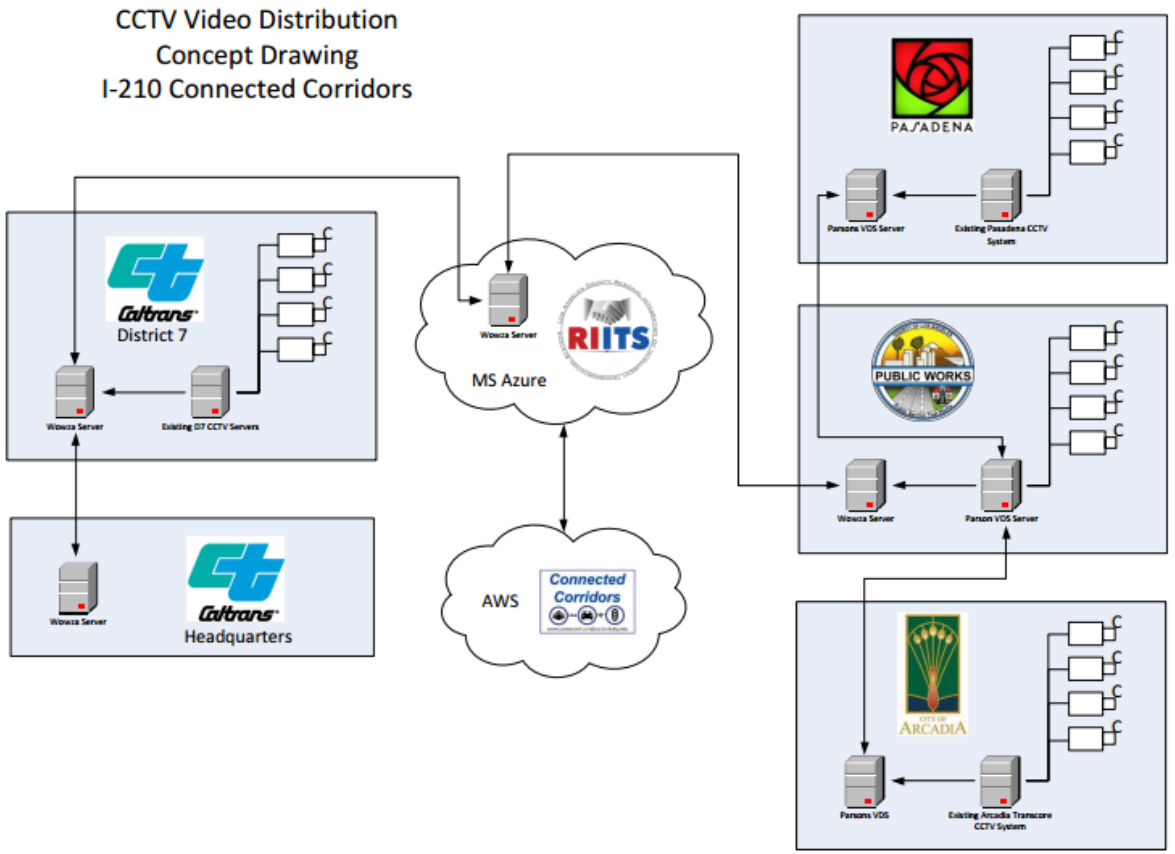
Los Angeles County (LACO)

- **Will have access to the Caltrans network Via two routes**
  - First route is by connecting onto the Caltrans fiber network using the two strands Caltrans is providing along the I-210
    - This will allow LACO to gain access for intersections that communicate over their wireless network
      - The Bandwidth limitations of the radios may not allow for full access over this route
  - Second route is by connecting onto the RIITS network via LACO owned fiber between the LACO TMC and LADOT ATSAC
- **LACO would like to find an alternate fiber access point**
  - This fiber provides communication between LACO TMC and Southbay area intersections
  - Concerned bandwidth obtained via proposed network may not be sufficient to support existing data and proposed data needs

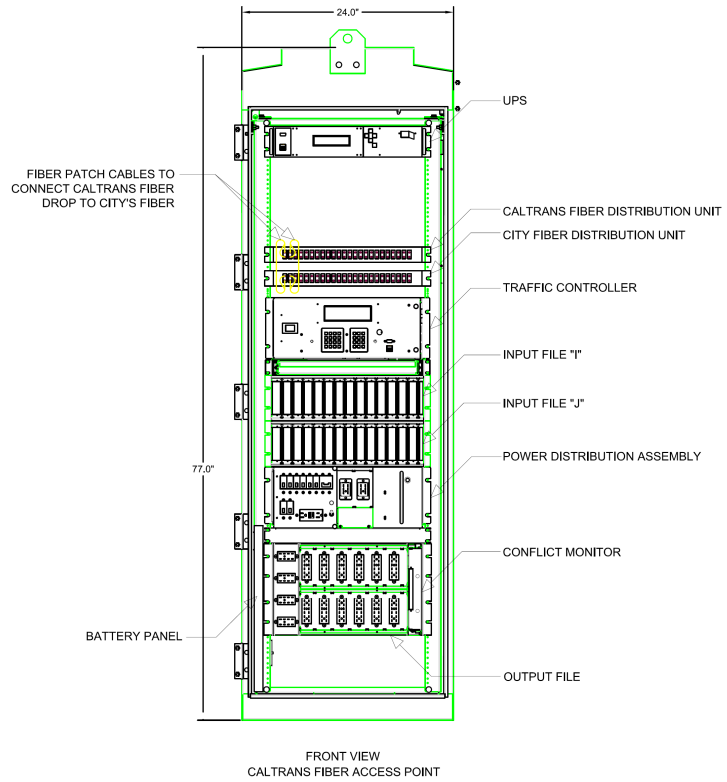
Communication Network



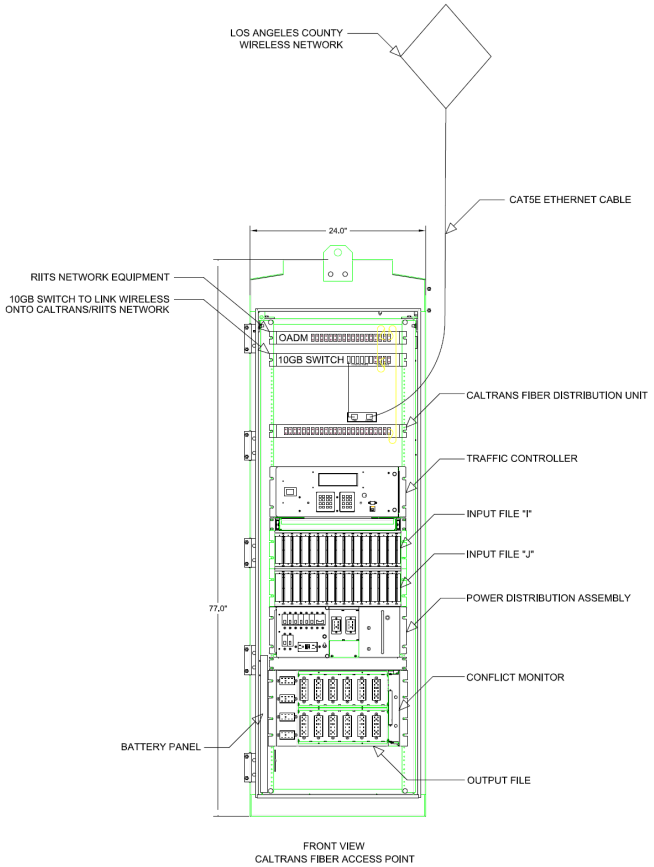
Video Distribution



Typical Caltrans Fiber Drop (Pasadena & Arcadia)



Typical Caltrans Fiber Drop (LACO)



Next Steps

- Caltrans completes fiber installation
- Arcadia has gone to bid
- Pasadena to provide connectivity
- Continued discussions with LA County
- Team to determine exact path forward for F2C
- Finalize fiber path and location for hub and node sites
- Identify exact application, video and field element requirements
- Coordinate agency site visits and conduct capacity analysis
- Obtain current network parameters and diagrams for network integration
- Expect frequent communication over the next month with the team

C2C Updates

- **Transcore – Ryan**
  - Ryan has accepted our terms and conditions
  - Ryan will provide Caltrans solution free of charge to Arcadia
  - Ryan awaiting final TMDD update
- **Kimley Horn**
  - Awaiting proposal from them, Jason back from vacation on June 16th
- **McCain**
  - Awaiting final TMDD update
- **PATH adding in installation, network integration and data quality to all contracts**

TMDD Updates

- When using a document/literal style SOAP binding for an operation with messages (input, output, or fault) that are defined with multiple parts, only one of those parts should be bound to the SOAP body in order to be compliant with the WS-I Basic Profile 1.1.

  In TMDD, the messages created for subscription model have multiple parts, while its wsdl binding uses document/literal style. This is not compliant with the WS-1 standard.

- The "Unique Particle Attribution" rule is a mechanism to prevent ambiguity in the W3C XML Schema version 1.0.

