Connected Corridors
Face-to-Face Meeting

Tuesday, June 7th, 2016 – 1:30 – 3:30 pm
Caltrans D7 HQ
Agenda

- Introductions
- Quick Summary
- Schedule Update
- Outreach and new ATCMTD Proposal
- Infrastructure – SHOPP and Metro Funded Project Details
- Requirements Update
- High Level Design and Caltrans Update
- AMS and Response Plan Design
- 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
Quick Summary
Leadership Transition – Joan to Nick

- Nick is now – Chief, Office of Strategic Development
- Previously Nick:
  - Managed the PEMS system
  - Worked in the Director’s Office and at the CTC
  - Worked in District 3 in Modeling and Forecasting
  - Received a Ph.D. from UC Irvine
Leadership Transition – Sam to Allen

• We will miss Sam and know that he will be thinking about us every day….
• Welcome to Allen Chen
  • Allen has many years of experience working on and leading IT projects
  • Allen’s leadership of the LARTMC project is an impressive accomplishment
  • Allen will be able to combine work on the ATMS, DCCM, CC and other systems
Quick Summary – Last Meeting was March 8th

- **Outreach**
  - Connected Newsletter, meeting with MTC/D4/HQ, web site updates
  - ATCMTD Proposal

- **Requirements**
  - All comments reviewed – Next version nearing completion. Anticipate next week.

- **Infrastructure Improvements**
  - Call for Projects inventory being refined. Start date delayed by two months.
  - I-210 SHOPP program beginning construction

- **Architecture and High Level Design**
  - High Level Design has begun – Diagram to be shown today
  - Good meetings with Caltran’s HQ and D7 personnel

- **AMS/Response Plan Generation**
  - Good progress on Corridor Model and Response Plan Rules
Schedule Update
## Schedule

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Schedule Updates

- New Launch Date for Connected Corridors - July 2018
- Infrastructure work on corridor
  - SHOPP – To be completed by mid-2018
  - Metro Call for Projects Improvements - To be completed by late 2018
12 Outreach
Spring Connected Newsletter

Update

The fall and winter months have been busy for the CC Pilot and for national transportation issues. In October, CA Assemblymember Jim Frazier visited UC Berkeley to learn about its various transportation institutes and projects including the CC Pilot (see page 3). In December, President Obama signed the FAST Act into law, marking the first long-term transportation bill passed by Congress in 10 years (see page 4). For the Pilot, both the CC Doc website and the CC website were updated (see page 5). In January, Connected Corridors was once again represented at the Transportation Research Board’s annual conference held in Washington D.C., where Dr. Frances Bonn presented the Connected Corridors program and the I-210 Pilot on behalf of Caltrans and the entire team. Lastly Mr. Horace Noroson became the new National Principal Engineer at Caltrans District 7. Noroson will be leading the implementation of District 7’s organizational realignment concurrent with the development and deployment of TSD50 strategies and ITS technologies. Welcome to the team, Mr. Noroson!

Requirements Draft Ready for Review

After more than 20 meetings with over 75 stakeholders, the first draft of the Connected Corridors High-Level System Requirements document (“Requirements”) is now being reviewed. This crucial document defines what the system and all its components—including people, organizations, software, and hardware—must do. While a lengthy and ambitious process, well-developed requirements create a strong foundation for the next step in the Systems Engineering process, system design, and ultimately help ensure the long-term success of the pilot.

“I am extremely grateful for every person who took the time to meet with us and work on these requirements,” said Samson Trabue, Corridor Manager for Caltrans District 7. “It’s a new process for many of our stakeholders, but with full engagement of our partners, I know we are on the path to success.” One unique attribute of the CC requirements document is the three levels of detail, making it usable for a range of audiences. The three formats are:

- Brief summaries: primarily written for upper management and for inclusion in informational presentations.
- Generic explanations: place each requirement in the context of how things are going to be done, such as who carries it out, the skill set needed, how success is measured, maintenance required, degree of automation, and relation to other requirements. There is no mention of specific agencies, local data sources, or other I-210 Pilot-specific information, making it easier to modify for future pilots or for other agencies to use as a starting point.
- Requirements tables for the I-210 Pilot contain the most detail, including corridor specifics, stakeholder agencies, and particular systems.

By providing the requirements in these varying levels of detail, the team hopes to address the many different expectations, experiences, and communication preferences found among the people who have been involved in the requirements process over the last six months.

