Connected Corridors

ICM Systems Architecture and Operations Workshop

March, 2014
Agenda and Introductions

- 8:00-9:00  - Coffee and Pastries
- 9:00-9:15  - Introductions
- 9:15-9:30  - Remarks by Kris Kuhl, Roberto Horowitz, Alex Bayen
- 9:30-10:15  - Planning, Implementation and Operation - User needs for ICM
- 10:15-10:30  - Break
- 10:30-11:45  - Discussion of integrated corridor management architecture requirements
- 11:45-12:45  - Lunch
- 12:45-2:15  - Review of SANDAG, D4, D7 and DART architectures, Lessons learned
- 2:15-2:30  - Break
- 2:30-3:15  - Connected Corridors/ICM operation and maintenance discussion
- 3:15-3:30  - Closing and next steps
- 3:30-??  - Wine and cheese reception with faculty, students and staff
Goals – This is a conversation

- **Basic Goals**
  - Get to know each other
  - Discuss the system architecture needed for Integrated Corridor Management
  - Discuss the operational support needed for these systems

- **However there are deeper goals:**
  - Develop common understandings
  - Expand our sense of community
  - Grow our ability to collaborate
  - Commit, as a team, to the success of ICM in California
  - Know that Caltrans is committed to leading and enabling this team
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
Integrated Corridor Management

- ICM – Managing a multi-model, multi-jurisdictional transportation corridor so that corridor wide metrics such as efficiency, sustainability, safety and quality of life are maximized

- History –
  - 2005 – USDOT begins ICM efforts
  - 2006 – USDOT selects 8 Pioneer Sites for ConOps Development
  - 2009 – SANDAG and DART selected for field demonstrations
  - 2009 – Approval of Alameda County Transportation Commission I-80 ICM
  - 2011 – Connected Corridors Program is started in California
  - 2013 – SANDAG and DART go live
  - 2015 – Expected launch of I-80 ICM
  - 2016 – I-210 ICM goes live
Caltrans and ICM - Connected Corridors

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

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

- “Connected Corridors” – The multi organizational program tasked with delivering all reusable components of “ICM California.”

- “Connected Corridors: VIP (Vehicles, Infrastructure and People)” – The 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) 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
- Enhancing decision support tools using new data sources, simulation methods and highway/arterial/multi-modal management strategies
- Supporting the day to day needs of the I-210 Pilot planning and implementation
- Documenting the I-210 pilot so that its tools and processes may be more easily reused in other corridors
Stages in ICM – Focus on Planning

- **Planning – We are here!**
  - Assemble Sponsors and Stakeholders
  - Concept of Operations
  - Corridor Analysis
  - High level Architecture
  - High Level Deployment Planning
  - 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
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)
Concepts and Metrics: I-210 Stakeholders

- **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
Vendor Involvement – A few Examples

Delcan
McCain
here
TSS
Kimley-Horn and Associates, Inc.
SIEMENS
INRIX
PTV GROUP
ITERIS
TransCore
at&t
Mygistics
ECONOLITE
CAMBRIDGE SYSTEMATICS
System Metrics Group
Vendors Interactions – A few Examples

**Caltrans D7**
- System Integrator: Delcan
- Statewide Signal Control: TransCore
- Simulation: Cambridge Systems, System Metrics Group

**LA County**
- Traveler Information: Blue Commute
- Data Communication: TransCore, IEN

**Pasadena**
- Traffic Signal Control / Detection: Siemens, McCain, TransCore, Econolite
- Controllers: Blue Commute
- Video Detection: IEN
- Simulation: PTV Group, Mygistics
- Dynamic Traffic Assignment Model: VISSIM

**Arcadia**
- Traffic Signal Control: TransSuite
- Traffic Detection: Iteris
- Video Detection: Pelco
- CCTV Cameras: CCTV Cameras
ICM Architecture

- **First - Understand and agree upon the overall generic components of an ICM Architecture**
  - Data Sources from numerous jurisdictions
  - Signals and Signs in numerous jurisdictions
  - Real time data communication requirements
  - Real time decision support and decision agreement

- **Next – Review implementations**
  - SANDAG
  - DART
  - Bay Area

- **Review current architecture of D7 as discussion point for future plans**
Architecture – At its most basic

- Sensors & Feeds
- Corridor Management
- Decision Implementation
- Decision Support
Adding the stakeholders

- Caltrans
- Cities & Counties
  - Information Service Providers
  - Transit
- Sensors & Feeds
- Corridor Management
- Decision Support
- Decision Implementation
  - Transit
  - Information Service Providers
  - 511, Web Site, Social Networking
- Caltrans
- Cities & Counties
Communication and Data Standardization
Stakeholder Data and Controllers

