Connected Corridors
Face-to-Face Meeting

Tuesday, Jan 31st, 2017 – 1:30 – 3:30 pm
Caltrans D7 HQ
New Faces at Caltrans HQ

- **HQ**
  - Amarjeet Benipal – Acting Division Chief for Traffic Ops
  - Robert Peterson – Acting Assistant Division Chief for the Traffic Ops Operations Program

- **D7**
  - Sarah Horn – New Corridor Manager – Corridors TRB
  - Richard Hung – System Modeling, Data Collection and Analysis
Agenda

- Introductions
- Schedule Review
- Outreach
- Data Quality and Estimation
- Corridor Model Update
- High Level Design and Implementation
- Call for Projects Update
- 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
Transitioning

- We are transitioning to a phase where we will be more involved again with the stakeholders
  - Model Reviews
  - Response Plan Generation
  - Call for Projects Installation details
  - Data Quality
  - Demonstrations of functionality
  - Software Installations
  - Communications upgrades
  - Memorandum of Understanding
  - Roles and Responsibilities
  - Outreach, demonstrations and presentations

- We are moving from design to doing
Schedule Update
## Schedule

<table>
<thead>
<tr>
<th>Project</th>
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<th>End Date</th>
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<tbody>
<tr>
<td>1. Project Management</td>
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<td>2. Outreach &amp; Communications</td>
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<td>3. Concept Exploration &amp; User Needs</td>
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<td>19. Lessons Learned</td>
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Outreach and Communications
Outreach

- **Project Charter Amendment**
  - Awaiting signature from Duarte

- **Winter Connected Newsletter distributed**

- **Connected Corridors and the I-210 at TRB**

- **Connected Corridors Program at Berkeley selected by USDOT as an Innovation Center**

- **CC Statewide Rollout website – continuing to add content**
How to Manage an Incident: Response Plans

A package is thrown from a car on the 1-210 corridor in La County by a man near the Gold Line transit tracks. It could be a bomb or worse. The authorities shut down the 1-210 and the Gold Line transit service, bringing transportation to a standstill at 6 a.m. on Monday, December 17, 2012. Unfortunately, the Connected Corridors program had not been launched, and there was no way to offer a clearly defined traffic management response plan to be put in place that would allow several people in the vicinity of the scene and reduce the chaos that resulted in city systems.

Understanding how the 1-210 corridor can be effectively supported to various traffic incidents is what the Connected Corridors program is all about. Over two years ago, the stakeholders began focusing on designing corridor-wide response plans for incidents such as those what should a response plan do? What ITS infrastructure is needed to implement the response plan? How do we decide if real-time response plan to meet what a corridor can be seen? And how do we make in the definition of response plan? What's the definition of a response plan? The definition of a response plan was the identification of multiple supply points and alternate routes within the corridor. This list went through several iterations of the number of options and match them to available ITS elements. The list is now up to approximately 20 alternate routes for both the east and west directions. The 2010 draft for project funding approved by Metro and Caltrans for project funding was being used to purchase and install traffic signals, traffic sensors, and the necessary changeable message signs needed to guide travelers along the designated alternate route.

A response plan is not limited to a traffic control signal and managing light timing changes, equipment and personnel requests, and communication plans could also be deployed as a part of a response plan. Stakeholders are currently developing all these response plans components and when and where they will be used. Rules are being developed to the form of if an event occurs at location X, do Y and notify Z. These rules will be processed by a rule engine, which will evaluate many rules and determine the best response plan.

The rule engine must support a complete set of conditions to account for the complexity of incidents, considering factors such as time of day, day of the week, expected duration, location of the incident, and possible issues with alternate routes such as an active school zone. A response plan can also be scaled depending on the severity and length of the incident, for example, if two lanes of the freeway are expected to be closed for one hour, that would warrant a different response plan than if the two lanes were expected to be closed for ten hours or if the lanes were to occur at an intersection.

Continued on page 2
ITS California

- Would like to partner with stakeholders on presentations and demonstration

- Submitting 5 abstracts
  - I-210 Update (and statewide rollout?)
  - Detailed Roles and Responsibilities for ICM
  - Operational Data Hub with new technologies
  - Use of the cloud for operations management
  - Modeling and estimation
  - Your ideas?