Two key items included in the document are performance metrics and institutional requirements. For performance metrics, each requirement has a specific metric with the level of proficiency (the metric value) necessary for that requirement to be considered functioning or successful. For example, for Incident Detection

Continued on page 2
Updates to the Website
ATCMTD Proposal
ATCMTD Proposal

- ATCMTD - Advanced Transportation and Congestion Management Technologies Deployment Initiative
- USDOT - FHWA
- Up to $12 Million can be requested
- 100% match is required
- 1 to 4 year timeframe
- Heavily focused on deployment-ready requests
- Due June 24th
- Will be submitted by Caltrans D7
- Award to be made before the end of the year
ATCMTD Connected Corridors Proposal

- Expand the state-wide Connected Corridors program to be:
  - Multimodal and demand management
  - Additional safety enhancements

- We are asking for $9 Million with a $10 Million existing match = $19 Million
  - ICM 2, LA Metro ITS Element Funding, SHOPP Funding

- Includes new funding for:
  - Management
  - Software
  - Hardware
  - Deployment

- The proposal must be for $19 Million and thus includes I-210 Pilot work that is already planned
**Funding Allocation**

**ATCMTD Funds**
- Multimodal DSS
- Mode shift
- Pedestrian and bicycle safety improvements
- End-of-queue messaging
- Comparative travel times
- Transit signal priority

**Matching Funds**
- Expanded data collection and integration on freeways, arterials, and transit
- Improved traffic operations in the corridor (ramps and signals communicate)
- Message signs on freeways and arterials
- Re-routes during incidents and planned events
- Decision Support System

**I-210 Previously Applied Funding**
- Caltrans leadership
- Corridor selection
- Stakeholder identification and executed Project Charter
- Asset identification
- User Needs, ConOps, System Requirements
- High-level design
- Corridor ITS Element Upgrades
Technologies and Strategies in Proposal

- Rerouting of autos, trucks, and buses around incidents and events
- Promoting mode shift towards transit, biking, and walking
- Enhancing safety
- Utilizing a Real-Time Multimodal Decision Support System (RTMDSS)
- Effectively inform travelers and operators
- Deploying transit signal priority
- Improving maintainability of ITS Elements
- Designing reusable system components
Selection Criteria

- **Technical Merit**
  - Alignment with program goals
  - Readiness of technology
  - Scalability and portability
  - Commitment to evaluate effectiveness
  - Clarity of proposal

- **Staffing**
  - Successful program management structure
  - Expertise and qualifications of key personnel
SHOPP Funds Update
I-210 Pilot – SHOPPP Project Update

- EA 30640 – Freeway Improvements (SHOPPP Project)
  - Finish Construction July, 2018
- Awaiting for a CPM schedule from contractor to determine when work up to the 605 will be completed
- Includes communication, signal upgrades, cameras, etc.
Metro Funded Projects Update
I-210 Pilot - Status Summary

- EA 32910 – Arterial Improvements (Metro Call for Projects)
  - Complete PSR-PR: December, 2016
  - Ready To List: December, 2017
  - Start Construction: April, 2018
  - Finish Construction: October, 2018

- LA County – IEN upgrade for the corridor
  - Schedule?


Call For Projects

- Review meeting held at Caltrans D7 to establish needs for PSR preparation

- Agency meetings held
  - LA County
  - Arcadia/Monrovia
  - Pasadena
  - Duarte

- Key findings:
  - Some project scope elements have already been implemented through other agency projects
  - Replacement project elements supportive of the project have been requested
  - Specific location information still needed, e.g. for signs and detection
Summary of Issues raised at Agency Meetings (1)

- **Signal Systems**
  - LA County
    - KITS Data Collection already in place (-$600K)
    - No KITS interface to Omni-eX firmware needed (-$30K)
  - Pasadena Corridor Intersections:
    - QuicNet system (IEN connected)
    - Fair Oaks only SCATS (not to be IEN connected)
    - Caltrans intersections currently operated by the City: what will be the future arrangement?
Summary of Issues raised at Agency Meetings (2)

- Communications Improvements
  - Interconnect requests:
    - Arcadia network (tbd)
    - Duarte network ($300K)
    - Monrovia network ($250K)
  - Caltrans Fiber connect:
    - RIITS-IEN and IEN – TransSuite via (new) dedicated Caltrans fibers accessed at pullbox adjacent to CT intersection (Caltrans change order)
    - Caltrans reported that a RIITS networking solution is being considered for interconnecting systems
    - Monrovia/Duarte/Arcadia requesting fiber links to Caltrans for video sharing
Summary of Issues raised at Agency Meetings (3)

