Connected Corridors
Systems Engineering Update
Agenda and Introductions

- Vision
- Corridor
- System Engineering Schedule
- Status by High Level Tasks
- Generic ICM System Components
- Discussion
The Connected Corridors Vision

Connected Corridors – VIP
Vehicles, Infrastructure and People

- Connected & Automated Vehicles
- Connected Infrastructure
- Connected Travelers
- Enhanced Decision Support
- Corridor Centric Social Networking

TRB 2015 Theme: Corridors to the Future – Transportation and Technology
Caltrans and ICM - Connected Corridors

- **Goal:** Caltrans will lead the planning, implementation and ongoing operational support for 50 corridor segments in California – “ICM California”

- “**Connected Corridors Program**” – Multi organizational program tasked with delivering the reusable components of “ICM California” and piloting those components

- “**I-210 Pilot**” – First Caltrans-lead ICM effort in California and first corridor site in the “ICM California” plan.

- “**Connected Corridors: VIP (Vehicles, Infrastructure and People)**” – Longer term vision of coordinating all major actors in a transportation corridor.
The Connected Corridors Program

- **Caltrans**
  - Leadership of corridor management efforts
  - Organizational and cultural changes (HQ and districts)
  - Corridor focused and prioritized funding
  - Commitment to proper sensing and control elements
  - Integration with CMM (Capability Maturity Matrix) and TSM&O processes
  - Development of Corridor Wide operational scenarios, systems and awareness
  - I-210 Pilot

- **PATH**
  - Working with industry, government and academia to provide recommendations for “ICM California” components and methods
  - Performing applied research on macro models, probe data, cell tower data and control strategies
  - Designing fast, easy to calibrate simulation tools for use by Caltrans in day to day operations
  - Supporting Caltrans in I-210 Pilot planning and implementation efforts
  - Documenting the I-210 pilot so that its tools and processes may be more easily reused in other corridors

- **Our 210 Stakeholders –** LAMETRO, LACounty, SCAG, SGVCOG, Pasadena, Arcadia, Monrovia, Duarte ++

- **Our 210 Partners and Vendors –** SMG, SANDAG, TSS, Delcan, ITERIS ++
**I-210 Project Corridor & Caltrans Partners**

**Phase 1 Area of Interest**

**Current Partners Identified (but not limited to):**

- Caltrans, Metro, UC Berkeley PATH, LA County, Pasadena, Arcadia, Monrovia, Duarte

(Phase 2 - Irwindale, Azusa, Glendora, San Dimas, and La Verne)
# Project Schedule

## Key Deliverables

<table>
<thead>
<tr>
<th>Name</th>
<th>Date</th>
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<tbody>
<tr>
<td>Submit Draft Project Management Plan</td>
<td>6/2014</td>
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<tr>
<td>Submit Preliminary System Concept to Stakeholders</td>
<td>8/2014</td>
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<tr>
<td>Submit Draft SEMP to Stakeholders</td>
<td>10/2014</td>
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<td>Submit Draft ConOps to Stakeholders</td>
<td>11/2014</td>
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<tr>
<td>Submit Draft System Validation Plan to Stakeholders</td>
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<tr>
<td>Alternative Analysis Report</td>
<td>12/2014</td>
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<tr>
<td>System Acceptance Tests</td>
<td>9/2016</td>
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<td>System Validation and Acceptance Report</td>
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<td>System Launch</td>
<td>10/2016</td>
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<td>System Evaluation Report</td>
<td>11/2017</td>
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<tr>
<td>Lessons Learned</td>
<td>12/2017</td>
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Main Project Tasks