  In the TMDD schema section, some XML objects have <xs:any> attribute which creates ambiguity in XML.

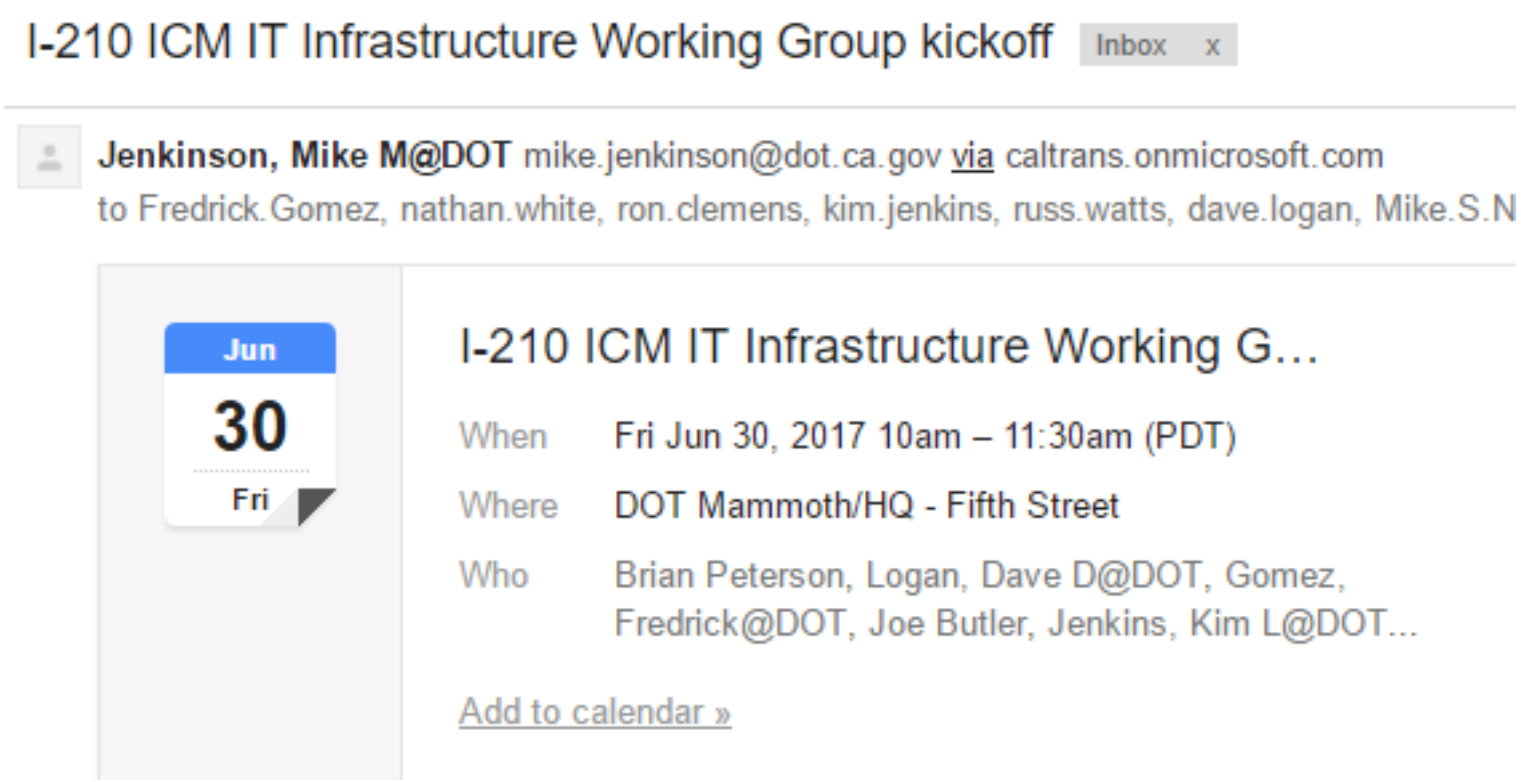
ATMS, PEMS, Lane Closure

- **ATMS Upgrades – (High Priority, High Risk)**
  - Entering the procurement cycle – This is good
- **PEMS**
  - Design meetings held with Caltrans, Iteris and PATH
  - Awaiting quote from Iteris
- **Lane Closure**
  - Mike Jenkinson should be providing software in the near future

Working with Caltrans IT

- There are three sets of ongoing meetings
  - Security group
  - Ops group.
  - Infrastructure group

IT Meeting



I-210 ICM IT Infrastructure Working Group kickoff Inbox x

Jenkinson, Mike M@DOT mike.jenkinson@dot.ca.gov via caltrans.onmicrosoft.com
to Fredrick.Gomez, nathan.white, ron.clemens, kim.jenkins, russ.watts, dave.logan, Mike.S.N

Jun
30
Fri

I-210 ICM IT Infrastructure Working G…

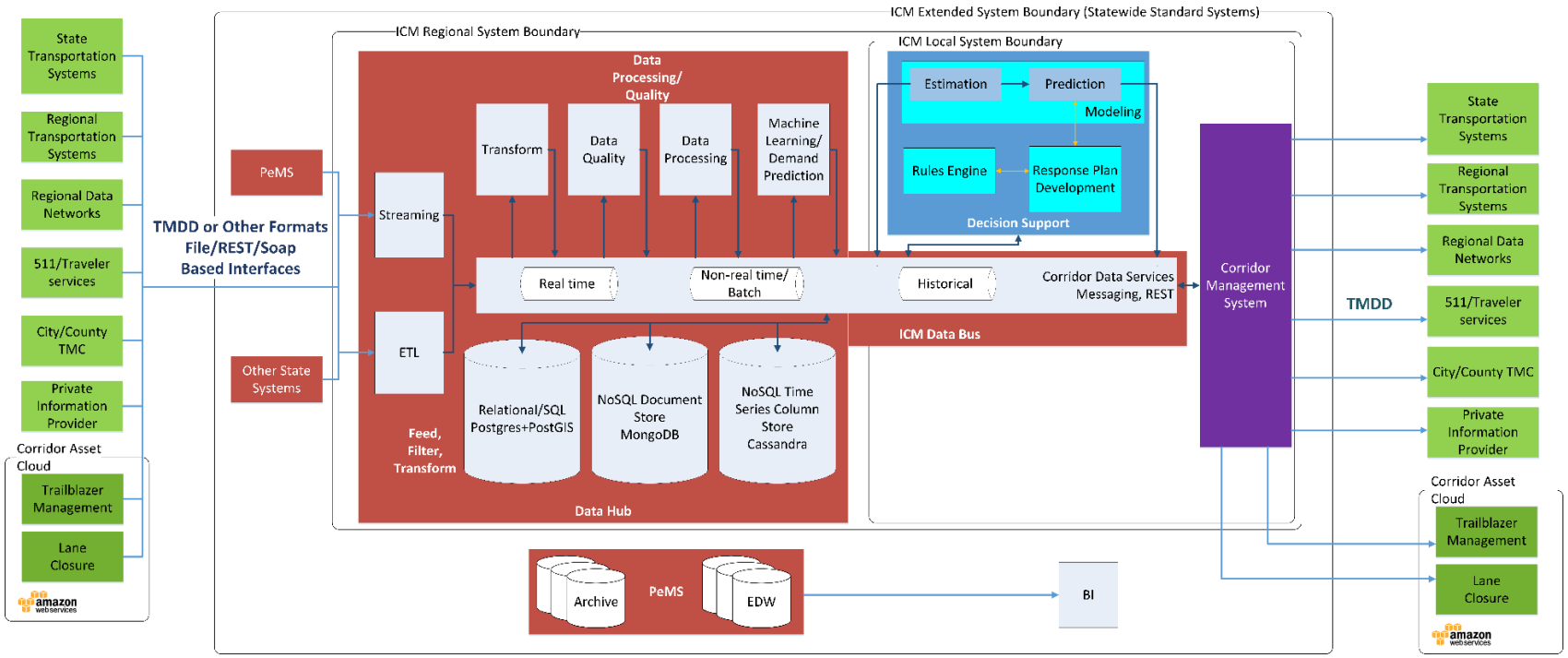
When Fri Jun 30, 2017 10am – 11:30am (PDT)

