AMS and DSS concepts in the Connected Corridors Program

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Enable existing transportation infrastructure and vehicles to work together in a highly coordinated manner

Deliver improved corridor performance (safety and mobility)

Improve accountability

Evolve Caltrans to Real-Time operations and management

Enhance regional, local, and private sector partnerships
• Previous/Ongoing Efforts
  – USDOT ICM Efforts
  – PEMS – California Performance Measurement
  – TOPL – Tools for Operational Planning (Macro Modeling)
  – Mobile Millennium - Big Data fusion with probes
• Concurrent Efforts
  – Organizational Analysis for Corridor Mgmt
  – San Diego and Dallas ICM Implementations
  – Connected Vehicles
• New Research Efforts
  – Machine Learning
  – Corridor Control with highly fused data
  – Demand Mgmt with crowd sourced decisions
  – True Collaborative Commuting – People, Infrastructure and Vehicles
Some key concepts from the FHWA foundational research program

- Components
  - Scenario generator
  - Data generator
  - Network simulator
  - Decision gate
- Phases
  - Monitor
  - Assess system performance
  - Evaluate strategies
- Analysis plan: 4 packages
Freeway-Arterial coordination in CC

- We are taking a proactive, dynamic, simulation-based approach.
- Coordination to us means that,
  a) controllers on each side can access the measurements and calculations of the other side, and
  b) there is a high-level decider.
- Coordination does not mean that we solve a single, monolithic control problem.
- We will focus on four solving/simulating scenarios,
  1. Fwy congestion → suspend the onramp queue override,
  2. Fwy congestion → store more on the arterial,
  3. Art congestion → increase flow to the freeway,
  4. Freeway incident → divert traffic to the arterial.
Scenario #1

Trigger
- The freeway is congested and the onramps are full.
- The queue override prevents ramp metering from being effective.

Action
- Suspend queue override; allow the queue to spill into the streets.

Predict
- Net effect on the system.
Scenario #2

**Trigger**
- The freeway is congested and the onramps are full.
- The queue override prevents ramp metering from being effective.

**Action**
- Adjust arterial signals to decrease the flow on critical onramps.

**Predict**
- Net effect on the system.
Scenario #3

**Trigger**
- Demand surges on the arterial (e.g. ball game is over).
- Ramp metering is responsive to freeway demand only.

**Action**
- Increase metering rate to accommodate the surge.

**Predict**
- Net effect on the system.
Scenario #4

**Trigger**
- Accident on the freeway.

**Action**
- Put a message on a freeway CMS.

**Predict**
- Response to the message, impact on the streets.

**Diagram:***
- Accident ahead. Use side streets.
ATDM/DSS flow

1. How to define/measure activating events?
2. What are the actions related to each event?
3. How do we predict the impacts of the actions?
4. What are the criteria for taking action?

- Select action
- Predict impacts
- Perf. assess
- Monitor
- Deploy
Simulation environment

- BeATS : BErkeley Advanced Traffic Simulator.
- BeATS builds upon TOPL’s Aurora Road Network Modeler.
- Based on the Link-Node Cell Transmission Model (LNCTM).

Network parameters:
- Link parameters
  - capacity (*),
  - free-flow speed (*)
  - etc.
- Demand profiles (*),
- Split ratio matrices (*),
- Sensor locations,
- Freeway and arterial control,
- Events (e.g. accidents)

- Simulation start and end time,
- Number of runs.

Predicted performance distributions
Architecture

Database
Raw data feeds:
• PeMS     • Weather
• Probes   • CHP
• Bluetooth • etc…
Architecture

Fundamental diagram
parameters

Initial condition

Boundary conditions

Data check and filters

Model calibration

Freeway state estimation

Arterial state estimation

Split ratio estimation

Demand prediction

Stochastic Network simulation & Performance prediction

Database
Architecture

Database

Fundamental diagram parameters

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Stochastic Network simulation & Performance prediction

Action plan
Architecture

- Data check and filters
- Model calibration
- Freeway state estimation
- Arterial state estimation
- Split ratio estimation
- Demand prediction
- Stochastic Network simulation & Performance prediction

Action plan

Database

Visualization
System monitoring
Architecture

Monitor & Assess → Plan bank → Decision gate

trigger

Data check and filters → Model calibration → Freeway state estimation → Split ratio estimation → Stochastic Network simulation & Performance prediction

Model calibration → Arterial state estimation

Split ratio estimation → Demand prediction

Stochastic Network simulation & Performance prediction → Action plan

Action plan

Database

Visualization

System monitoring

Simulated world (e.g. microsim)
Summary

• Connected Corridors program
• TOPL’s Aurora → BeATS
• Freeway/arterial coordination with 4 scenarios.
• Critical components,
  • Automatic model calibration,
  • Freeway and arterial state estimation,
  • Split ratio estimation,
  • Demand prediction,
  • Massive simulation,
• Performance distributions.