Connected Corridors
Face-to-Face Meeting

Tuesday, Oct 25th, 2016 – 1:30 – 3:30 pm
Caltrans D7 HQ
Agenda

- Introductions
- Schedule Update
- Outreach
- High Level Design
  - Software
  - Hardware
- (AMS) – Analysis, Modeling and Simulation
  - Modeling
  - Response Planning
- System Evaluation
- Action Items and Closing
Our Corridor: The I-210
Systems Engineering Next Steps

- Systems Requirements – What should the ICM system do
- Design Documents – How will the requirements be met
Schedule Update
Outreach and Communications
Received two minor comments (County and Metro)

Changes from the June 2015 Project Charter:

**THE CORE STAKEHOLDERS NOW DESIRE TO AMEND THE PROJECT CHARTER AS FOLLOWS:**

- The following Primary Contact Persons shall be updated as follows:
  - Caltrans District 7 – Samson Teshome
  - Metro Operations – Bruce Shelburne
  - SGVCOG – Phil Hawkey, Executive Director
  - SCAG – Naresh Amatya, Acting Director, Transportation Planning

- The Core Stakeholders will, in a timely manner, review and approve the I-210 Pilot System Requirements and the design documents.

- LACDPW, Pasadena, Arcadia, Monrovia, Duarte, and Foothill Transit are receiving infrastructure and/or software improvements as part of the LA Metro 2015 Call for Projects funding. These agencies agree that the improvements, while installed by CT D7 (the Project Sponsor), will be owned, operated, and maintained by LACDPW, Pasadena, Arcadia, Monrovia, Duarte, and Foothill Transit respectively. Separately, the agencies will work with CT D7 to execute an “Asset Transfer Agreement” or similar document that outlines the improvements in each jurisdiction.

- CT D7 agrees to 24 hours per day/7 days per week corridor/asset monitoring from the Los Angeles Regional Transportation Management Center (TMC) near Glendale, CA.

- **The Core Stakeholders agree to execute additional agreements for various aspects of the Project. Possible examples include an Operations and Maintenance Plan, a System Integration Plan, and a Memorandum of Understanding.**
Connected Newsletter

- Currently writing articles
- Distribution in November
CC Statewide Rollout

- PATH and CT HQ are working on the project
- The information will be presented via a website at CT – first on the CT intranet and then on the internet
- An outline has been prepared
- Working on the layout for the website
- Starting to add text (using some information from the CC website and the CCDocs website, as well as new text)
- Project will be complete by the first quarter of 2017 but hope to have a majority of the work done by December
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
System Engineering – Requirements

Connected Corridors: I-210 Pilot
Integrated Corridor Management System

System Requirements

October 13, 2016
Connected Corridors: I-210 Pilot
Integrated Corridor Management System

Validation Plan

September 12, 2018

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.
## Subcomponents - Schedule

<table>
<thead>
<tr>
<th>Subcomponent</th>
<th>2016</th>
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<th>2018</th>
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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

I-210 Pilot System Requirements:

Job Descriptions and Duties/Tasks
September 9, 2016
Job Descriptions and Duties/Tasks

• OVERVIEW and PROCESS
  • Three additional columns have been added: “Needed for Pilot,” “Filled By,” and for CT, “Who?”
  • The section referenced from the System Requirements is being added
  • Hope to have all additional information added by the end of October
  • Information has been added for the Corridor Manager, Corridor Technical Manager, and the Corridor Data Analyst for now
### 3.3. STRATEGIC INCIDENT/EVENT RESPONSE PLANNING

Strategic Response Planning means ensuring that response plans for incidents/events can be designed, developed, reviewed and tested.

