Multi-Modal Intelligent Traffic Signal System (MMITSS) Development in California

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Caltrans

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MMITSS Project Background

- Funded through the Connected Vehicle Pooled Fund Study, led by Virginia DOT
- Additional funding from USDOT Dynamic Mobility Applications (DMA) program
- University of Arizona and University of California PATH Program
- Phase I: March 2012- June 2013 (Concept of Operations, System Requirements, Preliminary Design)
- Phase II: October 2013 – December 2015 (Implement, Test, and Evaluate)
California Connected Vehicle Test Bed

- New
- Original Sites

- Stanford
- Cambridge
- Page
- Mill
- Portage/Hansen
- Matadero
- Curtner
- Ventura
- Los Robles
- Maybell
- Charleston
California Connected Vehicle Test Bed

1. Stanford
2. Cambridge
3. California
4. Page Mill
5. Portage/Hansen
6. Matadero
7. Curtner
8. Ventura
9. Los Robles
10. Maybell
11. Charleston
Example Installation

6. Matadero Avenue
RSE goes above mast arm on the vertical
Antenna on the mast arm;
Needs Bracket
Actual Installation (Page Mill Road and El Camino Real)
Example Layout Schematic

Intersection list:
- Stanford
- Cambridge
- California
- Page Mill
- Portage/
- Hansen
- Matadero
- Ventura
- Los Robles

Schematic 1
Somak Datta Gupta 01/18/2013

Note: Not to scale
Multi-Modal Intelligent Traffic Signal System (MMITSS)
MMITSS Application Categories

• Intelligent Traffic Signal System (ISIG)
  – Signal actuation
  – Coordinated section of signals
  – Congestion control
• Transit Signal Priority (TSP)
• Freight Signal Priority (FSP)
• Emergency Vehicle Priority (EVP)
• Pedestrian Mobility
## What does CA MMITSS Offer?

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<tr>
<th></th>
<th>AZ Site</th>
<th>CA Site</th>
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<tbody>
<tr>
<td>Test bed traffic</td>
<td>Suburban intersections</td>
<td>Major arterial in congested intersections</td>
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<tr>
<td>Traffic Controller</td>
<td>Econolite ACS3 traffic controller software</td>
<td>Caltrans 2070 controller software (similar to LADOT’s traffic signal control software)</td>
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<tr>
<td>System Architecture</td>
<td>▪ Savari RSE directly connected with Econolite controller</td>
<td>▪ Interface controller between traffic controllers (any traffic controller types and RSEs)</td>
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<td>▪ Peer to peer data communication</td>
<td>▪ Data Manager for centralized data control, time stamping, and synchronization</td>
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<tr>
<td>MMITSS Algorithm</td>
<td>MMITSS traffic and priority control algorithm based on adaptive traffic control system</td>
<td>MMITSS traffic and priority control algorithm based on adaptive traffic priority algorithm for actuated traffic signals</td>
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MMITSS System Architecture with Centralized Data Management

- **MMITSS function**
- **MMITSS function**
- **MMITSS function**
- **Other CV Function**
- **DSRC**
- **MMITSS Data Manager**
- **MMITSS Data Manager**
- **Traffic controller**

Multi-Modal Intelligent Traffic Signal System
Changes to Caltrans 2070 Controller

2070 Traffic Signal Control Program (TSCP) software modifications for MMITSS:

- Increased the rate for transmitting the controller state message (for generating SPaT) to 10 Hz (for serial port 1)
- Added two new sets of AB3418 messages (on serial port 2)
  - Loop presence at 1 Hz
  - System loop count and occupancy at the cycle end
- Implemented soft-calls via AB3418 protocol (on serial port 2)
  - Vehicular and pedestrian soft-call
  - Vehicular phase actuation (extended green for advance loop function)
  - Signal priority request (early green; extended green)
- AB3418 messages for changing the control plan (cycle-length; green split; and offset) already exist in TSCP
PATH Development

• California MMITSS software is implemented with software developed by PATH

• Modified wmefwd software module
  – Uses USDOT standard PSIDs (BSM, SPAT, MAP, SRM, ART)

• Improved software maintainability
  – wmetx & wmerx
  – Both handle two radios and multiple PSIDs
PATH Development (Cont’d)

• Modified MRP_TrajectoryAware software module
  – Improves software robustness by adding tracking capability
    • Inaccurate heading when speed is low
    • GPS error
PATH Development (Cont’d)

• Modified MRP_TrajectoryAware software module
  – Addresses the hard limit of 1K MAP message size - projects car GPS onto lane instead of finding the closest way-point
• Stand-alone ASN.1 encoding/decoding library
  – PATH MRP processes are hosted by an embedded PC, cannot directly call Savari’s ASN.1 library functions

• Soft-call timing
  – Sends priority request call every 50 ms until either a cancel priority request is received or the priority phase has been terminated (for extended green) or has turned to green (for early green)
  – Sends vehicular phase actuation/extension call every 50 ms until either the vehicle has passed the intersection or the phase green has terminated
Status of California MMITSS Project

• The CA MMITSS signal priority and Intelligent Traffic Signal is built upon the adaptive signal priority algorithm
• The algorithm was thoroughly tested using 3G based communication network (emulating transit Advanced Communication System)
• MMTISS traffic and priority control software modules have been developed and tested at the Richmond Field Station intersection
• Caltrans HQ Traffic Ops has modified 2070 TSCP software
• Field testing will be conducted in October 2015; final demo for FHWA in mid-November
Questions?

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