- **Traffic Signal Controllers/Intersections**
  - **Arcadia:**
    - Four controllers already replaced under other contracts
    - 2 new cabinets requested
  - **County**
    - Some controller upgrades already done
    - Controller (170 ATC) and Firmware upgrades (D4 and LACO4E) requested
  - **Duarte**
    - New Signal: Buena Vista/Central in Duarte
      - Work may be funded by Caltrans from a separate source (-$300K)
      - Funds would be re-allocated to support turning movement upgrades at intersections on Huntington Avenue (diversion route) (tbd)
    - Minor changes in firmware upgrades to match County policy (LACO4E and D4)
Summary of Issues raised at Agency Meetings (4)

- Traffic Signal Controllers/Intersections
  - Monrovia
    - One of 3 controllers already changed-out
    - Minor changes in firmware upgrades to match County policy (LACO4E and D4)
  - Pasadena
    - Requested 3 additional upgrades to controller cabinets and foundations
Summary of Issues raised at Agency Meetings (5)

- Intersection Detection Improvements
  - Arcadia:
    - 2 new Complex and 2 new 4-leg VIDS installations requested ($170K)
  - County
    - Largely within project scope
  - Duarte
    - Largely within project scope
  - Monrovia
    - Largely within project scope
  - Pasadena
    - Largely within project scope, locations to be confirmed by the City
Summary of Issues raised at Agency Meetings (6)

- Bluetooth Detection
  - Arcadia:
    - Add to existing server; largely within project scope
  - County
    - Largely within project scope
  - Duarte
    - Largely within project scope as part of County BT deployment
  - Monrovia
    - Largely within project scope as part of County BT deployment
  - Pasadena
    - Largely within project scope, locations to be confirmed by the City
    - Communications options to be explored (e.g. cellular vs hardwired)
    - Locations to be confirmed by the City
Summary of Issues raised at Agency Meetings (7)

- **Arterial Signing (locations tbd)**
  - **Arcadia**
    - Preference for cellular communications; no mast arm mounts; AC power from luminaries
    - Requested control access for signs to be used in conjunction with special events
  - **County**
    - Supports limited (small) dynamic signing and static route identification
  - **Duarte/Monrovia**
    - No issues
  - **Pasadena**
    - Supports use of simple blank-out signs along the routes in stead of combined dynamic/static signing
    - Preference for AC power; permanent locations; mount on new poles
    - Raised concerns over O&M costs of cellular communications
Agency Meetings

- **Open Issues:**
  - Transit Agency System Interfaces
  - Transfer of BlueTooth data to ICM
  - Air Quality Sensors
    - Type
    - Cost
    - Location

- **Next Steps**
  - Collect location information
  - Validate cost estimates
  - Scope within budget
Requirements Definition
Connected Corridors: I-210 Pilot
Integrated Corridor Management System

System Requirements (Draft)
June 3, 2016

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

- We have completed processing 544 comments
- The next version of the requirements document will be ready in two weeks
- We still need to hold a meeting to review Caltrans comments with stakeholders
  - Let’s pick a date for that meeting
## Summarized City and County Requirements

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<td>To the extent possible, Cities shall communicate special events, street closures and recommended detour information to the CM that may affect traffic operations on identified detour routes. Caltrans shall disseminate information.</td>
<td>Cities will assist the CM in defining and maintaining rules for building response plans, handling special situations, messages to be displayed on CMS signs, selecting response plans and sending response plans to corridor assets.</td>
<td>Cities shall permit the Core ICM System, using the cities’ signal control software, to select and implement preapproved signal plans for intersections on preapproved detour routes.</td>
<td>Cities shall remain engaged, attend meetings and/or teleconferences, and meet quarterly or as needed regarding incident/event responses.</td>
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<td>Cities shall maintain up-to-date definitions/inventory of arterial network elements</td>
<td>County, in consultation with cities and Caltrans, will create and maintain coordination timing plans for use during incidents. Cities and/or county shall load the timing plans onto the controller for use during an incident.</td>
<td>The cities shall permit the Core ICM System, using the CMS control software, to select and implement preapproved messages for display on preapproved detour routes. Cities shall be allowed access to the CMS control software to make changes within their jurisdiction.</td>
<td>Cities shall assist with editing, reviewing, and executing documents and agreements.</td>
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<td>Cities shall communicate forthcoming approved/pending changes in roadway geometry and operations affecting traffic conditions, restrictions, and traffic control devices on designated arterials to the CM</td>
<td>Where possible, the ICM system shall determine the end-time of a city initiated incident/event. Where not possible, the cities shall indicate when an incident/event has terminated or is expected to terminate. The ICM system determination may be overridden by the City.</td>
<td>The cities shall permit the Core ICM System, to contact designated city personnel with requests for performing preapproved actions</td>
<td>Cities shall provide updated information on City contacts. Caltrans shall disseminate information.</td>
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| Caltrans and cities shall work together to assist in resolving data, hardware, and software issues in a timely manner (the definition of timely manner will be determined at design time). | Caltrans CM, as necessary, will request meetings with cities in order to review rules used during incidents/events to determine if they worked correctly and, if they did not, resolve any issues | Overall ICM system will function correctly 85% of the time.  
• Signals 99%  
• Detection 85%  
• Communication 85% (70%-75%)  
• Software 95% | Cities will work with Caltrans to apply for federal, state, regional, and local funding sources. |
| Caltrans and cities shall ensure that system detection at key ICM arterial locations will be given priority maintenance. (Response time to be determined during design). | Stakeholder agreed to share video feeds as long as Caltrans’ videos are not stored | ICM Steering Committee shall define roles, responsibilities, and reporting structures for the ICM system. Cities shall ensure key personnel and support personnel are in place and trained. |
Caltrans Office of Technology
Caltrans Agreements