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>Requirement Source</th>
<th>Needed for Pilot</th>
<th>Filled By</th>
<th>Who</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lead incident/event response planning.</td>
<td>9.3.1</td>
<td>✓</td>
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<td>C</td>
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<tr>
<td>2. Determine the percentage of time that appropriate Traffic Engineers are present for response planning sessions, work with stakeholders to resolve attendance issues.</td>
<td>8.3(1)</td>
<td>✓</td>
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<td>3. Determine and ensure rules exist.</td>
<td></td>
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<tr>
<td>a. Determine and ensure rules exist for incident detection.</td>
<td>8.3(2)</td>
<td>✓</td>
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<td>C</td>
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<tr>
<td>b. Determine and ensure rules exist for incident severity.</td>
<td>8.3(5)</td>
<td>✓</td>
<td></td>
<td>C</td>
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<tr>
<td>c. Determine and ensure rules exist for zone of influence.</td>
<td>8.3(4)</td>
<td>✓</td>
<td></td>
<td>C</td>
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<td>d. Determine and ensure rules exist for special situations.</td>
<td>8.3(7)</td>
<td>✓</td>
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<td>e. Determine and ensure rules exist for building response plans from components.</td>
<td>8.3(8)</td>
<td>✓</td>
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<tr>
<td>f. Determine and ensure rules exist for selecting a response plan for implementation.</td>
<td>8.3(9)</td>
<td>✓</td>
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<tr>
<td>g. Determine and ensure rules exist for sending response plan instructions to corridor areas.</td>
<td>8.3(10)</td>
<td>✓</td>
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<tr>
<td>4. Ensure that stakeholders have identified and defined all response plan components needed to manage incidents and events; determine, with Traffic Engineers, the percentage of required response plan components that are defined and listed.</td>
<td>8.3(5)</td>
<td>✓</td>
<td></td>
<td>P</td>
</tr>
<tr>
<td>5. In consultation with all relevant stakeholders, determine the information to be sent to 911 services, HAR stations, and third-party providers as part of response plans.</td>
<td>9.3.2</td>
<td>✓</td>
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<tr>
<td>6. Post-incident/Event Review:</td>
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<tr>
<td>a. Ensure that reports summarizing the results of the incident response plan and its effects on corridor performance are generated after each incident or event in the corridor for which a response plan was generated.</td>
<td>8.3(13)</td>
<td>✓</td>
<td></td>
<td>C</td>
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<tr>
<td>b. Conduct a post-incident analysis review with all affected agencies within one week of each significant event.</td>
<td>9.3.3</td>
<td>✓</td>
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<td>c. After each incident, unscheduled event, or planned event, in coordination with Traffic Engineers and other agencies.</td>
<td>8.3(2)</td>
<td>✓</td>
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Overall Themes

When thinking about the roles and the duties, CT has responsibilities and PATH has responsibilities for the Pilot (which will extend at least one year past the actual “launch”)

- **Caltrans**
  - Leadership
  - Day-to-day response plan and incident management work
  - Hardware and communication system maintenance
  - Outreach (shared with PATH)
  - Performance monitoring
  - Data quality reporting

- **PATH**
  - Identifying software and data system problems
  - Software and data system maintenance
  - Overall system integration measurements & efforts
  - Update/refine the system based on new reqmts.
  - Model management tasks related to estimation and prediction
  - Outreach (shared with CT)
Job Descriptions and Duties/Tasks, continued

- **Timeline:**

  - Complete new columns and links to the System Requirements for all roles
  - Finalize Job Descriptions and Duties/Tasks document
  - High-Level Design: Reconfigure roles and tasks based on CT D7 roles and tasks
Education and Training

- Gathering information from Caltrans (IT/HQ Ops/D7), University and various consulting partners

- **Seeking top 10-15 classes that would provide essential skills in:**
  - Data Analysis
  - Modeling
  - Cloud Computing
  - Software Engineering
  - Collaboration and Outreach

- Also speaking with University about new Undergraduate and Masters programs

- Provided with contacts at NIT
## High Level Implementation Schedule

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Software
Updates

- **Requirements being broken apart into technical components**
  - Detailed review
  - Sequence diagrams
  - Definition of exactly what goes in each box
  - Preparation for Proof of Concept

- **Engagement with Caltrans IT**
  - POC – Mike Nguyen
  - Meeting on 9/16/16 with IT Managers to review CC Architecture
  - Very successful meeting