1. **Ongoing**: Project Initiation & Management
2. **Ongoing**: Outreach & Communications
3. **11/13 – 10/16**: Corridor Preparation
4. **11/13 – 9/14**: Concept Exploration & User Needs
5. **1/14 – 12/14**: Analysis, Modeling & Simulation (AMS)
7. **8/14 – 2/15**: Concept of Operations (ConOps)
8. **1/15 – 5/15**: System Requirements
10. **5/15 – 2/16**: Technical Design
11. **6/15 – 5/16**: Component Development
12. **7/15 – 8/16**: System Integration
13. **7/15 – 1/16**: Institutional Deployment
14. **11/15 – 9/16**: Technical Deployment
15. **6/16 – 10/16**: Training
16. **5/15 – 10/16**: System Validation & Acceptance
17. **10/16 – 10/17**: System Operations & Maintenance
19. **9/17 – 12/17**: Lessons Learned
# Project Schedule

## 2014

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<thead>
<tr>
<th>Project Initiation &amp; Management</th>
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<td>Outreach &amp; Communications</td>
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### 1st Quarter
- **Corridor Preparation**: 11/1/13 - 10/4/16
- **Concept Exploration & User Needs**: 11/4/13 - 5/7/14

### 2nd Quarter
- **Analysis, Modeling & Simulation**: 1/6/14 - 12/10/14
- **EMPI**: 7/11/14 - 12/19/14
- **ConOps**: 8/22/14 - 2/9/15

### 3rd Quarter
- **System Requirements**: 1/5/15 - 5/20/15

### 4th Quarter
- **Organizational & Technical Design**: 4/2/15 - 7/4/15
- **Component Development**: 6/5/15 - 5/18/16
- **System Integration**: 7/10/15 - 8/9/16
- **Technical Deployment**: 12/2/15 - 9/2/16
- **Institutional Deployment**: 1/22/15 - 1/28/16
- **System Validation & Acceptance**: 5/14/15 - 10/24/16

### 2015

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Stages in 210 Pilot – Focus on Planning

- **Planning – We are here!**
  - Assemble Sponsors and Stakeholders
  - Concept Exploration
  - AMS
  - PMP and SEMP
  - Concept of Operations
  - Funding and Organizational Structures
  - Initial Requirements

- **Implementation**
  - Agree on MOUs, Playbooks, Deployment
  - Integrate/build supporting systems
  - Refine corridor sensing and control capabilities
  - Deployment (System and MOUs)

- **Operations and Maintenance**
  - Operate the system
  - Evaluate the system
  - Maintain the system
  - Upgrade the system
1. Project Initiation and Management

- **Corridor Selected end of 2013**

- **Contractual Items**
  - Program currently funded by Caltrans HQ through June 2015
  - Subsequent three year contract in process

- **Funding efforts at Caltrans**
  - PID due by end of June

- **Organizational efforts**
  - Reorganization plan in process

- **PMP in internal PATH review. Caltrans review in early June**
2. Outreach and Communication

Engaged primary stakeholders early on – Caltrans D7, LA Metro, LA County Dept. of PW, and Phase 1 cities (Pasadena, Arcadia, Monrovia, Duarte) – Held initial and technical meetings; User Needs Workshop

Outreach & Communications is going well and on schedule; positive feedback from stakeholders!

Outreach meetings: San Gabriel Valley Council of Govts. (staff and Transportation Committee), SCAG, CHP/Coroner, Metro Transit

Prepared Outreach & Communications Work Plan (part of Project Management Plan) in late 2013

Videoconference series this summer for “launch;” newsletter and Fact Sheets under development; upcoming conference participation; Letter Agreement with primary stakeholders; then MOU; Resolution of Support from SGVCOCG

Upcoming meetings: City Councils, Foothill Transit, South Coast Air Quality Management District, Metro Gold Line Construction Authority, other first responders, community and non-profit groups

Developed one page fliers, website, and bi-monthly “Digest”
3. Corridor Preparation

- **Corridor Analysis**
  - Detector health
  - Detection gaps
  - Current traffic control capabilities

- **Maintenance and upgrade needs**
  - Preparation of PIDS
  - Lining up of possible funding

