Connected Corridors
Face-to-Face Meeting

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

1. Project Management
   10/1/13 - 6/30/20

2. Outreach & Communications
   10/1/13 - 6/30/20

3. Concept Exploration / User Needs
   11/1/13 - 12/26/14

4. Corridor Preparation
   12/2/13 - 9/28/18

5a. AMS - Phase 1
    1/6/14 - 5/29/15

6a. SEMP
    1/15/15 - 6/30/15

5b. AMS - Phase 2
    6/1/15 - 9/28/18

6b. SEMP Updates
    7/2/15 - 6/30/16

5c. AMS - Phase 3
    10/1/18 - 6/30/20

7. ConOps
   9/12/14 - 5/20/15

8a. System Requirements
    4/23/15 - 7/29/16

8b. Validation & Verification Plans
    8/1/16 - 8/31/17

8c. SEMP Updates
    7/2/15 - 6/30/16

9. Organizational Design
   9/1/15 - 12/30/16

10. Technical Design
    7/1/16 - 8/31/17

11. Component Development
    8/15/16 - 6/30/18

12. System Integration
    10/3/17 - 9/28/18

13a. Institutional Design
    1/2/17 - 9/28/18

13b. Institutional Operations
    1/2/17 - 9/28/18

13c. Institutional Operations
    10/1/18 - 6/30/20

14. System Deployment
    7/2/18 - 4/1/19

15. Training
    7/2/18 - 4/30/19

16. Validation & Acceptance
    7/2/18 - 6/28/19

18a. Pre-Deployment Evaluation
    9/1/17 - 9/30/18

18b. Post-Deployment Evaluation
    10/1/18 - 6/30/20

19. Migration to Production
    1/1/19 - 6/30/20

19. Lessons Learned
    1/1/20 - 6/30/20

Launch Oct 1st 2018)
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

System Integration

- Data Quality - All
- Modeling Estimation
- Modeling - Prediction
- COTS - Parsons
- COTS - Kapsch
- COTS - Telegra
- Lane Closure FW
- Lane Closure - Arterial
- Signal Control - TSMSS
- Signal Control - Transcore
- Signal Control - McCain
- Signal Control - KH
- LA County F2C Comm
- Network C2C Comm
- Cloud Architecture
- Video
- PEMS
- 511
- MOU

210 TMS Upgrade
- DSS
- Rules
- Rules Engine
- Data Hub
- ATMS - CMS Signs
- ATMS - Ramps
- ATMS - Loops
- TMDD Interfaces
- Call - Foothill
- Call - Pasadena Transit
- Call - Air Quality
- Call - Arterial Detection
- Call - Signs
- Call - Sign Control
- Call - Blue Tooth
- Call - Cabinet/Controller
- Call - F2C Comm
- Personnel KSA and Org
- Outreach
Integration - Subcontractors

- Transcore
- Amazon
- McCain
- TSS
- Iteris
- SMG
- Emergent
- Parsons
- Kapsch
- Telegra
- AT&T (RIITS)
- Kimley-Horn
- ATMS Vendor
- Cambridge
Technical Design
Design

All Requirements

Hardware and Software
- Technical Design
- Service Level Agreements

Individual and Group
- Technical Requirements
- Organizational Design
- MOUs

Operational Roles and Responsibilities

Technical Design

Operational Roles and Responsibilities

Service Level Agreements

MOUs
Connected Corridors: I-210 Pilot
Integrated Corridor Management System

Core System High-Level Design

June 9, 2017
### Requirements Mapped to Subsystems

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
<th>Subsystem</th>
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<tbody>
<tr>
<td>RP-3.23</td>
<td>The ICM Core System shall include a function to develop multiple potential response plans in response to a given incident or event.</td>
<td>Decision Support</td>
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<tr>
<td>RP-3.23.1</td>
<td>The ICM Core System shall be able to develop multiple response plans as a response to an incident or event.</td>
<td>DSS</td>
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<tr>
<td>RP-3.25</td>
<td>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.</td>
<td>Corridor Management</td>
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<td>RP-3.25.1</td>
<td>Following the development of a response plan, the ICM Core System shall disseminate the following information to transit field supervisors:</td>
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<td>• Location of incident</td>
<td>CMS</td>
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<td>• Time incident occurred</td>
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<td>• Expected duration of incident</td>
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<td>• Agency responsible for managing the incident</td>
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<td></td>
<td>• Recommended detour(s) for the passenger cars</td>
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<tr>
<td></td>
<td>• Recommended detour(s) for buses</td>
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<td></td>
<td>• Messages to be passed along regarding the incident or detour</td>
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<tr>
<td>RP-3.25.2</td>
<td>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.</td>
<td>CMS</td>
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<td>RP-3.25.3</td>
<td>Transit field supervisors shall use information from the response actions to make potential transit service adjustments.</td>
<td>Institutional Job Tasks</td>
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<td>RP-3.26</td>
<td>The ICM Core System shall evaluate all developed valid response plans.</td>
<td>Decision Support</td>
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<td>RP-3.26.1</td>
<td>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.</td>
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<tr>
<td>RP-3.26.2</td>
<td>The ICM Core System shall evaluate all response plans developed by Decision Support.</td>
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## Gantt Chart – 1 of 3