- Requesting a demonstration of the data and modeling flow
  - Data Quality
  - Estimation for the corridor
  - I-210 Model running a scenario
Data Quality and Estimation
sensor availability

- Serious problems resulting in temporary loss of data
- Most configuration changes for basic corridor are now completed
- There are now fwy-fwy loops registered on Westbound I-210 PM 22.6 to PM 25 and on Eastbound SR-134 PM 11.4 to PM 13.5.
# Sensor Availability Report

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### Arcadia

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<td>31.35</td>
<td>5.79</td>
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- Now that we are receiving County, Monrovia and Duarte data we should be able to start looking at the quality of that data also
- Looking forward to Pasadena data
Estimation

- As a reminder data quality ultimately is used to:
  - Indicate where data is missing
  - Indicate bad data for removal

- **Estimation fills in:**
  - Where there are no sensors
  - Where the data is missing
  - Where the data was bad

- **Progress on Estimation**
  - Expanding arterial estimation to entire corridor
  - Work reviewed by TSS
  - Simplifying freeway estimation
Next Steps: City Data Quality Review and Estimation Reviews

- **March**: Stakeholders review model in detail
- **April**: Modifications are made as needed
- **April**: Stakeholders review model and accept
- **May**: Response plan development begins
- **June**: First detailed response plans including signal timing are modeled and reviewed with stakeholders
- **July**: Modifications are made
- **July**: First approved response plan is completed
- **August and forward**: Response plans for remainder of corridor are generated, modeled and approved
Corridor Model update
Outline for Aimsun model discussion

- **Road geometry**
- **Traffic control elements**
  - School zones
  - Conflicting flows at intersections
- **Driver behavior**
  - Secondary stop lines at intersections
  - Forced turns
- **Trip cost calculations**
  - Travel costs formulas

- **Demand modeling**
  - Origin-destination matrix adjustments based on traffic counts
  - Manual flow adjustment

- **Model Calibration**

- **Next Steps**
Geometrical Elements

- Addition of U-turns where permitted
Traffic Control Elements

- Mapping of schools affecting traffic operations
- Coding of school zone speed limits
  - Forced speed reduction to 25 mph by all vehicles
  - Active from 10 min before bell to 30 min after bell
  - Coding of regular bell schedule only – Too much variability with alternative schedules (short days, etc.)
- **Conflicting flows at intersections**
  - Identification of conflicting volumes for permitted left turns and right turn on red at signalized and 2-way stop intersections
  - Information used by Aimsun to calculate conflicting traffic volumes for each movement
  - Conflicting volume information input to user-defined formulas to estimate travel cost associated with gap-seeking movements
Driver Behavior

- **Secondary intersection stop lines**
  - Coding of “in-intersection” stop lines to replicate vehicles pulling into the intersection waiting for a gap in opposing traffic
Trip Cost Calculations

- **Updates to formulas used to calculate travel costs during a simulation**
  - Dynamic cost function per vehicle type (DCFVT) — Travel costs during simulation based on current travel time
  - Initial dynamic cost function per vehicle type (ICFVT) — Travel costs at start of simulation based on free-flow conditions

- **Updates to formulas used to calculate travel costs during static traffic assignments**
  - Volume-density functions (VDF) — Travel time along roadway segment based on volume-to-capacity ratio
  - Junction delay functions (JDF) — Additional 0.10 to 2.00 min of perceived travel time to factor difficulty of seeking gap against opposing flow
  - Turn penalty functions (TPF) — Additional 0.375 to 1.25 min of perceived travel time (higher values for trucks) to account signs and signals along path
Demand Modeling

- Development of base origin-destination matrices from SCAG data
  - Obtained 2016 estimated trip pattern for corridor from SCAG
  - Used the SCAG data to developed O-D matrices matching the specific origin-destination layout of the Aimsun model
  - Matrices developed for:
    - Cars
    - HOV
    - Medium trucks
    - Heavy trucks
Demand Modeling

- **Matrix adjustment to reflect observed traffic data**
  - Developed a multi-step process to “adjust” the base O-D matrices derived from SCAG data into matrices better reflecting observed traffic counts

- **Reference data**
  - Traffic counts from continuous traffic monitoring systems
  - Intersection turning counts
  - Traffic counts from traffic impact studies

- **Current focus has been on adjusting matrices for passenger cars**
Demand Modeling

- **Manual adjustment to developed origin-destination matrices**
  - Automated process used by Aimsun to adjust O-D matrices to observed traffic data can lead to too much/too little flow associated to specific ODs
  - Example: *Do we really have 750 vehicles per hour going to the Double Tree in Monrovia?*
  - Manual corrections are made where necessary to ensure realistic traffic patterns
Model Calibration

- **Simulation runs with modeled demands have been executed to ensure no unusual problems affect the simulation**
  - 2-hour test runs
  - Tests for both AM and PM peak periods
  - Constant traffic demand within each period

High density sections – 8:30 AM (1.5 hour within simulation)
Next Steps

- **Updates to traffic signal control elements**
  - Available timing sheets used to model corridor reflect existing situation at end of 2015 / early 2016
  - Evidence of some signal operational changes on Google Street View
    - Example: new protected left turn at California @ Pasadena

- **Development of typical traffic demand profiles**
  - AM peak
  - Midday
  - PM peak