- Caltrans will start an IT Project to interface the CC system with the D7 ATMS.
- Institutional and personnel requirements, identified in the CC requirements document, will be provided to Kimley Horn for inclusion in the document they are generating on needed KSAs.
- Caltrans will obtain licenses for data transformation and data storage functionality identified in the CC requirements document. These will initially run in the cloud and be usage license based.
- PATH, working with Caltrans, will engage commercial vendors in a proof of concept operation for certain CC functions.
- Caltrans will use these requirements to procure (in the cloud and on a usage license basis) COTS software.
- Beginning in July, PATH will generate a gap analysis to identify missing components in the CC system implementation.
- Caltrans will work with PATH to develop and present material describing the CC strategy and framework.
Office of Technology

- Continued participation with the DCCM DSS RSCS
- Coordination meetings with HQ IT
- Research on Data Hub
- TMS Pilot Corridor Reporting Coordination
High Level Design
High Level Design

- All Requirements
  - Hardware and Software
    - Technical Design
    - Technical Requirements
  - Individual and Group
    - Organizational Design
    - Operational Roles and Responsibilities
  - Service Level Agreements
  - MOUs
Current Proposed ICM Architecture
High Level Design – Gap Analysis

- Map requirements to components
- Map components to owners who will provide the components
  - Existing
  - Existing requiring modifications
  - New
- Perform gap analysis
  - Components with no owners
  - Components with owners but lacking resources to provide components
High-level Architecture
Cloud Computing

• Utilizes hardware and software hosted in large data centers
  • Traditionally organizations would buy hardware
  • Scaling up quickly was impossible and technology was soon outdated
  • Installation of new software required a long purchasing cycle

• The immense need for computing permits companies to offer
  computing by the minutes of CPU usage and the Gigabyte stored
  • Immediate scalability
  • Only pay for what you use
  • No hardware maintenance needed
  • Cost is highly competitive because of scale (Amazon, Microsoft, Google)

• This allows an organization to focus on business needs and less on IT
Data Quality
Is there data on the freeway?

Question: For a given week and sensor category, what percentage of sensors are providing data of any quality (good or bad)?

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Answer: Provided by weekly summaries taken directly from PeMS detector health reports. (Calculated once a day and summarized)
Is there data on the arterial?

- **City of Arcadia**

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<tr>
<th>Intersections</th>
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<td>51</td>
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- **Detector health report**
  - **Criteria:**
    - Missing rate <5%
    - Inconsistency rate <15%
    - **Not reporting zero values (Major issue)**
  - **Assessment:** Good/ Bad/ No data
  - **Can provide daily/weekly/monthly reports**

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<th>Weekly Data Quality (%)</th>
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<th>Arcadia</th>
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Freeway data PeMS configuration

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Response Plan Meetings

- Caltrans HQ (including IT), Caltrans D7, PATH, System Metrics Group meet every 6 weeks to prepare for presenting initial response plans to cities and county.

