California Connected Corridors: Vehicles, Information, and People Pilot

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A graphical illustration of ICM

- Ramp Metering
- Smartphone enabled reroute
- Parking
- CMS
- BART
- Local Arterial Traffic Signals
- Express Lanes HOT/HOV control
Institutional architecture for connected corridors

Caltrans, TMC, MPO(s), Counties
Actuation infrastructure
- Metering
- CMS
- HOV/HOT

Operational commands

Collaborative commuters
- Web apps
- Mobile apps

Transit agencies
- BART
- Buses
- Carpool, zipcar, etc.

Services
- Real-time access, data

Sensing infrastructure
- Loops (PeMS)
- FasTrak

Real-time access, data

Advisories
- Commands
- Travel info

Real-time access, data

Industry partners
- Data agreements
- Services (backend, front end)
Process for the implementation of the pilot

Three fundamental aspects to cover for pilot deployment
- Organizational: Are proper components available (meters, support systems, shoulders, etc.)
- Institutional: Statutory framework needs to be worked out. Authorization needs to be obtained.
- Political: Is corresponding measure politically acceptable?

5 stages of research and technology deployment and piloting

1: Organizational, institutional, political feasibility work [society compatible Goals and metrics]
2: Site selection
3: Algorithm development
4: Simulations and hardware preparation
5: Field Implementation and testing

2011 2012 2013 2014 2015
Implementation milestones

Three step process to field deployment

– Caltrans internal planning (headquarters and districts)
– Corresponding regional Metropolitan Planning Organizations (MPOs): integration with their regional plan
– County plan (sales tax measures)
Using the tools developed by the PATH TOPL program

Select & “prune” corridor from Google maps

1880 corridor

Import corridor freeway and arterial topology into a macroscopic CTM-based simulator

Use PeMS traffic data for automatic
- model calibration
- imputation of missing mainline and ramp data

Perform traffic management simulation studies on diverse scenarios and test enhancements:
- ramp metering, variable speed limits
- incident management,
- traveler information, 
- demand management, etc.
Ramp metering

- Simulation capabilities a variety of ramp metering algorithms
  - ALIENA, HERO, SWARM, TOD, TOS, Traffic responsive, etc.
  - Queue overrides.
I-80E Queue limit parametric study.

Velocity Contours: I 80 E  20 Aug 2008

NO RAMP METERING

Delay Reduction: 15.3%

RAMP METERING:

Current ramp storage limits
Delay Reduction: 17.3%

RAMP METERING:

Current ramp storage limits + 35 vehicles extra storage
Delay Reduction: 17.3%
2008 → 2012: web 2.0 on wheels

Emergence of the mobile internet
- Internet accesses from mobile devices skyrocketing
- Mobile devices outnumber PCs
- 4 billion phones on earth
- 1 billion smartphones on earth

Sensing and communication suite
- GSM, GPRS, WiFi, bluetooth, infrared
- GPS, accelerometer, light sensor, camera, microphone

Smartphones and Web 2.0
- Context awareness
- Sensing based user generated content
Mobile Millennium as an example of consortium

A novel prototype system launched in 2008

- Funded by California DOT (DRI), US DOT, Nokia, NAVTEQ, NSF
- Initially, 5000 downloads of the FIRST Nokia traffic app worldwide
- Today: gathers about 60 million data points / day from dozens of sources (smartphones, taxis, fleets, static sensors, public feeds)
- Provides real-time nowcast (soon forecast) of highway and arterial traffic, provide routing and data fusion tools.
One day of Mobile Millennium data (SF taxis)
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Partners of the Mobile Millennium consortium

- Caltrans
- RITA (U.S. Department of Transportation Research and Innovative Technology Administration)
- Nokia
- University of California
- Rutgers University
- WINLAB (WIRELESS INFORMATION NETWORK LABORATORY)
- TEKES
- California Center for Innovative Transportation (CIT)
- Institute of Transportation Studies (IIS)
- Renault
- New Cities Foundation
- AGRANGIAN SENSOR SYSTEMS LABORATORY
Project timeline