- **Adjustments of driver behavior and O-D trips to ensure adequate replication of**
  - HOV movements on freeway
  - Bottlenecks on freeways
  - Congestion on arterial segments
Next Steps: Generation and Acceptance of Model and Response Plans

- March: Stakeholders review model in detail
- April: Modifications are made as needed
- April: Stakeholders review model and accept
- May: Response plan development begins
- June: First detailed response plans including signal timing are modeled and reviewed with stakeholders
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High Level Design
High Level Design

All Requirements

Hardware and Software
- Technical Design
- Technical Requirements
- Service Level Agreements

Individual and Group
- Organizational Design
- Operational Roles and Responsibilities
- MOUs
Architecture - Systems within and connecting to the Amazon Cloud (Not network arch)
Major Components Within the Cloud
## Subcomponents - Software

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## Subcomponents - Other

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Highest Risks

- **Metro Call for Projects — (High Priority, High Risk)**
  - Starting later than expected
  - Procurement approach being developed
  - Many components are part of this call

- **Inclusion of COTS Corridor Management systems (High Priority, High Risk)**
  - Plan to release request for participation in pilot
  - Uncertain of number of responses
  - Need to refine final purchase plans

- **C2C Connections — (High Priority, High Risk)**
  - Unexpected change, involves 3 systems and 4 (6) organizations
  - Unclear if C2C exists for all systems
Call for Projects
Update
Call for Projects Update

- The draft Funding Agreement and attachments have been submitted and reviewed by Metro
- There are a few remaining comments that need to be addressed
- Then the agreement will be sent to Metro and CT legal for review.

- Procurement Plan:
  - Status of using a Service Contract to deliver the project
  - Awaiting word from DPAC
I-210 East Reroutes
I-210 West Reroutes
Progress
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
• TMS/TCS Operators
• Transit Field Supervisors
• Public Information Officers
• First Responders
• Outreach and Communications Manager
Job Roles and Responsibilities

- Caltrans has completed assigning roles/personnel to the job roles and responsibilities

Next steps
- Review Caltrans’ assignments
- Implementation and training plan
- Transition plan for PATH roles to Caltrans
Data Hub and DSS within the cloud
Internals of Amazon Cloud
Data Hub Streaming Progress
Heterogeneous Sources Progress

Prototype Path

- Intersection Signal Reader
- Mongo
- Intersection Signal Processor
- ActiveMQ/Kafka
- Persistence Worker
- Postgres/PostGIS

Decision Support
Corridor Monitoring/Control
Proof Of Concept

- Continued engagement with possible corridor management system (purple box) partners
  - Met with Parsons
  - Met with Telegra
  - Met with Kapsch
  - All have indicated interest in working with us

- We are tailoring requirements based on feedback. Requirements requiring custom development will be minimized

- How to advertise POC
  - ITS American and ITS California
Proof of Concept Dates

- The anticipated schedule for the COTS pilot is:
  - February 17 – Release of this document
  - April 17 – Receive responses
  - May 17 – Choose vendors
  - July 17 – Complete agreements
  - August 17 – Begin integration planning
  - Sept 17 – Begin integration
  - Oct 18 – Launch with first vendor
  - Jan 19 – Launch with next vendor
  - April 19 – Launch with next vendor

- The anticipated schedule for Caltrans procurement is:
  - April 18 – Begin internal procurement process
  - Oct 19 – Procurement RFP Released
  - March 20 – Vendor Chosen
  - June 20 – Complete negotiations
  - Sept 20 – Install production software
  - Dec 20 – Complete pilot
I-210 SHOPP Construction Project Update

- Partnering meeting held on Jan 10th with all corridor stakeholders
- Construction progress, issues resolution and communication plan were discussed
- The project is on schedule to deliver Phase 1 (CC area) by end of 2017
- Next partnering meeting is scheduled for May
Items of Note

- Rules Engine – Going with Drools
- RIITS account setup and able to request data
- Iteris providing CC ITS Architecture for internal review
- Receiving data from Arcadia, County, Monrovia and Duarte from IEN. Awaiting Pasadena.
- Awaiting install of communication line from TMC to Amazon cloud
- Data hub design presented to Kapsch, Telegra, Parsons, Iteris and in summary to USDOT. Next to Irvine Consulting
RIITS Interface
RIITS Services — Basic info available

- Rail - Real Time Location (Text and Map)
- Travel Time — Travel time values between nodes (Text)
- Bus - Real Time Location — (Text and Map)
- Congestion - PEMS, LA Sensors (Text and Map)
- Ramp Meter - Basic Info (Text and Map)
- Cctv - Basic Info (Text and Map, but no video)
- Cms - Info — (Text and Map)
- Event - Info (Text and Map)
- Signal - Unable to access and not on map
Thank You and
Next Meeting