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<tr>
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<th>Task Name</th>
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<th>Q3</th>
<th>Q4</th>
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</tbody>
</table>

Gantt Chart – 3 of 3
Job Descriptions and Duties/Tasks

- 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

<table>
<thead>
<tr>
<th>Caltrans shall be responsible for operating and maintaining the ICM Core Software and Hardware System:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Security</td>
</tr>
<tr>
<td>• Maintenance</td>
</tr>
<tr>
<td>• Working with stakeholders to implement upgrades</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Knowledge of the basic principles of Caltrans’ System Management philosophy and integrated corridor management concepts and strategies (K4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broad knowledge of evolving real-time transportation information systems (K7)</td>
</tr>
<tr>
<td>Knowledge of electrical systems, as applied to automated traffic surveillance and control (K8)</td>
</tr>
<tr>
<td>Knowledge and experience in the field of computer networking and electronic communications (K9)</td>
</tr>
<tr>
<td>Knowledge of Caltrans’ organization, department policies and financial constraints and procedures (K10)</td>
</tr>
<tr>
<td>Knowledge of communications network design as it relates to ITS infrastructure (K14)</td>
</tr>
<tr>
<td>Knowledge of systems and applications used to monitor and analyze transportation data (K18)</td>
</tr>
<tr>
<td>Basic knowledge of personal computer usage and its applications (K21)</td>
</tr>
<tr>
<td>Knowledge of stakeholder agencies’ processes and systems (K28)</td>
</tr>
<tr>
<td>Advanced outreach and communications knowledge (KP2)</td>
</tr>
<tr>
<td>Knowledge of corridor ITS software (KP6)</td>
</tr>
<tr>
<td>Knowledge of corridor ITS hardware (KP7)</td>
</tr>
<tr>
<td>Knowledge of industry-standard system security best practices, including tools, functions, processes, protocols (KP21)</td>
</tr>
</tbody>
</table>
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

- District 7 LARTMC
- Pasadena TMC
- Arcadia TMC
- District Office
- San Gabriel Hub
- LACO TMC
- RIITS
- ATSAC

Connected Corridors

County Fiber
RIITS Fiber

Video
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

- Caltrans HQ
- Wowza
- ATMS
- TSMSS
- TMC Terminals
- Caltrans FireWall
- Net Bond
- VPN
- RIITS Router and End Point

Logos of various organizations are also present on the diagram.
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

CCTV Video Distribution Concept Drawing
I-210 Connected Corridors

[Diagram of network distribution involving CCTV servers, cloud services (AWS, MS Azure, RIITS), and connected corridors in Pasadena and Arcadia.]
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
I-210 ICM IT Infrastructure Working Group kickoff

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

I-210 ICM IT Infrastructure Working Group kickoff

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
DSS – Design Detail

[Diagram of decision support system with various components and processes, including data hub, modeling controller, estimation, prediction, and decision making pathways.]

Note: Flows assume confirmed incident will require a response.
Data Quality and Estimation
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
773205 = B2
774264 = B3
774261 = B4

Issue: Check if Flow(B1) + Flow(B2) = Flow(B3) + Flow(B4)
Big differences between in/out

Flow comparison - raw data

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
Demand profiles considered

Simulation Model – Recent Activities
Simulation Model – Recent Activities

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

  - PM Peak Bottlenecks
  - I-210 queue reaching Mountain
  - Near-continuous queue from 605 to Sierra Madre Villa
  - 605 queue reaching Arrow Hwy

- Adjustments to arterial demands
Incident/Response Plan Modeling

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

  - 2 right lanes blocked for 1 hour (2:15 – 3:15)
  - Increased green time and cycle (150 s) along detour for 75 minutes (2:25 – 3:40)
  - Increased metering rate after incident has terminated for 30 minutes (3:20 – 3:50)
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 starting at 7:05 AM
3 lanes blocked on I-210 EB: (HOV, Mainline L1 and L2)

Reroutes involving San Gabriel, Altadena and Hill off-ramps
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