2008
- Mobile Century
- Initial R&D

2009
- ITS World Congress
- Mobile Millennium

2010
- Continued Public-Private R&D on Probe Data Processing

2011
- Commercialization

2012
- Industrial Development
- Commercialization
- IT World Congress
- Google

Nokia
- Connecting People

Navteq
- telenav

Microsoft
- Apple
- Google
1. Institutional leadership: PATH, UC Berkeley

2. Associated institutes and Universities:
   1. CITRIS
   2. UC Davis
   3. Univ. of Illinois
   4. INRIA (France)
Connected Corridors: consortium members

Funding members:
1. California DOT
2. Google
3. Ericsson
4. Nokia
5. NAVTEQ
6. Telenav
7. New Cities Foundation
Connected Corridors: consortium members

Associated members

1. Waze
2. Roadify
Information / control actuation flow

Human:
- In the loop: decision support
- Out of the loop: control

Actuation module
- Generates info
- Generates commands

Optimizer

Combination of maneuvers
- Metering
- Reroutes
- Playbooks, etc.

Forecast module
- “What if” scenarios
- Forecast of current strategy

Estimation

Operator high level commands
- Maximization of efficiency
- Tot. travel time reduction, etc.

Web

Hardware actuators
- Meters
- CMS

Phones

Sensors
- Loops
- Radars, etc.

DB

Historical and additional data

Traffic info

Info and advisories

Control command

Info and advisories

result

strategy

solution

human
Leveraging Hybrid Traffic Data

The Connected Corridor Consortium will use novel types of data
- Unprocessed data ("dust", "raw") probe data
- Data can be used to enhance traffic estimates on freeways
- Data will be used for places with no detectors (arterials)
- Data will be integrated into decision support tool

REQUEST FOR PROPOSALS:
UNAGGREGATED DATA PROCUREMENT
TRAFFIC DATA FOR I-15 & I-880 CORRIDORS
Leveraging Hybrid Traffic Data

**Transmission delay**

The amount of time that elapses between the device recording its location and the corresponding record being inserted into the database, in seconds. Line is the average; shaded area represents a standard deviation on either side of the average. Data aggregated every two hours.

**Time coverage**

- Thursday rush hour peaks clearly visible
- Friday am peak much less pronounced

**Speed**

- As expected, data volumes drop at night
- Midday drop in data volumes on weekends due to fleet data sources
- Sundays particularly low on data (Aug 7, 14, etc)
The Connected Corridor Consortium will rely on social networks

- Partnerships with major players in the ecosystem (e.g. Waze)
- Use of novel types of data (contextual, text based)
- Use of incentivization (not only through information)
- Behavioral response analysis
An integrated approach to corridor management includes

- Interfacing hardware and approaches which have worked in isolation
- Using tools which were not used before for management
- Creating a coordination layer among tools which are traditionally operated by different jurisdictions
CC of the future: collaborative commuting

The difference between previous approaches and the future includes

- Massive use of connected devices for traffic / demand management
- Apps will be built on existing services (Google maps, etc.)
- Apps will contain specific functionality
  - Travel info, advisories, parking etc.
  - Reroutes and incentivization
  - Diary system,...
CC of the future: cloud based backend system

Corridor specific hardware interface

- Data warehouse, databases
- Simulation, estimation, forecast, control engines
- Platform support (hardware, phone and web apps)
- Process monitoring
- Feeds, outputs, visualization
Closing remarks

Connected corridors is more than just “regulating traffic”:
- It relies on interagency collaboration
- It relies on private sector / public sector partnerships
- Its basis relies on classical approaches:
  - Metering, CMS, HOV/HOT, special use operations
  - Arterial / highway coordination
- It also will be the battleground for new approaches to emerge
  - CMS based reroutes, incentivization, tolling
  - Modeshift, integration of transit in management schemes
- It will also rely on new technologies
  - Social networks
  - Mobile / connected devices / connected cars

Connected corridors is new engagement of commuters
- Collaborative commuting, empowerment of the commuters
  - Comuto, rideshare programs, taxi share programs
  - Last mile problems, traffic Air B&B, etc.
- Moving management from TMC centric to decentralized
- Travel collaboration: a new paradigm to emerge
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