- Caltrans
  - Loop Data
  - Ramp Meters
  - Signals

- Cities & Counties
  - Sensors & Feeds

- Information Service Providers
  - CHP/Events
  - Industry/Probes
  - Rail
  - Parking
  - Bus

- Transit
  - Arterial Loops

- Decision Support
  - Transit
  - Information Service Providers
  - 511, Web Site, Social Networking

- Decision Implementation
  - CMS
  - Ramp Meters
  - Signals

- Cities & Counties
  - CMS
  - Signals
System Components
Corridor Management Subsystems

- Corridor Management
- Management/Control
- Security
  - Data Management
    - ATMS
      - Fwy CMS
    - Ramp Meter Control
    - Other
    - Caltrans Arterial Signal Control
    - City/County Arterial Signal Control
    - Arterial CMS/Wayfinding
  - Map
  - Metrics
# Existing ICM Efforts (United States)

<table>
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<tr>
<th>Corridor</th>
<th>Corridor Type</th>
<th>Lead Agencies</th>
<th>Activities</th>
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| I-15 Diego   | Suburban            | SANDAG        | • ConOps and System Requirements developed in 2008  
                   |                     |               | • Simulation evaluation in 2009-2010  
                   |                     |               | • System launched October 2013  
                   |                     |               | • Currently in evaluation phase |
| US-75 Dallas | Suburban & urban    | DART          | • ConOps and System Requirements developed in 2008  
                   |                     |               | • Simulation evaluation in 2009-2010  
                   |                     |               | • System launched in April 2013  
                   |                     |               | • Currently in evaluation phase |
| I-80 Bay Area| Suburban & urban    | MTC / Caltrans| • ConOps developed in 2010  
                   |                     |               | • Groundbreaking in October 2012  
                   |                     |               | • Expected to be completed Summer 2015 |
| I-95 / I-395 Virginia | Rural, Suburban & Urban | Virginia DOT | • ConOps development initiated in 2012  
                   |                     |               | • Currently developing deployment plan & partnerships |
Concept → Use → Logical → Process → Deploy → Implement → Data
DART – Dallas Area Rapid Transit

SmartNET System

Bluetooth arterial monitoring system + 3rd Party data

Simulation Model

Multimodal 511 system
DART – Decision Support System
I-80 Corridor – Dan Lukasik

- Over 20,000 vehicle-hours of delay per day
- Inconsistent level of service (C to F)
- Variable speeds (stop & go to 65 mph)
- High incident rates: over 2,000 incidents annually
- Un-reliability of travel (20 to >60 min)
I-80 ICM Solution

I-80 ICM deploys ATM and ICM strategies that will:

- Create a Well Balance System
- Maintain Optimal Operational Viability
- Proactively Avoid Flow Breakdown
- Detect and Respond to Congestion Events Faster
- Improve Safety
- Manage Congested Flow When it Does Occur
- Promote Transit Ridership and Mode Shifts
- Clear Local Arterials from Diversion
I-80 ICM Elements

Elements

1 - ARM
- Coordinated Ramp Meters
- Maximum Queue Detectors
- Variable Advisory Speed Signs
- Flush Plans
- Trailblazer Signs
- Lane Use Signals

2 - ATM

3 - Transit
- Changeable Message Signs
- Traveler Information

4 - Arterial
- Transit Signal Priority
- Expanded Signal Coordination
- CCTV Cameras
- Local Street Improvements
- Transit-Rescue Information
- System Integration

5 - Coordinated Ramp Meters

I-80 Integrated Corridor Mobility Project
Integration of various agency subsystems working together

1. Arterial
2. Freeway
3. Transit
4. Emergency Responders

Key Component is the Incident Response System
D4 ATMS Architecture

Red Items – New Components

Blue Items – Modified Components
TSMSS

(SONET* Ethernet)

*All analog communications are connected through Sonet

400+ miles Fiber optic Communication

D7 ATMS

TSMSS

Traffic Signal Management & Surveillance System

Detectors

1,400 RMS

490 CCTV

130 CMS

22 HAR

1300 Traffic Signals

DCRMS: (Dynamic Corridor Ramp Metering System) An upgraded Adaptive Corridor wide Ramp Metering System which will support DCCM operations.

RIITS: Operated by Metro in support of inter-agency information exchange (In addition to travel information to 511, also include Ramp Meter Operation Status/Meter Rate, CCTV Streaming Video).

511: Real time travel information (Congestion, CMS Message, Confirmed Event, Travel Time, CCTV Video).
Operations and Maintenance

- Operations Requirements
- Maintenance Requirements
- Liability Issues
- Staffing and Training
Conclusions and Action Items
Thank You

- Wine and Cheese
- Faculty
- Students
- Staff
I-210 Pilot Project Goals

- **Bring together corridor stakeholders** to create an environment for mutual cooperation, including sharing knowledge, developing working pilots, and researching and resolving key issues.