- **Engagement with possible “purple box” vendors**
  - Telegra and Kapsich meetings planned for November
  - Plan to setup meeting with Parsons for November or December
### Software

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Current Proposed ICM Architecture
Caltrans IT discussions – Productive meetings

- Review of System Architecture and current modeling architecture
- Will work with Caltrans and AWS to address CT-IT training needs
- Began acquiring connections to Caltrans data sources beyond PeMS
- Discussions regarding Security (Design, Policy, Practice)
  - AWS AMIs
  - Network
  - OS
  - Data (in transit and at rest)
  - Application
  - Authentication/Authorization
  - Policy
Data Hub

- **Resources acquisition underway**
  - Personnel
  - Consultants

- **Design**
  - Design underway
  - Beginning prototyping to confirm use of MongoDB for heterogeneous data sources
  - Loading IEN data
Modeling Subsystem

- **Freeway Estimation running 24 hrs/day in test cloud environment**

- **Working with TSS – Aimsun now able to run in cloud environment**
  - Working now to integrate it with other modeling components and set up automated scaling

- **Arterial Estimation technique being developed by research team**
  - Basic approach completed
  - Working on additional needs to pass estimation results to prediction (Aimsun)
Caltrans Systems

- **TSMSS**
  - Plan to have interface by end of year
  - CC access to TSMSS through IEN – Requested to be added to IEN functions

- **Lane Closure System**
  - Proof of Concept to be setup in corridor (Validate)

- **PEMS**
  - Decision made to use PEMS
  - Corridor PEMS will be expanded to the I-210
  - Must determine level of integration of Corridor PEMS with COTS interface
LA County – IEN

- Agreed to meet basic CC requirements
  - Some details still under discussion
  - Provided response to County’s questions/comments on CC requirements

- Schedule Risk
  - In February 2017, LA County will indicate schedule for IEN upgrades
  - If County cannot deliver functions in time for CC launch
    - CC will use IEN for reading of data
    - CC will potentially develop interfaces/software for
      - Requesting signal plans
      - CMS signs
      - Travel Time
  - We all hope County will be able to meet CC launch schedule
RIITS and 511

- **RIITS:**
  - Transit information from Metro, Foothill and Pasadena Transit
  - Waze information
  - Here information
  - Possibly environmental data
  - Possibly vide sharing

- **511:**
  - We will send information to 511 describing our reroutes. This will include a general message and a specific message for I-210 commuters.
  - We will use RIITS APIs to send an update at least once every 15 minutes.
  - We should be able to test this out beginning in January of 2017.
  - Agreed to provide call box locations for environmental sensors
Hardware
## Stage 1 - 134 to 605

### 134 Split to Sierra Bonita

<table>
<thead>
<tr>
<th>CMS</th>
<th>Description</th>
<th>Start Date</th>
<th>Duration</th>
<th>End Date</th>
<th>Duration</th>
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<td>A1380</td>
<td>Drill and Pour CIDH #1 Sta 1454+40</td>
<td>01-Mar-17</td>
<td>5d</td>
<td>07-Mar-17</td>
<td>71d</td>
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<td>A1920</td>
<td>Set Sign Structure (Truss) #1 Sta 1454+40</td>
<td>08-May-17</td>
<td>3d</td>
<td>10-May-17</td>
<td>29d</td>
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<td>A1950</td>
<td>Install CMS #1 Sta 1454+40</td>
<td>11-May-17</td>
<td>5d</td>
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### Arcadia

