Connected Corridors
Face-to-Face Meeting

Tuesday, July 25th, 2017 – 1:30 – 3:30 pm
Arcadia
Agenda

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

- Mr. Ken Young
  - Office Chief of Corridor Management (North)
  - (213) 897-6091
  - Amongst other areas, Mr. Young is the new office chief responsible for the safety and operations for the San Gabriel Valley.

- Mr. Farid Nowshiravan
  - Corridor Manager, I-210, I-10 and I-605
  - (213) 897-4655
  - Mr. Nowshiravan has assumed the day to day corridor manager responsibilities previously handled by Mr. Samson Teshome for the 210 project.
Our Corridor: The I-210
Systems Engineering Next Steps

- **Design Documents** – How will the requirements be met
- **Hardware and Software** – Building the system
Integration – Subsystems and Subefforts
Integration
Technical Architecture and Components
Replicable to other corridors and districts

1) Start with standards and cloud based Data Hub tuned for real-time operational data and scalability
2) Add open source rules engine designed for flexibility
3) Add modeling if desired
4) Add in ICM system vendors that meet standards. Currently working with Kapsch, Parsons, Telegra.
5) Add in TCS vendors that meet standards. Currently working with McCain, Transcore, Kimley-Horn
6) Add in sign vendors that meet standards. TBD
7) Add in interface to ATMS using vetted TMDD interface
8) Add in PEMS for long term metrics
9) Add in interfaces to transit, 511, air quality using predefined interfaces
10) Utilize predefined KSAs and organizational structures for staffing
11) Utilize existing system engineering documents, MOUs and funding mechanisms
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Risks - Summarized

- **Significant Risks**
  - C2C TMDD interface funding, contracting, development and installation
  - Wayfinding signs
  - Network Communication
  - Call for Projects on time completion
  - Overall integration of a large system composed of hardware, software and personnel

- **Secondary Risks**
  - Integration of Corridor Management Subsystem systems
  - Corridor wide data quality
  - Travelers following reroutes
  - Construction on the I-210
Outreach and Communications
Outreach

- Project Charter Amendment – have not received any comments; moving forward

- MOU – Outline and background information sent to Caltrans D7 who will manage the process

- Updates on SB 1 funding (Metro and Caltrans, in particular)
  - Workshops are underway for the different funding categories
  - Who is taking the lead on this re: ICM and future Connected Corridors?
Amazon awards CC 10K in funding

- Amazon awarded CC 10K in funding as part of the City on the Cloud’s Innovation Challenge
- Greg developed and submitted the application in both Caltrans and PATH’s name
AWS Amazon Cloud Training

- We suggest Tuesday August 15th
- Mike and Greg for sure
- Possibly others including Amazon
- At the TMC or ???
- Anyone interested is invited
Design

All Requirements

Hardware and Software
- Technical Design
- Technical Requirements

Individual and Group
- Organizational 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
Job Descriptions, KSAs, etc.

- We will setup a meeting with Caltrans, PATH and SMG to:
  - Determine how to prioritize and categorize personnel requirements
  - Determine what information to gather from D4 and D11

- Hold future meetings to:
  - Review information from D4 and D11
  - Perform prioritization
  - Develop justifications for additional resources
Proof of Concept
Proof Of Concept – COTS (Purple Box)

- The following companies have been selected to participate in the pilot
  - Kapsch
  - Parsons
  - Telegra

- We are working on legal agreements

- We have also requested technical requirements from the vendors (beginning of the integration effort)
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
Call for Projects
I-210 Connected Corridors Procurement Support Tasks

• Meet with project stakeholders to confirm scope and installation needs of the service contracts.
• Develop contract needs documents based upon meeting with cities and other project stakeholders.
• Develop high level work plans and bid specifications for the installation/configuration work that is required.
• Confirm cost estimates along with any additional add-on
• Develop quantities estimates for all of the installations
• Develop typical installation details
• Identify communications methods for communicating with field components and include typical communication installation details
• Assist in procurement preparation including selection/purchasing equipment
• Prepare and support RFI process
• Document all interfaces with stakeholders.
# Procurement List & Quantity