Where DOT Mammoth/HQ - Fifth Street

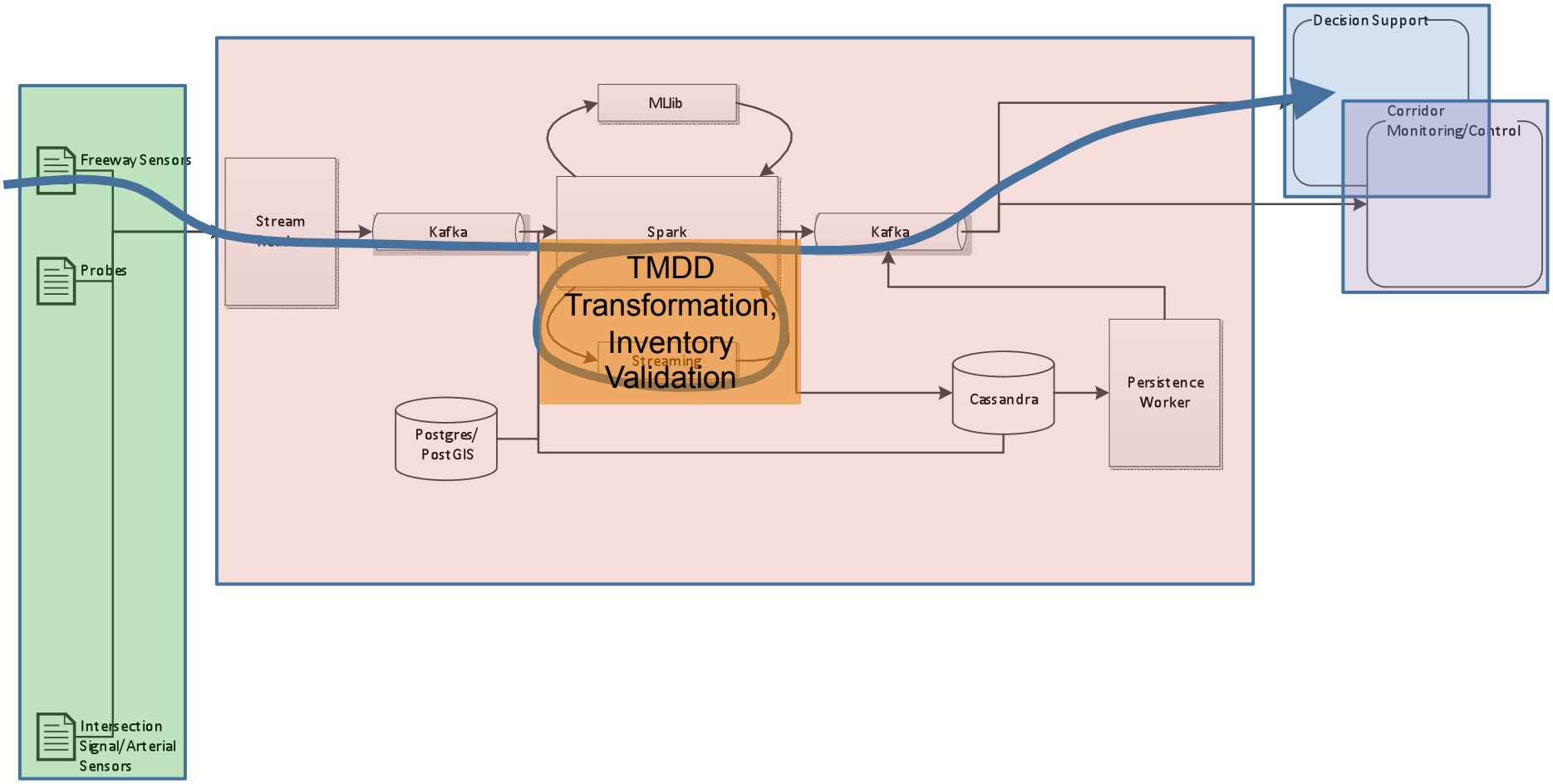
Who Brian Peterson, Logan, Dave D@DOT, Gomez, Fredrick@DOT, Joe Butler, Jenkins, Kim L@DOT...

Add to calendar »