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<th>Duration</th>
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<tbody>
<tr>
<td>A1220</td>
<td>Pothole - Arcadia</td>
<td>03-Nov-16</td>
<td>22d</td>
<td>07-Dec-16</td>
<td>2d</td>
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<tr>
<td>A2270</td>
<td>Conduit Verification - Arcadia</td>
<td>02-Dec-16</td>
<td>22d</td>
<td>04-Jan-17</td>
<td>89d</td>
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<td>A1230</td>
<td>Exc/Lay/BF Conduit - Arcadia</td>
<td>08-Dec-16</td>
<td>32d</td>
<td>25-Jan-17</td>
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<tr>
<td>A1240</td>
<td>Install Boxes - Arcadia</td>
<td>26-Jan-17</td>
<td>8d</td>
<td>06-Feb-17</td>
<td>56d</td>
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<tr>
<td>A1250</td>
<td>F/P Cabinet Controller Foundations and Pads - Arcadia</td>
<td>26-Jan-17</td>
<td>8d</td>
<td>06-Feb-17</td>
<td>56d</td>
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<td>Task Number</td>
<td>Task Description</td>
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<td>A1150</td>
<td>Install Loops - Stage 1 Wide</td>
<td>02-Aug-17</td>
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<td>Pull Cable - Stage 1 Wide</td>
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<td>Splice Mainline Cable - Stage 1 Wide</td>
<td>23-Aug-17</td>
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<td>Splice Breakouts and Terminate Fiber - Stage 1 Wide</td>
<td>07-Sep-17</td>
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<td>Fiber Integration (HUB and LARTMC) - Stage 1 Wide</td>
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<td>13-Oct-17</td>
<td>10d</td>
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Call for Projects – Hardware Components

- Awaiting Final Funding Agreement with Metro
- Refining final scope
- Caltrans has met with all cities and LA county
- Refining exactly what it takes to purchase and install the hardware components
- Schedule being developed
## Hardware and Equipment

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Data
Corridor Data

- **Freeway**
  - Good progress being made on configuration and basic hardware issues
  - Weekly hour-long meetings
  - Tracking of reasons for challenges in data quality

- **All cities and LA County**
  - Arcadia continuing to improve

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</tbody>
</table>
This week there is a big improvement on I-605 near the I-210 interchange. Northbound health jumped from 38% to 52% and Southbound health jumped from 25% to 42%.
...the really good news is about recent configuration fixes. The following VDS have been extended to include all five lanes of travel:

- E of Second
- San Gabriel River (WB)
- San Gabriel River (EB)
- W/O Irwindale
- Azusa 1
- Buena Vista

Thanks to Tadeo, Amahayes, and everyone on the team for making this happen. All these fixes are now confirmed in PeMS.

The upshot is that we can now obtain a full cross-section of flow at these locations. This is crucial for modeling, calibration, and for accurate performance measures.
## Arcadia Arterial Data Quality

