CONNECTED CORRIDORS

“ICM CALIFORNIA”
AND THE NEXT 20 YEARS
Vehicles are getting connected

1. Get in your car
2. Plug in
3. Enjoy your drive!

- MirrorLink: almost everybody is in it
- This week: number of smartphone sales / quarter surpasses feature phone sales
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Vehicles are getting connected
Infrastructure can now support traffic flow management at an unprecedented scale

- Convergence of communication, computing and sensing on single platforms has revolutionized traffic monitoring and is in the process of changing traffic management

- Cloud computing and HPC provides support for faster than real-time traffic management

- Connectivity gives ubiquitous actuation potential
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People are [part of] the transportation problem

- Population growth linked to economic growth
- Number of connected users of the social network exceeds 1.2B on Facebook alone
- Social has started to change travel behavior (Waze, Lyft, etc.)
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Vehicles, Information and People (VIP): here is how to make it work
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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
What is Connected Corridors?

- Program comprised of a number of efforts in partnership with various agencies and industry partners

- Tasked with:
  - Developing methods and tools for how transportation corridors will be managed in California (Connected Corridors templates)
  - Advancing and integrating technologies needed for corridor management
  - Planning for Caltrans district level organizational support for ICM
  - Identifying and securing funding
  - Providing strategic and tactical education on corridor management
  - Implementing a pilot showcasing the above elements
  - Facilitating the implementation of ICM in multiple corridors in California
PATH: the host institute of the Connected Corridors pilot
Cooperative adaptive cruise control

![Car images with text overlay: Hand view camera, Forward view camera, Driver's face camera, Pedal view camera, Experimenter's system Deactivation button.]

![Bar charts: Time-Gap Setting Usage for CACC and ACC, with comparison between Male and Female.]

![Group photo: Researchers or participants in a cooperative adaptive cruise control study.]

![Graph: Cruise Control System Time-Gap Setting (s) with data points for different time intervals.]
Shop space for vehicle development
Experimental vehicles
Silicon Valley
Caltrans System Management Goals

1. Create a system management culture

2. Performance-based framework for all TMS work activities and funding prioritization

3. Establish a well-maintained and high-performing TMS infrastructure that supports real-time traffic management

4. Cooperatively develop and implement real-time (active) traffic management to optimize flow, safety and aid regions and the State to meet greenhouse gas reduction (GHG) targets from transportation

5. Renew consensus on and adhere to critical statewide standards
California’s Progress towards ICM…
ICM as a blueprint for finishing the edifice?

- $20B transportation bond in 2006
- California Transportation Commission is on-board
  - Demand science based reasoning for project selection
  - Require to consider the use of technology as a cost effective investment
  - Allocate over $100M to ITS projects
- $4.5B for Corridor Mobility Improvement (CMIA)
- Corridor System Management Plans (CSMPs) required on all CMIA corridors
  - CSMPs developed for over 50 freeway corridors
  - 31 using microscopic traffic simulation to assess impacts of improvements
  - Simulations and scientific assessments point to ITS elements as being among most cost effective investments
ICM Element Examples

- **Enhanced traffic monitoring systems**
  - Collection of real-time freeway, arterial, transit and weather data

- **Enhanced communication**
  - Data sharing capabilities among agencies
  - Information service provider access to select datasets

- **Freeway operations**
  - Traffic-responsive ramp metering
  - Coordination of ramp meters with arterial traffic signals
  - Dynamic HOV/HOT restrictions
  - Ramp queue warning
  - Variable advisory speeds
  - Dynamic Lane use control, dynamic hard shoulder running

[Images of tolling, metering, variable speed limits, special lane use, HOT, intersection control]
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ICM Element Examples

- **Arterial operations**
  - Traffic-responsive signal control
  - Transit signal priority
  - Emergency preemption

- **Enhanced traveler information**
  - Multi-modal 511 systems
  - Real-time traffic/transit/parking info
  - Comparative trips across modes
  - Freeway CMSs
  - Arterial trailblazer signs
  - Mobile travel information applications
  - Social media links

- **Decision support system**
  - Automated response plan development
  - Evaluation of impacts using simulation
Integration

Institutional Integration

Coordination to collaboration between various agencies and jurisdictions that transcends institutional boundaries.

Operational Integration

Multi-agency and cross-network operational strategies to manage the total capacity and demand of the corridor.

Technical Integration

Sharing and distribution of information, and system operations and control functions to support the immediate analysis and response.
Institutional / technical Integration

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

Operational commands

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

Real-time access, data

Sensing infrastructure
- Loops (PeMS)
- FasTrak

Real-time access, data

Collaborative commuters
- Web apps
- Mobile apps

Advisories
- Commands
- Travel info

Services
- Real-time access
- Data

Industry partners
- Data agreements
- Services (backend, frontend)
Next 5-10 years goals
A typical ICM

- Stakeholders
  - State DOT – Freeway Management
  - Local Jurisdictions – Arterial & local traffic management
  - Transit Agencies – Bus, rail and other public transportation
  - Parking operators
  - Information service providers
  - Potentially many more…

- Travel Alternatives
  - Persons
  - Goods

- Map:
  - Central Business District
  - Sports Stadium
  - Event Center
  - Commercial Port
  - North Suburb
  - Business Park
  - South Suburb
  - Mall

- Symbols:
  - P: Publicly operated parking
  - Privately operated parking
  - Bus stop
  - Light rail station
  - Airport
  - Freeway
  - Interchange
  - Primary arterials
  - Secondary arterials
  - Rail line (freight)
  - Rail line (light rail or heavy rail)
  - Bike path
  - School
What does this mean for technology?
Decision Support System
Next Gen Model

Collection

Fusion (Multiple sources – Various data)

1. Speed Information
   - PNDs
   - Cell phones
   - Truck Fleets
   - Fixed Sensors

2. Traffic Operation
3. Planning - PM
What does this mean for data?

Private sector vendors
Data aggregators
Traffic information vendors
Public feeds

Data processing warehousing

Traffic management services
Traffic information services
Planning
Private sector

DOTs
MPOs, etc.
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Private sector
From Mobile Millennium to data procurement

An early instantiation of participatory sensing

- Consortium: NSF, US DOT, Caltrans, Nokia, NAVTEQ, + 10 others
- Initially, 5000 downloads of the FIRST Nokia traffic app worldwide
- Today: gathers about 60 million data points / day from dozen of sources (smartphones, taxis, fleets, static sensors, public feeds)
It would not have happened without Silicon Valley.
Leveraging Hybrid Traffic Data

The public agencies will use novel types of data

- Unprocessed data ("dust", "raw") probe data
- Data can be used to enhance traffic information and management
- Procurement procedures unknown until 2010 in California
- Pricing schemes unknown until 2010 in California
Hybrid Traffic Data – Data Quality Metrics

Provide public agencies with quality metrics, including:

- Latency
- Coverage
- Accuracy of tracks
- Volumes
- Etc.

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

The total number of data points at the time specified on the x-axis. Data aggregated every two hours.
Because it is possible to know who to target
Incentivization is going to happen, it might start in the Philippines
ERP2: how would you do it in Singapore?
Incentivization is going to happen, it might start in the Philippines
Incentivization is going to happen, it might start in the Philippines
But the question is: How to target them?

Good Morning ITS America! Radios are back!!!
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Because the boundaries between radio, social network, connected devices are porous
Questions?
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