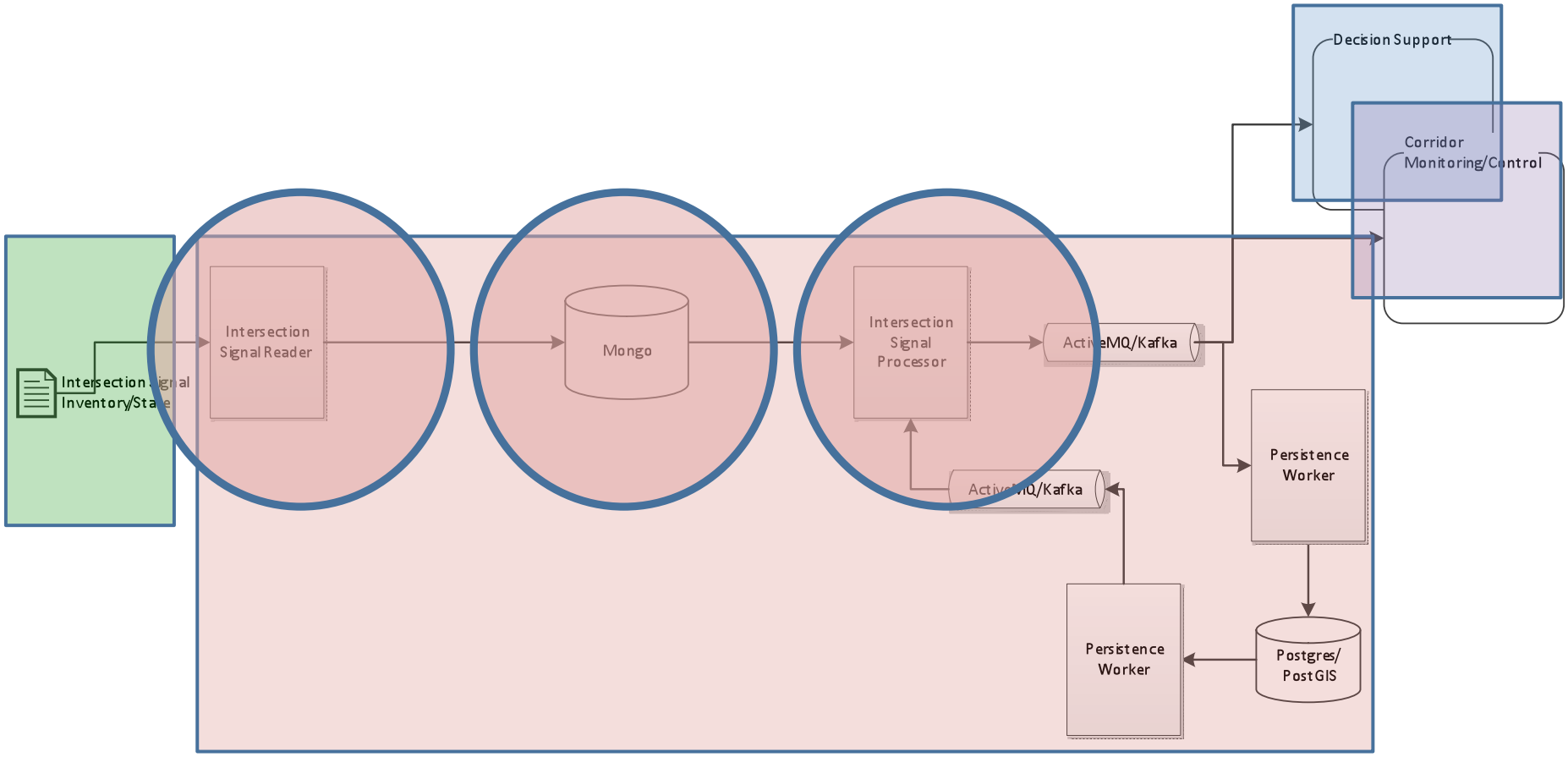
Data Hub and DSS within the cloud



PeMS to DSS/Modeling for Estimation Path Complete



Intersection signal TMDD Connectivity/ Pipeline Component Progress



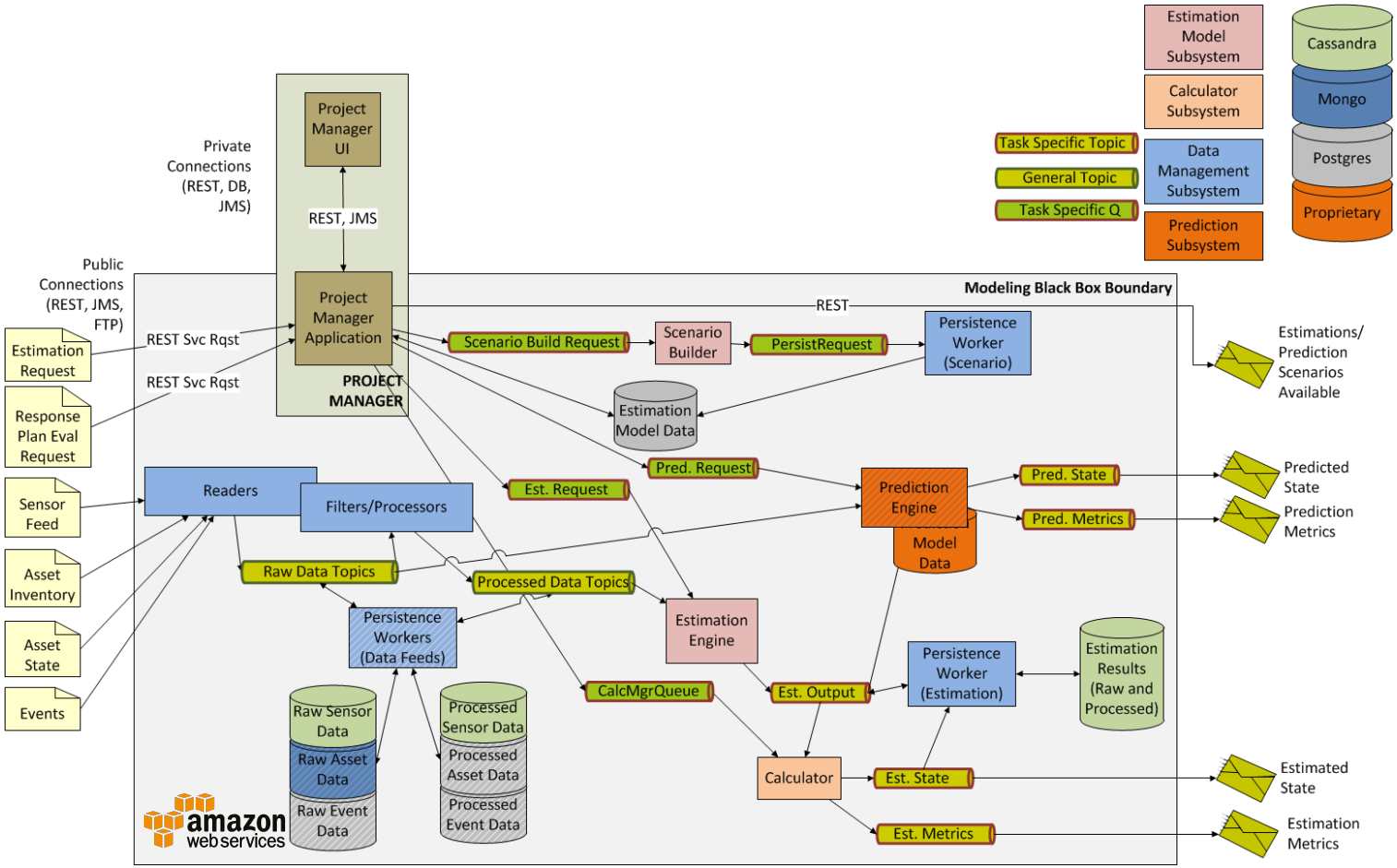
System Development Updates for Techies

- **Freeway estimation moved to new virtual private cloud with data hub**
- **Version upgrades to Modeling - Java, Postgres (moving to common component versioning between data hub and DSS)**
- **Camel interface for PeMS data – data hub to DSS complete. Camel is:**
  - An open source Java framework that focuses on making integration easier and more accessible to developers. It does this by providing:
  - Concrete implementations of all the widely used Enterprise Integration Patterns (EIPs)
  - Connectivity to a great variety of transports and APIs
  - easy to use Domain Specific Languages (DSLs) to wire EIPs and transports together

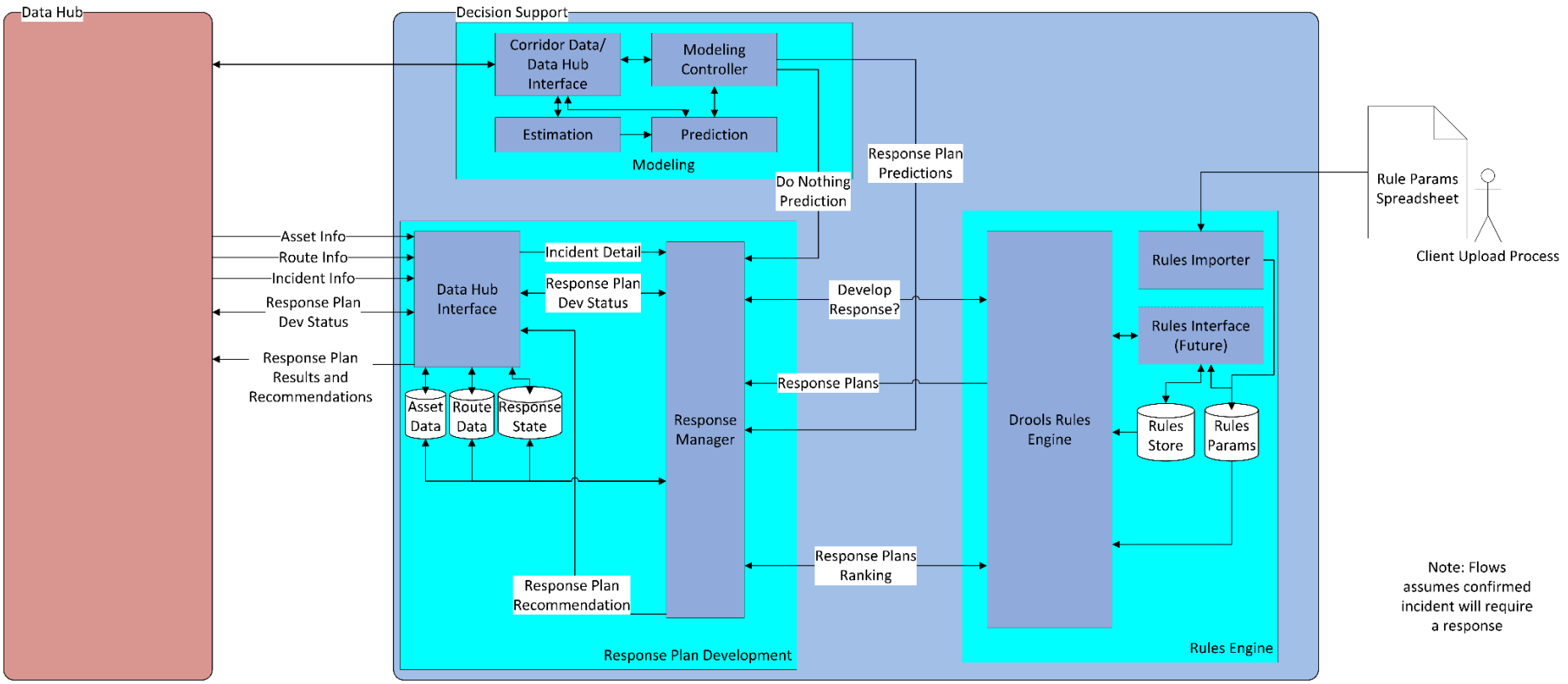
Next steps

- **Run estimation 24/7 to gain understanding of reliability**
- **Continue design specification work**
  - Kafka, ActiveMQ topic design
  - Refine interface definitions based on vendor conversation
  - System security design elements
  - Arterial estimation design
- **Verify integration of intersection signal pipeline components**
- **Meet with Caltrans IT Infrastructure Group, continue discussions with Solutions and Security groups**
- **Begin integration of prediction engine (Aimsun) into DSS**