<table>
<thead>
<tr>
<th>Weekly Data Quality (%)</th>
<th>Detour Routes</th>
<th>Arcadia</th>
<th>Not Detour Routes</th>
<th>All Detectors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good</td>
<td>Bad</td>
<td>No Data</td>
<td>Good</td>
</tr>
<tr>
<td>12-Jun-2016 To 18-Jun-2016</td>
<td>47.00</td>
<td>47.00</td>
<td>5.99</td>
<td>10.34</td>
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<tr>
<td>19-Jun-2016 To 25-Jun-2016</td>
<td>49.05</td>
<td>44.96</td>
<td>5.99</td>
<td>11.33</td>
</tr>
<tr>
<td>26-Jun-2016 To 02-Jul-2016</td>
<td>51.38</td>
<td>42.63</td>
<td>5.99</td>
<td>8.97</td>
</tr>
<tr>
<td>03-Jul-2016 To 09-Jul-2016</td>
<td>51.91</td>
<td>42.10</td>
<td>5.99</td>
<td>8.97</td>
</tr>
<tr>
<td>10-Jul-2016 To 16-Jul-2016</td>
<td>49.84</td>
<td>44.17</td>
<td>5.99</td>
<td>8.97</td>
</tr>
<tr>
<td>17-Jul-2016 To 23-Jul-2016</td>
<td>50.53</td>
<td>43.48</td>
<td>5.99</td>
<td>8.97</td>
</tr>
<tr>
<td>24-Jul-2016 To 30-Jul-2016</td>
<td>51.32</td>
<td>42.69</td>
<td>5.99</td>
<td>8.97</td>
</tr>
<tr>
<td>31-Jul-2016 To 06-Aug-2016</td>
<td>50.99</td>
<td>43.02</td>
<td>5.99</td>
<td>8.97</td>
</tr>
<tr>
<td>07-Aug-2016 To 13-Aug-2016</td>
<td>51.42</td>
<td>42.59</td>
<td>5.99</td>
<td>8.97</td>
</tr>
<tr>
<td>14-Aug-2016 To 20-Aug-2016</td>
<td>55.92</td>
<td>38.08</td>
<td>5.99</td>
<td>8.97</td>
</tr>
<tr>
<td>21-Aug-2016 To 27-Aug-2016</td>
<td>56.98</td>
<td>37.03</td>
<td>5.99</td>
<td>8.97</td>
</tr>
<tr>
<td>28-Aug-2016 To 03-Sep-2016</td>
<td>53.59</td>
<td>40.42</td>
<td>5.99</td>
<td>11.92</td>
</tr>
<tr>
<td>04-Sep-2016 To 10-Sep-2016</td>
<td>52.47</td>
<td>41.54</td>
<td>5.99</td>
<td>11.23</td>
</tr>
<tr>
<td>11-Sep-2016 To 17-Sep-2016</td>
<td>61.95</td>
<td>32.06</td>
<td>5.99</td>
<td>16.06</td>
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<tr>
<td>18-Sep-2016 To 24-Sep-2016</td>
<td>63.79</td>
<td>30.22</td>
<td>5.99</td>
<td>16.55</td>
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<tr>
<td>25-Sep-2016 To 01-Oct-2016</td>
<td>63.43</td>
<td>30.58</td>
<td>5.99</td>
<td>16.55</td>
</tr>
<tr>
<td>02-Oct-2016 To 08-Oct-2016</td>
<td>63.20</td>
<td>30.81</td>
<td>5.99</td>
<td>16.35</td>
</tr>
</tbody>
</table>
## Caltrans - Tracking data improvement requests

<table>
<thead>
<tr>
<th></th>
<th>Carried Over</th>
<th>Opened This Week</th>
<th>Closed By System Mon.</th>
<th>Closed By Mntc.</th>
<th>Total Closed</th>
<th>Remaining Open in Sys. Mon.</th>
<th>Remaining Open in Maintenance</th>
<th>Remaining Open others</th>
<th>Remaining Open Jetre &amp; Btieu</th>
<th>Total Remaining Open</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Route 210</strong></td>
<td>31</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>13</td>
<td>12</td>
<td>4</td>
<td>29</td>
<td></td>
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<tr>
<td><strong>Route 605</strong></td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td></td>
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<tr>
<td><strong>Route 10</strong></td>
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<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>39</strong></td>
<td><strong>5</strong></td>
<td><strong>6</strong></td>
<td><strong>1</strong></td>
<td><strong>7</strong></td>
<td><strong>13</strong></td>
<td><strong>20</strong></td>
<td><strong>4</strong></td>
<td><strong>37</strong></td>
<td></td>
</tr>
<tr>
<td><strong>CC: 210 (PM25-43.25)</strong></td>
<td><strong>21</strong></td>
<td><strong>3</strong></td>
<td><strong>3</strong></td>
<td><strong>1</strong></td>
<td><strong>4</strong></td>
<td><strong>8</strong></td>
<td><strong>10</strong></td>
<td><strong>3</strong></td>
<td><strong>21</strong></td>
<td></td>
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<tr>
<td><strong>CC: 605 (PM22.93-28)</strong></td>
<td><strong>2</strong></td>
<td><strong>1</strong></td>
<td><strong>1</strong></td>
<td><strong>0</strong></td>
<td><strong>1</strong></td>
<td><strong>0</strong></td>
<td><strong>2</strong></td>
<td><strong>0</strong></td>
<td><strong>2</strong></td>
<td></td>
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</table>
Analysis, Modeling and Simulation
<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4th Qtr</td>
<td>1st Qtr</td>
<td>2nd Qtr</td>
</tr>
<tr>
<td>Modeling</td>
<td>Design</td>
<td>Build</td>
<td>Build</td>
</tr>
<tr>
<td>Rules</td>
<td>Determine</td>
<td>Build</td>
<td>Build</td>
</tr>
<tr>
<td>Response Plans</td>
<td>Design</td>
<td>Design</td>
<td>Build</td>
</tr>
<tr>
<td>System Integration</td>
<td>Build</td>
<td>Build</td>
<td>Build</td>
</tr>
</tbody>
</table>
300 preliminary (i.e. possible) alternate routes were identified between Lake and Buena Vista on the approved arterial network.