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Timeline

- Coordinate Needed Preliminary Information 8/15/2017
- Review Lists with Stakeholders and Caltrans 8/18/2017
- Procurement Package Support and Development 8/21/17 - 1/31/18
- Develop Specification and Standard Details 8/21/17 - 1/31/18
Arterial Wayfinding Signs

- Detailed sign location suggestions will be discussed with stakeholders in the near future – Power and Communication
- Signs will be 3 x4 or 4 x5 and full color matrix (unless something else is specifically recommended)
- Concrete poles cannot be used
- Wind standards are either 85 or 100 mph gusts
- Need to understand the importance of O&M (pay more for less O&M?)
- Starting to work with Caltrans
Sign Locations

FOOTHILL at BALDWIN (WEST)
Both locations are at existing advance loops
### I-210 SHOPP Project – Year end delivery

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Network Communication

Jesus and Erlan
Network Discovery

- **Individual meetings were held with LACO, Pasadena and Arcadia, to conduct network discovery**
  - The goal of the meetings was to gather information from agencies utilizing existing network documentation as well as interviews to gain an understanding of the current state of the infrastructure.
  - The team analyzed the discovery information and compared the current environment with business needs and technical requirements.

- **Meetings provided the information necessary to recommend a high level network architecture and provide the timeframes required to execute the final solution.**
Network Components for the Fiber Infrastructure

- Blue Network Devices: RITTS operated and managed
- Gray Network Devices: Agency operated and managed
## Timeline

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- Identification of element, service and separation requirements (1 month)
- Identification of hub and node locations (1 month)
- Detail design of network infrastructure (2 months)
- Procure network & security hardware/software (12 months)
- Development of an installation and implementation schedule (1 month)
- Installation and configuration of hubs and nodes edge devices (1 month)
- Provision connectivity and integration of hubs and spokes (1 month)
- Configuration of security policies (1 month)
- Confirmation of a site and fiber readiness for sites (1 month)
- Cutover two hub sites and one node site as pilot/PoC (1 month)
- Cutover remaining sites (1 month)
- Clean up (1 month)
Phased Approach

- **Use existing connections to transmit traffic data to Caltrans Amazon Cloud (AWS)**

- **Phase 1 – Transmit traffic data only (no video data)**
  - Site-to-site VPN over the Internet (Recommended Solution)
    - Caltrans Amazon Cloud
    - RIITS
    - Caltrans
  - MPLS VPN with Netbond

- **Phase 2 – Transmit traffic data and video**
  - 10 Gbps fiber network
Phase 1 – Site to Site VPN
Traffic Flow – Phase 1 (VPN to AWS)
Traffic Flow – Phase 1 (VPN to RIITS)
Traffic Flow – Phase 1 (VPN to Caltrans)
Phase 2 – Fiber Network
Transition Phase
Bandwidth Consumption

- **Traffic Signals**
  - **Arcadia** communicates with approximately 59 intersections
    - Bandwidth consumption was observed at ~ 1 Mbps
  - **Pasadena** operated approximately 340 traffic signals
    - Traffic signal data is low and we can anticipate Pasadena’s consumption based on Arcadia’s data flow
      - 340 intersections / 59 intersections ≈ 6 x 1 Mbps ≈ 6 Mbps
      - 100 intersections / 59 intersections ≈ 2 Mbps x 1 Mbps ≈ 2 Mbps
  - **LACO** operates approximately 500 intersections on their KITS system
    - 500 intersections / 59 intersections ≈ 8.5 x 1 Mbps ≈ 8.5 Mbps
    - 56 intersections / 59 intersections ≈ 1 Mbps x 1 Mbps ≈ 1 Mbps
Bandwidth Consumption

- **Video Streaming**
  - After discussing anticipated usage with all agencies the following assumptions were agreed upon
    - Typical Camera utilization = 4 – 8 cameras
    - Max Camera Utilization = 12
  - CCTV camera bandwidth consumption can be configured
    - Assuming each camera requires 4 Mbps
      - Typical bandwidth = 16 Mbps - 32 Mbps
      - Max bandwidth = 48 Mbps
  - Video sharing, however, is typically not distributed at such high bandwidth
    - LACO streams video at 256 kbps which is a fraction of the calculated bandwidth shown above
Center to Center Data Exchange
C2C Updates

- **Transcore**
  - Ryan has provided a good quote. A few more items to discuss.