- Next Meeting on June 30th

- We are:
  - Utilizing modeling in order to run corridor wide simulations
  - Using synchro to develop response plan scenarios
  - Running data quality analysis
  - Capturing user defined rules
Response Plan Generation

Incident data entered by Operator

Response plan generated from rules
Rules Definitions in Progress

- Incident classification
  - TIM Severity *(based on duration)*
  - Corridor Impact *(based on duration, weather, time of day...)*

- Reroute around extended incident
  - Based on incident initial & end postmiles and predefined routes

- Arterial signal timing for reroute
  - Based on severity, time of day, and reroute’s arterial

- Ramp metering for reroute return onramp
  - Based on severity and reroute’s return onramp

- Notification recipients
  - Based on incident initial & end postmiles
Determine possible reroutes
Determine e-mail recipients for I-210 incident
Simulation Modeling
Aimsun Model

- Coding of geometrical and basic control elements completed
Aimsun Model

- **Freeway elements**
  - Roadways
    - Mainline lanes
    - HOV lanes
    - On-ramps and off-ramps
  - Speed limits
    - 65 mph on freeway
    - 50 mph on ramps
  - Truck restrictions
    - Two leftmost lanes
  - Traffic detectors
    - Mainline, ramps, HOV lanes
  - Ramp meters
    - Time-of-day operations for now
  - Changeable message signs
    - Current and future
Aimsun Model

- **Intersections elements**
  - Lane markings
  - Approach speed limits
    - 25 to 45 mph, based on posted signs and local regulations
  - Movements within intersection
    - Destination lanes
    - Yielding movements
    - Right turn on red
  - Traffic detectors
    - Location
    - Size
    - Signal control phase associations
  - Traffic signal operations
    - Fixed time and actuated-coordinated operations
    - Timing plan schedule (over 24 hours, weekdays and weekend)
  - Stop-controlled intersections

![Image of a traffic intersection with labels for detectors and transit stop bay]
Aimsun Model

- **Transit services modeled**
  - Metro Gold Line
  - Bus routes operated by Metro Bus (18), Foothill Transit (5), LA DOT (1), Pasadena Transit (9) and Duarte Transit (2)
Aimsun Model

- **Demand modeling**
  - Completed the mapping of modeled traffic origin/destination nodes to the regional Traffic Analysis Zones (TAZ)
  - Currently inputting available freeway and arterial traffic counts into Aimsun
    - Data to be used as calibration elements
  - Approached SCAG to obtain trip data from the 2008 Regional Travel Demand Model
    - Request cannot be fulfilled → Agency in process of developing next long-range plan
  - Obtained Caltrans 2008 Regional Travel Demand Model
    - TransCAD Model based on SCAG’s regional model
    - Raj Porandla, from Caltrans Headquarters, is assisting in running the model and extracting desired origin-destination flows and routing patterns
  - Extracted origin-destination demand data from Pasadena’s 2012 VISUM Dynamic Traffic Assignment model
    - Passenger cars
    - HOV vehicles
Synchro Analysis
Reroutes Analyzed

- Considering 2 short detours during peak travel periods

8 AM Detour
+500 veh/hr

5 PM Detour
+500 veh/hr
Foothill Detour

Timing changes
- 24 to 37 s green increase
- 150-s coordination cycle

Impacts
- Additional traffic increases travel time from 3.1 to 8.5 min
- Signal changes reduce travel time along detour from 8.5 to 4.3 min
- Route capacity increased from 376 veh/hr to 781 veh/hr (left-turn limit at Huntington/Mountain)

Notes
- Busiest intersection constrain what can be done
- Evaluation assuming peak-hour flow is sustained
- Some flows were estimated
- Likely conservative estimates, as Synchro has difficulty estimating delays in oversaturation
- Network effects not fully considered
### Potential benefits from timing adjustment

- Adding 10 s green reduce travel time along detour from 4.3 to 3.0 min

### Notes
- Busiest intersection constrains what can be done
- Evaluations assuming peak-hour flow is sustained
- Synchro has difficulty calculating delays where oversaturation occurs
- Network effects not considered
AMS Effort
AMS Effort – Next Steps

- **Calibration of Aimsun model**
  - Freeway flow calibration to occur first
  - Arterial calibration to occur in stage following freeway calibration
    - Tighter calibration for key arterials close to freeway and key reroutes
    - Looser calibration for non-reroute arterials away from freeway and secondary streets
  - Calibration for each hour of the day
    - AM Peak, Midday, PM peak
    - Individual weekdays

Goals:
- **Preliminary model** that can be used for concept assessment available in 3 months
- **80% calibrated model** in 6 months, if no major problems are encountered
AMS Effort – Next Steps

- Development and evaluation of signal timing response plans
  - Identify response plan needs for individual intersections based on:
    - Identified detours
    - Ability to use existing timing plans
    - Ability to store additional timing plans within each signal controller
  - Design coordination plans for individual reroutes based on:
    - Synchro optimization
    - Local control principles/constraints
  - Use Aimsun to simulate efficiency of proposed response timings

Goals:
- Preliminary evaluation of proposed response strategy for several key detours over next 3-6 months
- Use simulation results to develop general guidelines for the design of signal timing plans for incident response
Action Items and Next Meeting Time
Thank You