This set of 300 alternate routes is our “menu” of choices for alternate routes to support an incident at a given location.
Workflow

- Registered incident data delivered to response plan generation tool
- Response plan(s) created according to pre-established rules
Information captured in Public CHP CAD feed does not match what is needed for response plan tool
IEN IMS: Incidents via RIITS via Caltrans
Duty Pages from Caltrans

LARTMC@dot.ca.gov via berkeley.edu

11:21 PM (8 hours ago)☆
to joebutler

INITIAL DUTY PAGE - PHONE (323) 259-1922: (LA CNTY) SB 5, AT RTE 170, HOV, 1-5 LNS BLCKD. FOR APPROX 2 HRS, DUE TO MULTI VEH TC, RESLTNG IN FATALITY. 2 RT LNS TO SB 170 EXIT OPEN. MTCE ROLLING FOR HC. TMC, SHIV.

LARTMC@dot.ca.gov via berkeley.edu

11:49 PM (8 hours ago)☆
to joebutler

UPDATE DUTY PAGE - PHONE (323) 259-1922: (LA CNTY) SB 5, AT RTE 170, HOV, 1-3 CLOSED, #4 LN OPEN ONLY. BOTH LNS TO SB 170 OPEN. DUR APPROX 3 HRS. TMC, SHIV.

LARTMC@dot.ca.gov via berkeley.edu

12:58 AM (7 hours ago)☆
to joebutler

UPDATE DUTY PAGE - PHONE (323) 259-1922: (LA CNTY) SB 5, AT RTE 170, HOV, 1 & 2 CLOSED, #3 & 4 OPEN NOW. DUR APPROX.. TMC, SHIV.

LARTMC@dot.ca.gov via berkeley.edu

2:17 AM (5 hours ago)☆
to joebutler

FINAL DUTY PAGE - PHONE (323) 259-1922: (LA CNTY) SB 5, AT RTE 170, ALL LNS OPEN.. TMC, SHIV.
Aimsun Model

- Modeling of roadways, transit services, and basic control elements complete
Aimsun Model – Current Activities

- **Demand modeling**
  - Received 2012 SCAG travel demand data – currently processing the data for inclusion in the model
  - Adding traffic count data into the model – to be used for origin-destination demand modeling and calibration

- **Driver behavior calibration**
  - Tweaking driver behavior parameters to better reproduce traffic dynamics at freeway merge, weaving areas, and other bottlenecks
    - Lane changing aggressiveness
    - Acceleration/deceleration
    - Spacing between vehicles
    - Influence of slower traffic on adjacent lanes
Routing behavior calibration

- Evaluating alternate trip cost formulas to ensure realistic route choices under dynamic scenarios

Cost = Travel Time
= Travel Time + Distance
= Travel Time + 0.5 * Distance + Ramp Meter Costs
Video of Simulation of Reroute

Santa Anita Reroute
4:55 PM

+500 vph
No Optimization
System Evaluation
Facilities

- **I-210 corridor facilities to evaluate include:**
  - I-210 freeway and ramps (by city boundary segments)
  - Key parallel arterials & connecting arterials (by city segments)
  - Key intersections (at least 90 locations)
Strategies

- **Key strategies include:**
  - Non-Recurrent Congestion (focus of the project)
    - Incident Response Planning
    - Advisory Diversion Management and Rerouting
  - Recurrent Congestion & Off-Peak Period (measure residual benefits of project elements)
    - Freeway Adaptive Ramp Metering
    - Arterial Coordinated Signal Operations
Challenges