- **Kimley Horn**
  - Received proposal – Negotiations continuing

- **McCain**
  - Awaiting proposal

- We need to identify additional funding to complete C2C contracts for Kimley Horn and McCain.

- Caltrans is providing funding for Transcore
PATH has completed recommendations for updates to TMDD

It is vital that all vendors use the same TMDD format

Mike Jenkinson carrying them forward to ITE and the TMDD standards board

From: Siva Narla [mailto:snarla@ite.org]
Sent: Monday, July 24, 2017 6:16 AM
To: Nicola Tavares <ntavares@ite.org>; Jenkinson, Mike M@DOT <mike.jenkinson@dot.ca.gov>
Cc: Rausch, Robert <robert.rausch@transcore.com>; patrick.chan@consystec.com
Subject: RE: TMDD C2C Comments
Importance: High

Mike: Please continue to send us the comments on TMDD. We shall collect your comments and have our steering and its consultant review these comments and get back to you. We would also like to welcome you to our national TMDD steering committee meetings and like to have you present and contribute to the discussion. You shall receive responses correcting the TMDD as well.

Nicola will send you the invite for the next web/tele conference of the TMDD steering committee this Friday, July 28.

Once again your comments and participation is most valuable as you are deploying TMDD.
TMDD - McCain and Transcore and

- McCain
  - ...just spoke with Kevin. After our call last week, he talked some more with his team, someone at Sensys, and Delcan. He stated that .NET was more forgiving of the issues in the spec, which is what they use, but in talking with Delcan, found that they had raised the same issues in the past. ... he stated he'll support the change to TMDD.

  - He also asked that we provide at some point some sample code for both ends of the transaction and that a combination of their .NET code and our Java code may be used for others who wish to use the standard.

- Transcore
  - Also held phone meeting with Transcore developers.

  - They stated similar thoughts to McCain and will support
DSS, Rules and Response Plans

Greg
DSS – Design Detail

[Diagram of DSS system with various components and flow paths, labeled for decision support, modeling, and rule engine operations.]
Response Plans

- Responding to an incident
- A tool for building response plans from response plan elements
- Next step: using and expanding the tool
Responding to an incident:

**WB I-210 Incident: HOV, #1 lanes blocked at Allen**
Responding to an incident: arterials...
Responding to an incident: wayfinding...
Responding to an incident: routes...
 Responding to an incident: signals...
Responding to an incident: ramp meters...
...and more:
Tool for building response plans

- Desktop app
- Plan element data managed in Excel
- Incident parameters entered in app
- App’s rules build plans for the incident
- Plan files can be saved
Tool for building response plans from control strategy elements
Demonstration

(run demo)
Route Strategy

- A set of coordinated control strategies to support specific use of an alternate route:
  - A route
  - A set of specific signal timing plans for signals along the route
  - A set of specific signal timing plans for signals not on the route
  - A set of ramp meter plans/rates along the route
  - A set of ramp meter plans/rates not on the route
Simple network representation.

- The application uses a minimal network representation sufficient to support alternate routes for freeway incidents
- Spreadsheet-based; no model
Next steps: Workflow, Validation, and Rules

- **Supporting spreadsheets contain details of Route Strategy elements and their relationships.**
  - Workflow
    - How do people prefer to approach working with this data?
  - Validation
    - What types of data validation / data entry restriction are desired?