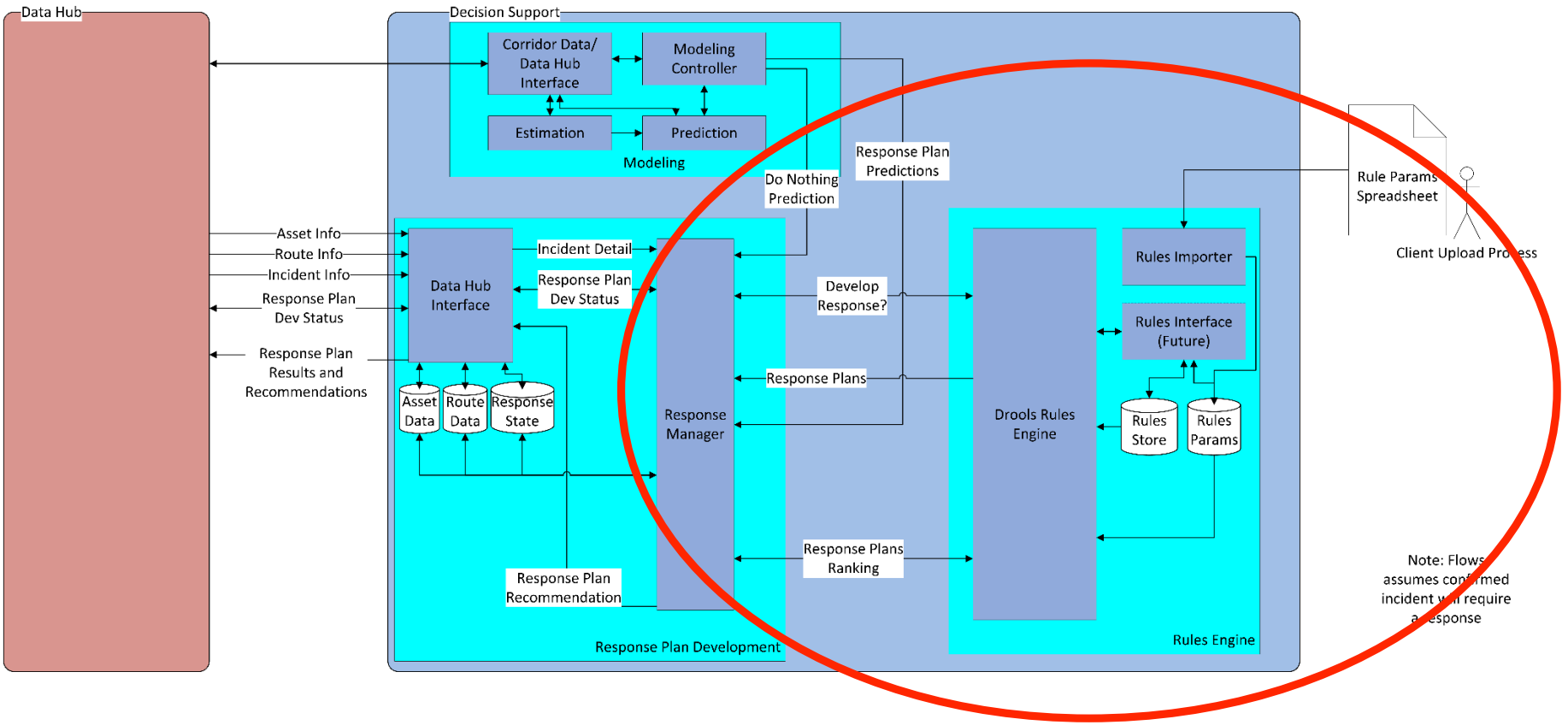
Modeling Component Architecture



DSS – Design Detail



DSS – Design Detail



Data Quality and Estimation

Freeway Sensor Availability

Weekly Average Sensor Availability

Hover over cells to view units in detector-days.

I-210 ▾ Eastbound PM 25 - PM 43.25 ▾

		CD	CH	Fwy-Fwy	HOV	Mainline	Off Ramp	On Ramp	Total
May	7 8 9 10 11 12 13			61.9%	75.9%	74.8%	71.9%	64.0%	73.2%
	14 15 16 17 18 19 20			66.7%	82.9%	81.6%	79.9%	73.1%	80.4%
	21 22 23 24 25 26 27			66.7%	85.7%	82.5%	77.1%	79.4%	81.5%
	28 29 30 31 1 2 3			57.1%	77.1%	75.1%	70.1%	73.1%	74.1%

Weekly Average Sensor Availability

Hover over cells to view units in detector-days.

I-210 ▾ Westbound PM 25 - PM 43.25 ▾

		CD	CH	Fwy-Fwy	HOV	Mainline	Off Ramp	On Ramp	Total
May	7 8 9 10 11 12 13			85.7%	74.8%	75.8%	71.0%	73.0%	75.1%
	14 15 16 17 18 19 20			46.4%	76.7%	75.3%	77.1%	73.0%	74.6%
	21 22 23 24 25 26 27			57.1%	82.7%	79.3%	80.5%	83.2%	79.7%
	28 29 30 31 1 2 3			85.7%	77.1%	75.5%	73.3%	76.5%	75.9%

For the past four weeks health has been consistently lower than what was seen in April or February of this year.

We need to develop maintenance processes to improve results

Arcadia

- **Big changes in Arcadia data quality on the way**
- **We have determined that we will not use speed information from the data**
- **Data quality results should be 80+% next month**

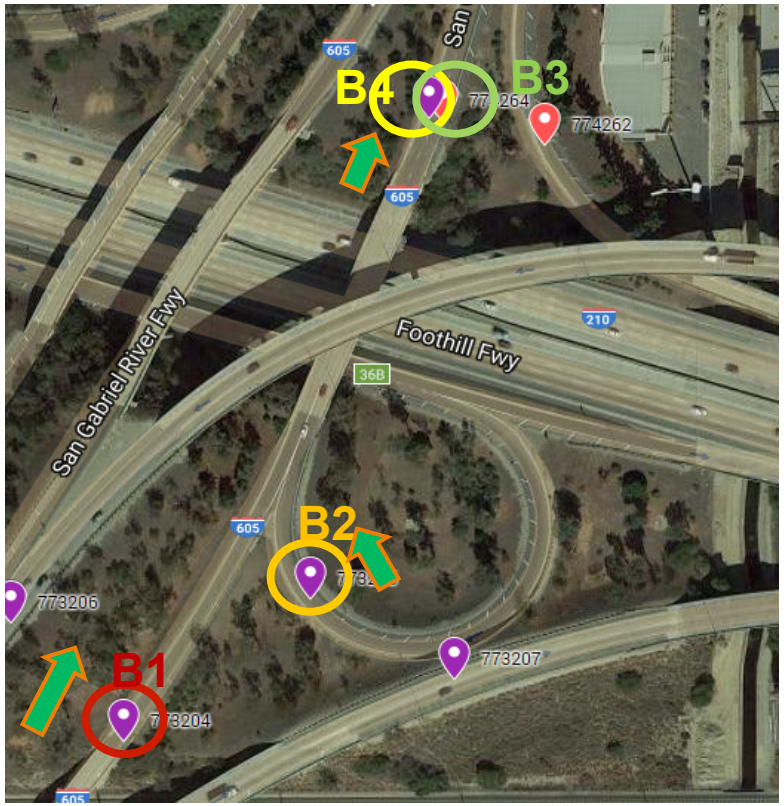
Data Collection for cities and county

- **Direct Non-Real Time Data Feeds**
  - Arcadia – Currently occurring
  - County, Monrovia, Duarte – Working with IEN to obtain data
  - Pasadena – Provided initial data for our review

VDS CONFIGURATION QUESTIONS

Update: June 7, 2017

Flow Balance Data Quality Checks



Detector Name

773204 = B1

Input

773205 = B2

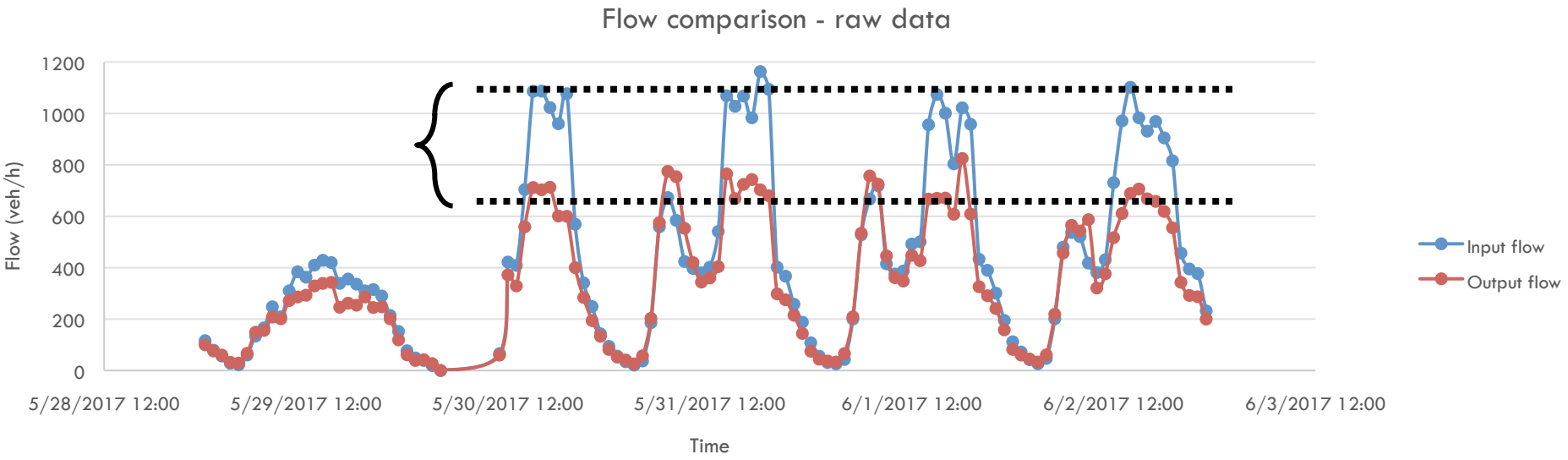
774264 = B3

Output

774261 = B4

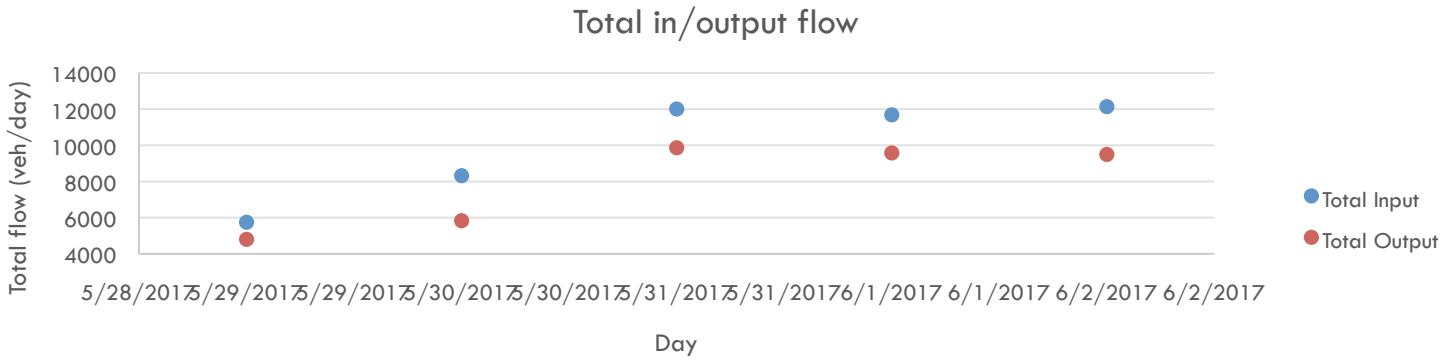
Issue: Check if Flow(B1) + Flow(B2) = Flow(B3) + Flow(B4)