- **Non-recurrent congestion:**
  - How do we compare conditions before/after incidents?
    - We cannot time accidents
    - Every accident is different and resulting traffic is different
    - Accidents do not occur at same time or like days
    - Incidents are unpredictable
    - Requires robust detection data
    - Requires expert analysis

- **Timing of implementation**
  - Implementation is not done at one time - it is done in phases
  - When is it truly “after”? (measure in between phases?)
  - When and what is “before”?
Why “Significant” Non-Recurrent Congestion

I-210 from SR-134 to I-605
Caltrans TASAS Data - 2012
Percentage of Days with Number of Collisions from Total Weekdays

- No Collisions: 5%
- 1 Collision: 12%
- 2 Collisions: 20%
- 3 Collisions: 20%
- 4 or More Collisions: 43%

Not many collision-free days
Suitable Performance Measures

- Estimated performance measures on other projects:

<table>
<thead>
<tr>
<th>PERFORMANCE MEASURE AREAS</th>
<th>San Diego</th>
<th>Dallas</th>
<th>Minneapolis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Travel Time Savings (Person-Hours)</td>
<td>246,000</td>
<td>740,000</td>
<td>132,000</td>
</tr>
<tr>
<td>Improvement in Travel-Time Reliability (Reduction in Travel-Time Variance)</td>
<td>10.6%</td>
<td>3%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Fuel Saved Annually (in Gallons)</td>
<td>323,000</td>
<td>981,000</td>
<td>17,600</td>
</tr>
<tr>
<td>Tons of Mobile Emissions Saved Annually (in Tons) (GHG Emissions)</td>
<td>3,100</td>
<td>9,400</td>
<td>175</td>
</tr>
</tbody>
</table>

Requires use of modeling (e.g., Caltrans Cal-B/C economic model)
Suitable Performance Measures

- **Potential suitable performance measures:**
  - Demand
    - Vehicle Miles Traveled (VMT)
  - Mobility
    - Speeds and Travel Times
    - Delay (vehicle and/or person) and Vehicle Hours Traveled (VHT)
    - Congestion Period (peak period hours)
  - Productivity
    - Traffic Flow (volumes - vehicles an/or persons)
    - Level of Service (intersections)
  - Reliability
    - Travel Time Variability (Buffer Index)
    - Planning Time Index
  - Safety (SWTRS/TASAS data available year or more later)
Suitable Performance Measures

- **Transit (?)**
  - Transit on-time performance *(if transit agency provides data)*
  - Average travel times *(if transit agency provides data)*
  - Transit ridership *(if transit agency provides data)*

- Need to investigate available Gold Line data
  - *Time of day*
  - *Accuracy*
  - *Access*

- Ridership on specific incident days
Data Sources

- **Data sources:**
  - Available sources (before & after)
    - Caltrans Freeway PeMS (or ATMS) – freeway & all ramps
    - Arterial intersection signal detection
    - Arterial segment speed/occupancy detection
    - Arterial blue tooth readers
    - Caltrans TASAS, CHP SWTRS, CHP CAD; Metro FSP data
    - Local agency collision database (Pasadena Traffic Records System)
    - INRIX or HERE crowd sourcing (Metro/SCAG in process of acquiring INRIX)
  - Potential manual needed (before & after)
    - Arterial link tube and I/S turning movement counts (before & after)
      - select locations where detection is not available
    - Probe vehicle runs to validate INRIX, HERE, PeMS, blue tooth
For Any Manual Data Collection

- **Before**
  - After sensing is installed – This is very important
    - Without waiting for the Call for Projects and other sensing improvements, it is financially and logistically difficult to provide the magnitude of sensing required to do a thorough before study of non recurrent congestion patterns
  - Before implementation of response plans
  - Spring 2018

- **After**
  - After implementation of response plans
  - After refinement of response plans
  - Spring 2019
Action Items and Next Meeting Time
Thank You