- **Rules - for next time**
  - Rules restricting asset availability
  - Rules that flesh out response plans based on elements of Route Strategy
Next Steps

- Who would like to work with Greg to build response plans and refine the application?
- Who would like to get a copy to explore?
ATMS, PEMS, 511, Lane Closure
ATMS, PEMS, 511, Lane Closure

- **ATMS Upgrades**
  - Vendor under contract – Excellent work by Caltrans
  - Kick off meeting held

- **PEMS**
  - Design meetings held with Caltrans, Iteris and PATH
  - Awaiting updated design and quote from Iteris

- **511**
  - RIITS and PATH need to schedule design reviews

- **Arterial Lane Closure**
  - Mike Jenkinson has provided the lane closure system
  - I will demonstrate
# Lane Closure System

## Road Closures

### Export to CSV

**Census Down**

Start date: [Input Field]

End date: [Input Field]

<table>
<thead>
<tr>
<th>Direction</th>
<th>Facility</th>
<th>Street Name</th>
<th>Reason Description</th>
<th>End Description</th>
<th>Closure Type</th>
<th>Estimated Delay</th>
<th>Lanes Closed</th>
<th>Total Lanes</th>
<th>Expected End</th>
<th>Cone-Down Date</th>
<th>Cone-Up Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>EB</td>
<td>Local</td>
<td>Colorado Blvd</td>
<td>Intersection of Colorado Blvd and Midr Street, Pasadena, CA 91107, USA</td>
<td>Intersection of Colorado Blvd and Rosemead Blvd, Pasadena, CA 91107, USA</td>
<td>Lane</td>
<td>15 minutes non Peak, 30 minutes Peak</td>
<td>1</td>
<td>2</td>
<td>08/30/2017</td>
<td>09/12/2017</td>
<td>08/22/2017</td>
</tr>
</tbody>
</table>
Using the lane closure system

- Link: https://210lcstest.dot.ca.gov/
- Mike approves new users
- Please try it out and see if it is acceptable for CC
Data Hub and Cloud
Data Hub and Internal Command and Control
System Development Status

- Met with Caltrans HQ IT Infrastructure and Solutions Groups
- Continuation of efforts
  - DSS/DH integration and data interface
  - TMDD WS-I issues regarding TMDD subscriptions
  - Design specifications
- Setting up DSS/DH integrated test environment with new VPC configuration
- Develop “desktop” rules engine for rules experimentation
- Met with Dr Kristen Tufte who works on the USDOT Open Data Exchange in order to review our data hub. She thought it was well done
Design – DSS/CMS Data Hub Pipelines
Next steps

- **Data Hub Command Gateway Interface**
  - Control center for data hub pipelines
    - Processes command controls for start, stop, status of data pipelines
  - Control management of DSS – Data Hub – Corridor Management System
    - Controls and routes commands between DSS and CMS
    - Ensures capture of events between DSS/CMS/Data Hub
  - Will set up prototype for data hub pipeline control first

- **Create environment for modeling to run Aimsun model in cloud at scale and test AWS/Aimsun configuration for speed**
Data Quality and Estimation
### Freeway Sensor Availability

<table>
<thead>
<tr>
<th></th>
<th>I-210</th>
<th>Eastbound PM 25 - PM 43.25</th>
<th>Westbound PM 25 - PM 43.25</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weekly Average Sensor Availability</strong></td>
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<tr>
<td></td>
<td>CD</td>
<td>CH</td>
<td>CD</td>
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<td></td>
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<td></td>
<td>I-210</td>
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<tr>
<td></td>
<td>Fwy-Fwy</td>
<td>HOV</td>
<td>Mainline</td>
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<td></td>
</tr>
<tr>
<td>July</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<td>6</td>
<td>7</td>
<td>8</td>
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<td>Fwy-Fwy</td>
<td>HOV</td>
<td>Mainline</td>
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<td>81.8%</td>
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</tr>
</tbody>
</table>

- Will refine the results to take into account planned construction events which can interrupt the ability to collect and process data
- The new IP network should raise overall data quality on the freeway
Data Collection for cities and county