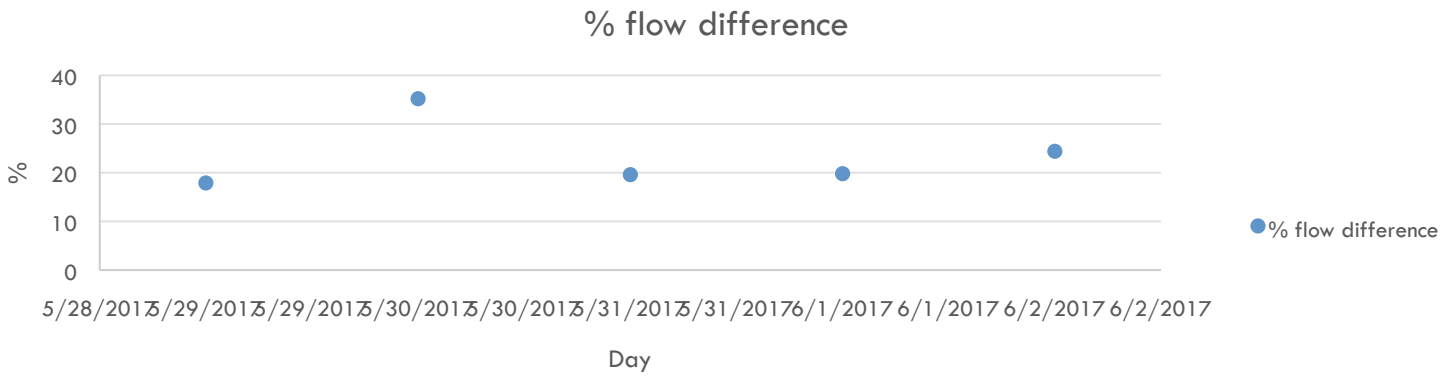
Big differences between in/out



Average afternoon mismatch is about 400 vph!

≈ 23.4 % difference over entire day





Corridor Model update

Response Plan Development Schedule

- **May:** Modeling of incidents to be used as showcases / testing of driver response to incidents/ Start of development of response plans
- **June 12 – 2nd Response Plan Review:** Review of developed response plans and simulated traffic behavior for two test incidents under 80% calibrated model
- **June-July:** Modifications to the model and incident modeling based on outcome of June 12 review
- **August – 3rd Response Plan Review:** Review of response plans for expanded set of incidents under calibrated model
- **September and forward:** Response plans for remainder of corridor are generated, modeled, and approved

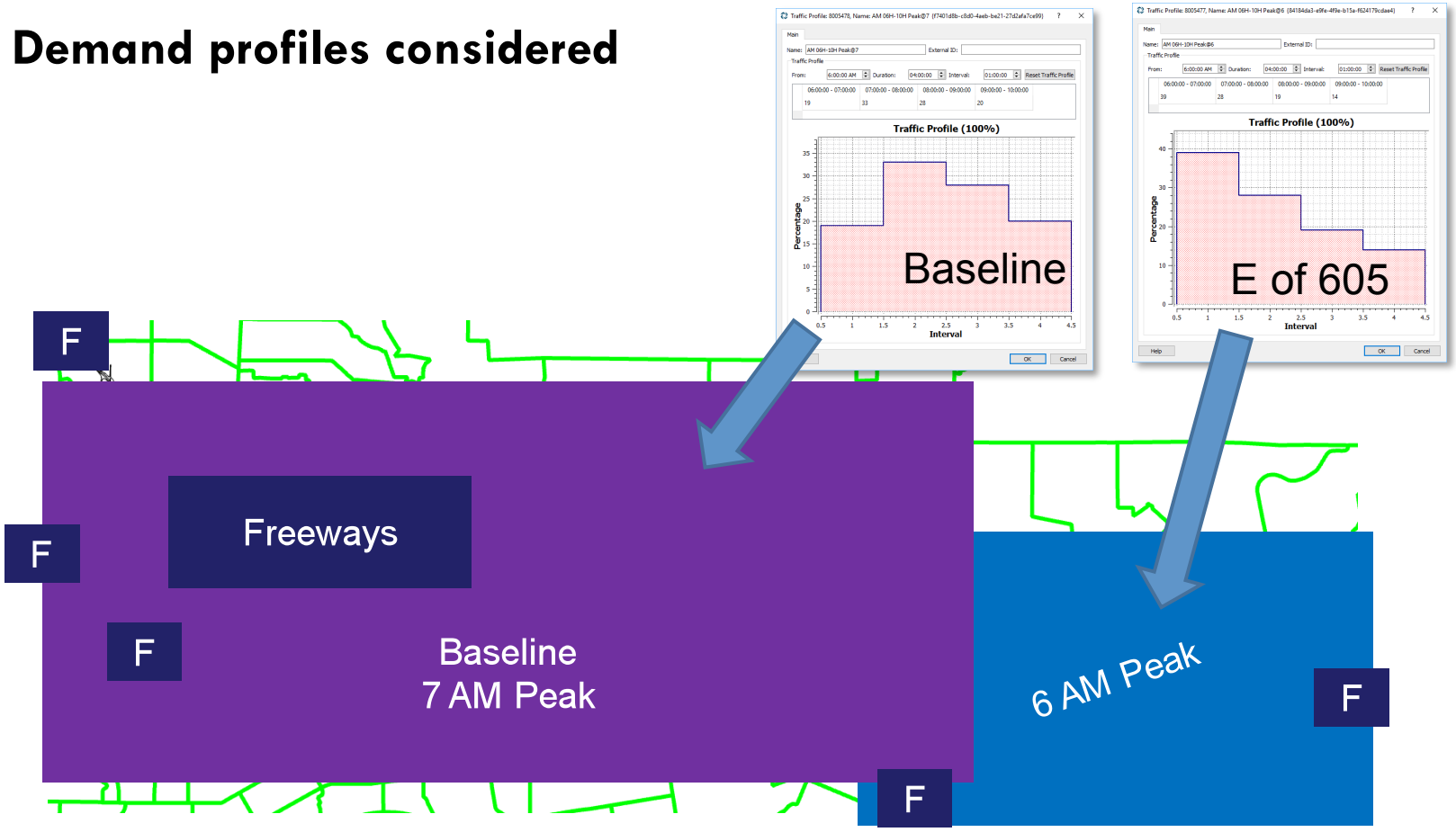
Simulation Model – Current Status

- **Completed elements**
  - Road geometry
  - Traffic control elements
    - Traffic signals operations
    - Ramp metering control
    - Truck restrictions
    - School zones
  - Transit elements
    - All bus routes and stops
  - Traffic demand
    - General vehicle behavior
    - Travel cost formulas
    - AM/PM Origin-destination flows
  - Decision-support elements
    - Coding of approved detours

- **Elements being refined**
  - Traffic demand
    - Flow profiles for AM peak (4 hrs) and PM Peak (8 hrs) periods
  - Incident modeling
    - Modeling of select major incidents that have occurred in the past year
  - Driver behavior
    - Lane-changing parameters at known bottleneck locations
    - Trip costs
    - Vehicle route choice behavior
  - Decision-support elements
    - Coding of changeable sign locations
    - Identification of signal control response strategies
    - Expanded ramp metering API to enable control overrides