- **Currently starting AMS**
  - Modeling of corridor for simulation analyses
  - Development of evaluation scenarios
4. Concept Exploration

- **Inventory of corridor systems**
  - Transportation networks (freeway, arterial, transit, parking, etc.)
  - Traffic signal control systems (intersections, ramp metering)
  - Traffic detection systems
  - Traveler information options
  - Understanding institutional environment

- **Review of other ICM efforts**
  - Lessons learned
  - Desirable common features
  - Basic connectivity needs

- **Identification of basic user needs for I-210 Pilot**

- **Review of regional ITS architecture**
  - Setting up a team to identify basic communication, sensing and control capabilities

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*Key Underlying Goal:*
To get a head start on funding requests and construction projects
4. Summary of User Needs and Metrics

- **Initial concepts defined by I-210 Stakeholders**
  - Focus on incidents where ramp metering rates, signal timings, alternate routes and transit services are modified to ameliorate the situation
  - Pre-agreed playbook scenarios
  - Enable turn key operations when traffic managers are not available and coordinated system actions are needed

- **Metrics recommended by I-210 Stakeholders**
  - Citizen and traveler satisfaction
  - Mobility, Reliability and Productivity
  - Safety and Incident Management
  - Air Quality
4. Preliminary User Needs

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<td>1. Asset Availability Monitoring</td>
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<td>2. Travel Demand Data Collection &amp; Processing</td>
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<td>3. Traffic Operational Data Collection &amp; Processing</td>
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<th>Decision Support</th>
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<td>4. Operational Forecasts</td>
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<td>5. Decision-making Assistance</td>
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<td>6. Operational Evaluation</td>
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<th>Control Capabilities</th>
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<td>7. Strategy Customization</td>
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<td>8. Automated Control</td>
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<td>9. Manual/Override Control Options</td>
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<td>10. Multi-Agency Coordination</td>
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<td>11. Information Visualization</td>
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<th>Information Dissemination to Travelers</th>
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<tr>
<td>12. Provision of Real-Time, Multi-Modal Information</td>
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<td>14. Trip Decision Support Tools for Travelers</td>
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<td>15. Data Archival</td>
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5. AMS

- Lack of detection health is a challenge

- Extension of Project Management Plan (PMP)
- **Focus on technical system engineering elements**
  - System configuration management
  - System verification plan
  - System deployment plan
  - Evaluation strategy
  - Operations and maintenance plan
  - Possibly others

- Initial draft in progress (started early)
7. Concept of Operation

- Expansion of preliminary concepts exploration and identified user needs into a formal ConOps document

- Key activities
  - Formalization of key system components
  - Development of operational scenarios
  - Development of key performance metrics
  - Characterization of operational and support environments
  - Assessment of potential impacts on corridor operations

- Preliminary step to the development of system requirements
Summary

- SE Plan being followed
- On Schedule

Challenges

- Apparent gaps in both data and control capabilities – Are working to reduce these but this is slowing down the AMS effort.
- Corridor Infrastructure upgrades take time – Wise to start early before detailed requirements are in place.
- Education on ICM – Introduction to other ICMs and their components underway. Will speed up subsequent tasks.
- Diversity of traffic control and detection systems – Start planning for communication and standardization where possible.
- More agencies wish to be involved than originally planned – Adjusting tasks and schedules (hopefully only in a small way)
ICM System

- Sensors & Feeds
- Corridor Management
- Decision Implementation
- Decision Support
Communication and Data Standardization
Items for Discussion

- **Connected Corridors Messaging**
  - Role of other organizations in this effort
  - Role of PATH in future corridors
  - Interplay between work PATH is doing for Caltrans on DSS and the requirements we end up with

- **Registration for TRB Mid Year (Posters etc)**

- **D7 beginning to work with us on simulation tools**
  - Demonstration end of June?
  - Ongoing work each month or so

- **Upgrading**