- **Arcadia**
  
<table>
<thead>
<tr>
<th>Week</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th><strong>Total</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td><strong>79.2%</strong></td>
</tr>
</tbody>
</table>

- **County, Monrovia, Duarte** – Working with IEN to obtain data

- **Pasadena** – PATH awaiting feedback on questions regarding the data provided
Device Update Response Time: LACO

Device update response time for LACO

- **Connection OK**
- **Empty Response**
Corridor Model update
Aimsun on the Cloud

- Able to run Aimsun model on Amazon Web Services
- Working with TSS to understand software challenges when running on a different environment
- Building tools to view and interpret model output when run without GUI on the cloud

Space time diagram, speeds in mph
Aimsun Meso-Model Calibration

- Calibrating the meso-simulation model in Aimsun
- The meso-model will enable us to more effectively use features in Aimsun to improve:
  - 24-hour demand profiles
  - Time-sliced demand matrices
  - Time-sliced vehicle path assignments
  - Day-of-week refinements
Inventory of flush plans at each signal

- Building inventory of flush plans required at each signalized intersection to support the reroutes

<table>
<thead>
<tr>
<th>Main Street</th>
<th>Cross Street</th>
<th>Reroute Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walnut St</td>
<td>Lake Ave</td>
<td>SRL</td>
</tr>
<tr>
<td>Walnut St</td>
<td>Mentor Ave</td>
<td>EBT</td>
</tr>
<tr>
<td>Walnut St</td>
<td>Cahuenga Ave</td>
<td>EBT</td>
</tr>
<tr>
<td>Walnut St</td>
<td>Wilshire Ave</td>
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<tr>
<td>Walnut St</td>
<td>Hill Ave</td>
<td>EBT</td>
</tr>
<tr>
<td>Walnut St</td>
<td>Sierra Bonita Ave</td>
<td>EBT</td>
</tr>
<tr>
<td>Walnut St</td>
<td>Allen Ave</td>
<td>EBT</td>
</tr>
<tr>
<td>Walnut St / Football Blvd</td>
<td>Greenwood Ave</td>
<td>EBT</td>
</tr>
<tr>
<td>Walnut St</td>
<td>Sierra Madre Blvd</td>
<td>EBT</td>
</tr>
<tr>
<td>Walnut St</td>
<td>Alhambra Dr</td>
<td>EBT</td>
</tr>
<tr>
<td>Walnut St</td>
<td>San Gabriel Blvd</td>
<td>EBT</td>
</tr>
<tr>
<td>Walnut St</td>
<td>Daisy Ave</td>
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</tr>
<tr>
<td>Walnut St</td>
<td>Kenmore Ave</td>
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</tr>
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<td>Football Blvd</td>
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<td>Football Blvd</td>
<td>Santa Paula Ave</td>
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</tr>
<tr>
<td>Football Blvd</td>
<td>Sierra Madre Villa</td>
<td>EBT</td>
</tr>
</tbody>
</table>
Micro Model Calibration

- Continued development and calibration of demand profiles for:
  - 4-hour AM peak simulation period (6-10 AM)
  - 8-hour PM peak simulation period (1-9 PM)
Arterial Traffic Estimation

- **Validation of the queue estimation algorithm**
  - We want to use the synthetic data from Aimsun to validate the accuracy of the queue estimates from our algorithm
  - We have found that:
    - The traffic profiles, especially detector outputs, from Aimsun are consistent with those from the field
    - Our proposed algorithm can be applied to the detector data obtained from Aimsun
    - More traffic states can be observed from the flow-occupancy data at advanced detectors: “Uncongested”, “Congested”, “Congested with downstream queue spillback”
    - The flow count at stopbar detectors is not reliable when traffic is very congested with small vehicle gaps.
  - We are currently working on:
    - Refining our queue estimation algorithm
    - Model development on the detection of lane blockages and downstream queue spillback using loop detector data
Thank You
and
Next Meeting
(Suggest Sept 12th)