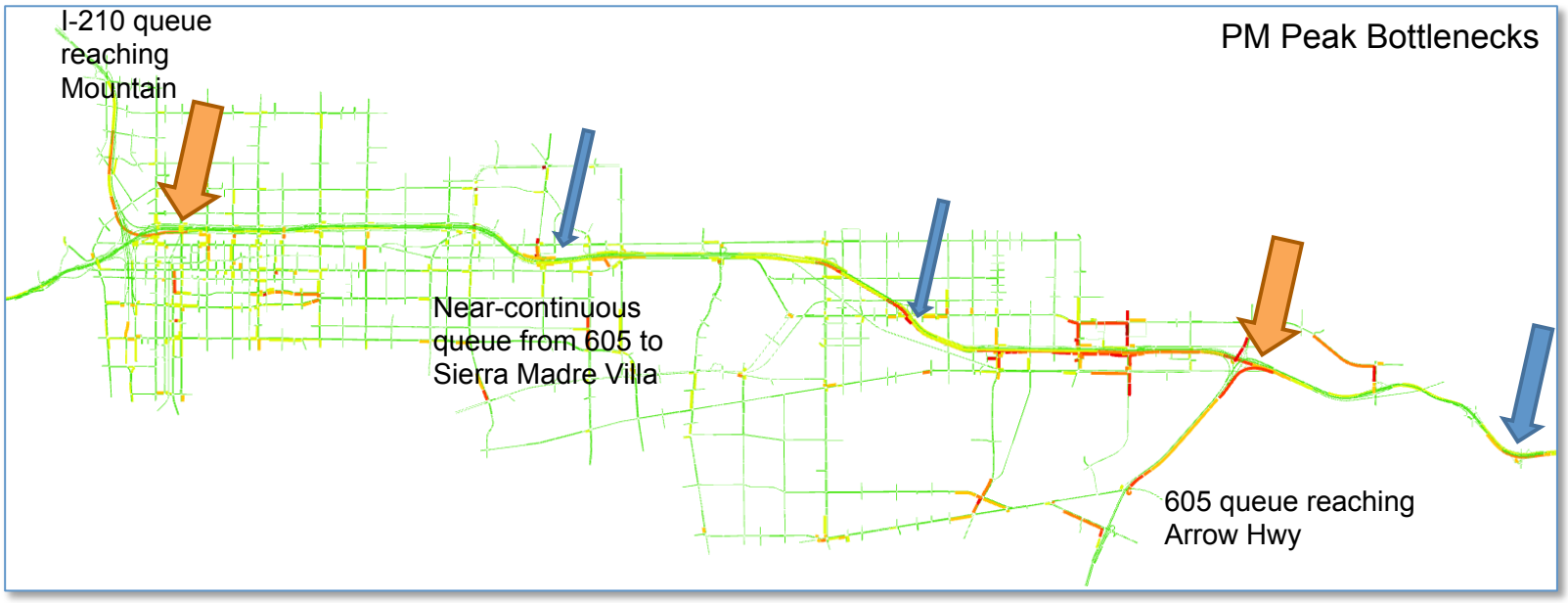
Simulation Model – Recent Activities

- **Demand profiles considered**



Simulation Model – Recent Activities

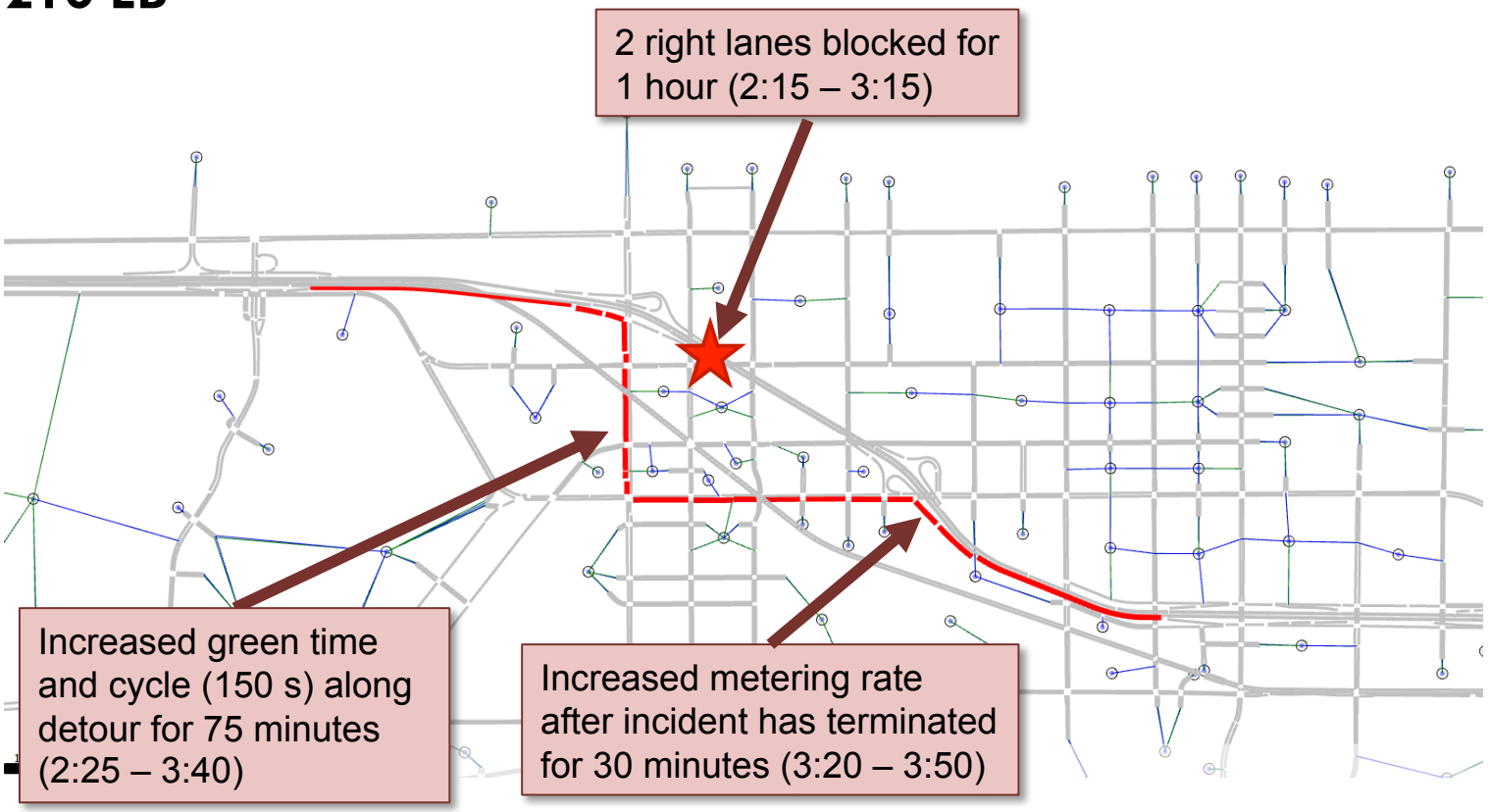
- **Calibration of freeway flows (mainline/ramps) and bottlenecks almost complete for both AM and PM peak periods**



- **Adjustments to arterial demands**

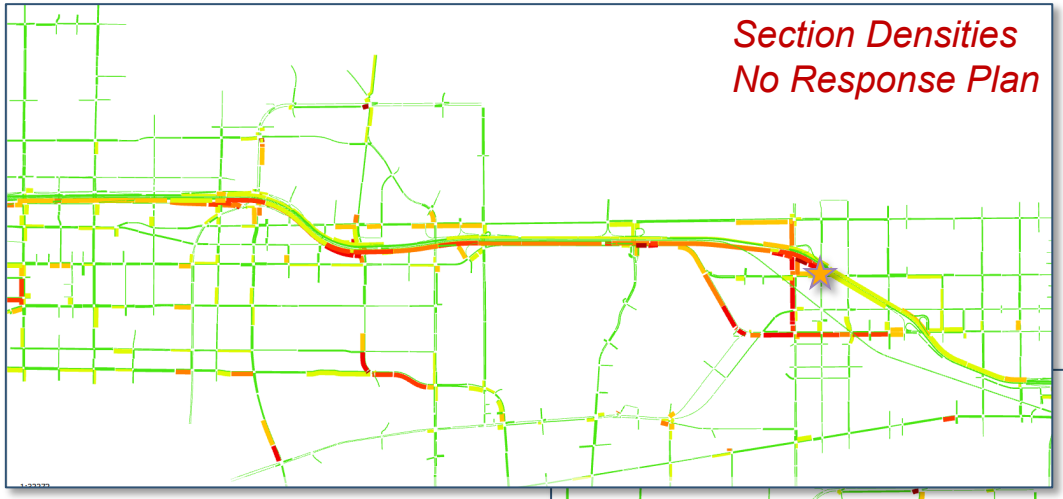
Incident/Response Plan Modeling

- **Incident 1 – Incident closing 2 lanes for 1 hour at Santa Anita on I-210 EB**