- **Formulate a roadmap** for the cost-effective implementation of future innovations.

- Develop and deploy an integrated, **advanced decision support system** for use by the stakeholders as they actively manage the corridor.

- Develop a **set of performance measures** to quantify the successes of the Connected Corridors pilot project.

- **Demonstrate project effectiveness** that can lead to additional phases and funding for more advanced tools and capabilities.

- Develop a pilot system that **can be replicated** on other corridors and be a model for other corridors in the state and country.
The Connected Corridors Program

- Organizational and cultural changes
- Funding and strategic planning
- System Engineering
- Relationship management with gov agencies, industry, legislature
- Decision Support Tools
- Applied research
- 210 Pilot
- Evaluations
- 50 corridors in Ca
I-210 Pilot – Overall Schedule

1. Project Initiation & Management
   10/1/13 - 12/29/17

2. Outreach Activities
   10/1/13 - 12/29/17

3. Corridor Preparation
   11/1/13 - 10/1/16

4. Concept Exploration & User Needs
   11/1/13 - 8/14/14

5. Analysis, Modeling and Simulation
   1/6/14 - 3/4/15

6. SEMP
   6/13/14 - 12/22/14

7. ConOps
   7/28/14 - 1/20/15

8. System Requirements
   12/12/14 - 4/30/15

9. Institutional Design
   4/10/15 - 8/3/15

10. Technical System Design
    3/26/15 - 5/5/16

11. Component Development
    4/24/15 - 5/12/16

12. System Integration
    6/22/15 - 12/6/17

13. Institutional Deployment
    8/4/15 - 12/13/15

14. Technical Deployment
    10/13/15 - 10/18/16

15. Training
    7/26/16 - 10/18/16

16. System Validation and Acceptance
    4/24/15 - 1/13/17

17. System Operations
    10/19/16 - 1/4/18

18. System Evaluation
    4/21/15 - 12/28/17

19. Lessons Learned
    5/5/17
I-210 Pilot – Overall Schedule

2014

1. Project Initiation & Management
   10/1/13 - 12/29/17

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3. Corridor Preparation
   11/1/13 - 10/3/16

4. Concept Exploration & User Needs
   11/1/13 - 8/14/14

5. Analysis, Modeling and Simulation
   1/6/14 - 3/4/15

2015

6. SEMP
   6/13/14 - 12/22/14

7. ConOps
   7/28/14 - 1/20/15

8. System Reqs
   12/12/14 - 4/30/15
Vendors Interactions

**Caltrans D7**
- System Integrator
  - Delcan

**LA County**
- Traffic Signal Control
  - Kimley-Horn and Associates, Inc.
- Traveler Information
  - Blue Commute

**Pasadena**
- ITS Solutions
  - TransSuite
  - SCATS
- Traffic Signal Control
  - i2tms
  - QuickNet Pro

**Arcadia**
- Traffic Signal Control
  - TransSuite
- Video Traffic Detection
  - CCTV Cameras
- Traveler Information
  - Blue Commute

**Simulation**
- Cambridge Systematics
- System Metrics Group
- TransSuite
- TransCore
- PTV Group
- Mygistics
- VISSIM
- Dynamic Traffic Assignment Model
Vendors Interactions

Monrovia
Traffic Signal Control
Kimley-Horn and Associates, Inc.

Duarte
Traffic Signal Control
Kimley-Horn and Associates, Inc.

Irwindale
Traffic Signal Control
TransCore

LA Metro
Bus Tracking / Traveler Information
nextbus

Common Equipment Vendors
ECONOLITE
ITERIS
McCain
SIEMENS
Schneider Electric
Sensys

CALTRANS
Delcan
TSS
here
Sandag
System Metrics Group
PATH
Vendors Interactions

Simulation/Analytical Tool Providers

- Aimsun
- Vissim
- TransModeler
- TransCAD
- Synchro
- SimTraffic
- Paramics

Potential Engineering Consultants

- SAIC
- Fehr Peers
- URS
- AECOM
- Kittelson & Associates
- HNTB
- Parsons Brinckerhoff
- CH2M HILL
- PARSONS
- TELVENT
- Schneider Electric
Applied Research

- Real Time Origin Destinations from Cell Tower Data (AT&T)
- Full integration of probes as data source (Here/Nokia and Inrix)
- Macro modeling capabilities based on measured traffic data and not driver behavior estimates
- Highway, arterial and transit coordination in real time
- Improvements in reroute response and estimation
- Determination of modeling accuracy
- Human Factors – outward looking
- Institutional issues