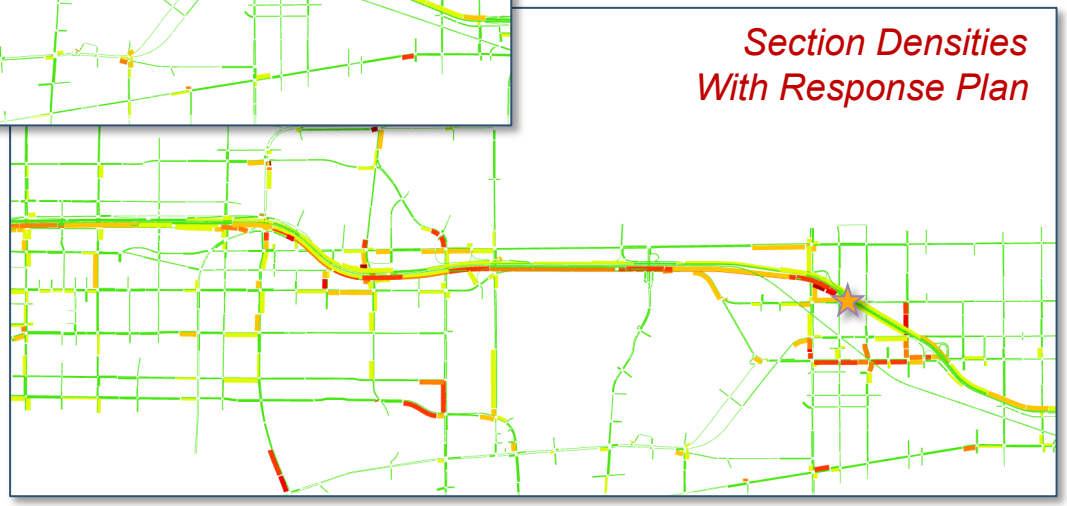


Incident/Response Plan Modeling

- **Incident 1 – Simulated impacts of proposed response plan**

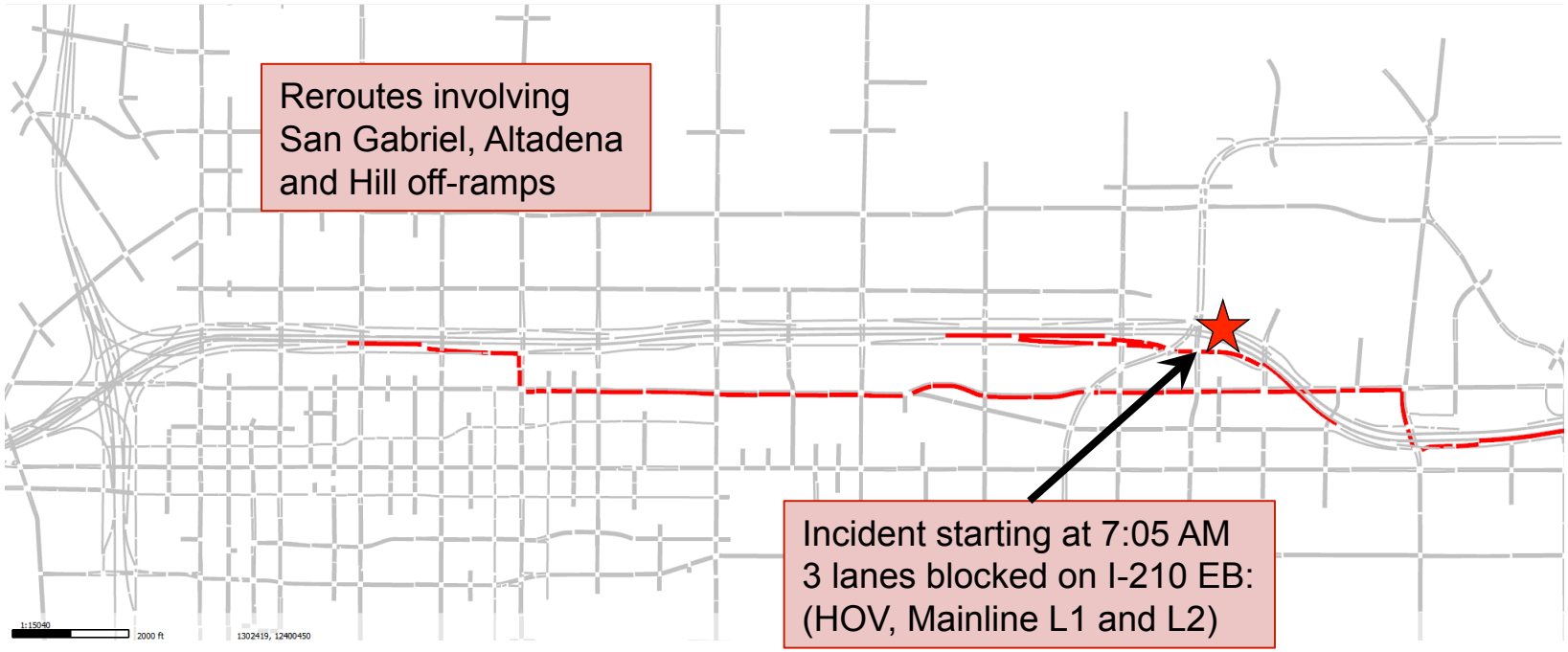


- Shorter congestion on freeway
- Reduced congestion on arterials
- 200 veh/hr flow increase along detour
- 840 veh-hr delay reduction



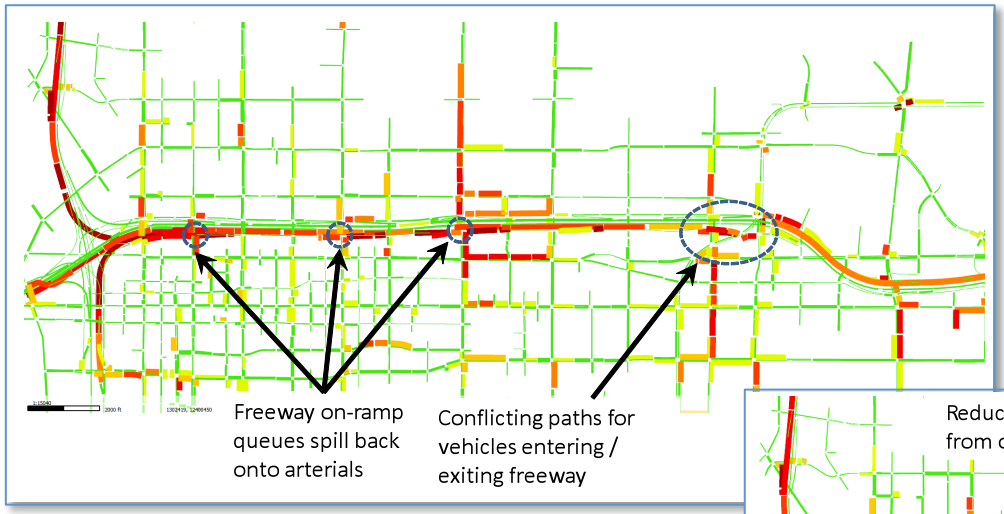
Incident/Response Plan Modeling

- **Incident 2 – Big rig crash closing 2 lanes on I-210 EB at San Gabriel**

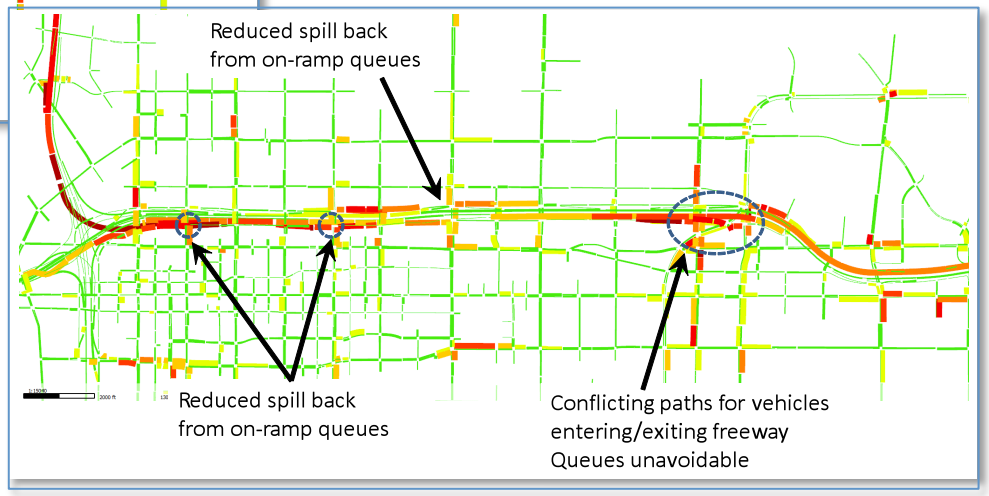


Incident/Response Plan Modeling

- **Incident 2 – Simulated impacts of proposed response plan**



- Shorter congestion on freeway
- Reduced congestion on arterials
- 200 veh/hr flow increase along detour
- 140 veh-hr delay reduction



Incident/Response Plan Modeling

- **Simulation observations:**
  - Ramp metering
    - Existing LMR algorithm may provide adequate response during incidents
    - Increase in metering rate downstream of incident location needed after end of incident to help clear local arterials
  - "Detour stealing"
    - Traffic using alternate routes may join a detour midway → Negative impact on effectiveness of detour
  - Number of detours
    - Unclear how much benefits can be obtained from using multiple detours, particularly if the various detours considered are closed

Incident/Response Plan Modeling

- **Approved types of signal timing changes**
  - Signal cycle
    - 150s would generally be OK
    - 180s may be allowed in Pasadena for very short periods / would be OK in Arcadia
  - Left-turn changes
    - Protected left may be reduced in duration, but not eliminated
    - Permitted/protected lefts may be changed to protected left
  - Phase sequence
    - Lead/lag changes in left-turn sequence allowed
    - Dual left-turn phasing allowed by Arcadia

Thank You
and
Next Meeting