CONNECTED CORRIDORS

"ICM CALIFORNIA" AND THE NEXT 20 YEARS

8/16/2013

Vehicles are getting connected

1 Get in your car

2 Plug in

3 Enjoy your drive!

Car OEMs: GM, BMW, VW, Hyundai, Volvo, PSA Peugeot Citroën, Mazda, Fiat, Renault, Ford, Honda, Toyota, BYD

Mobile OEMs: Nokia, LG Electronics, Panasonic, HTC, Sony, Samsung

Tier-1: Continental, JVCKENWOOD, Mitsubishi Electric, Garmin, TomTom, Alpine, Renesas, Fujitsu Ten, QNX, Harman, Sharp, Toshiba, Clarion, Delphi, Valeo, Bosch, Denso, Pioneer

- **MirrorLink: almost everybody is in it**
- **This week: number of smartphone sales / quarter surpasses feature phone sales**

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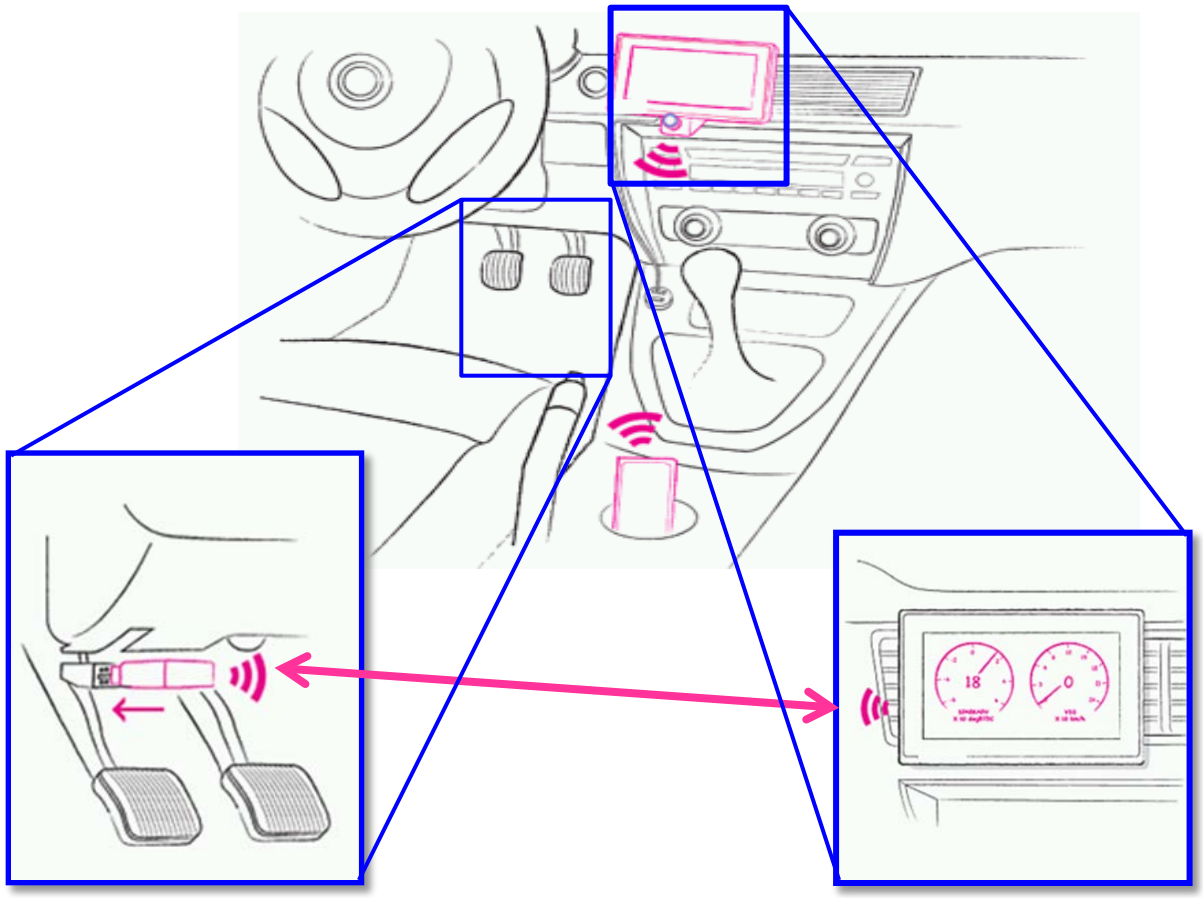

Caltrans CALIFORNIA PATH

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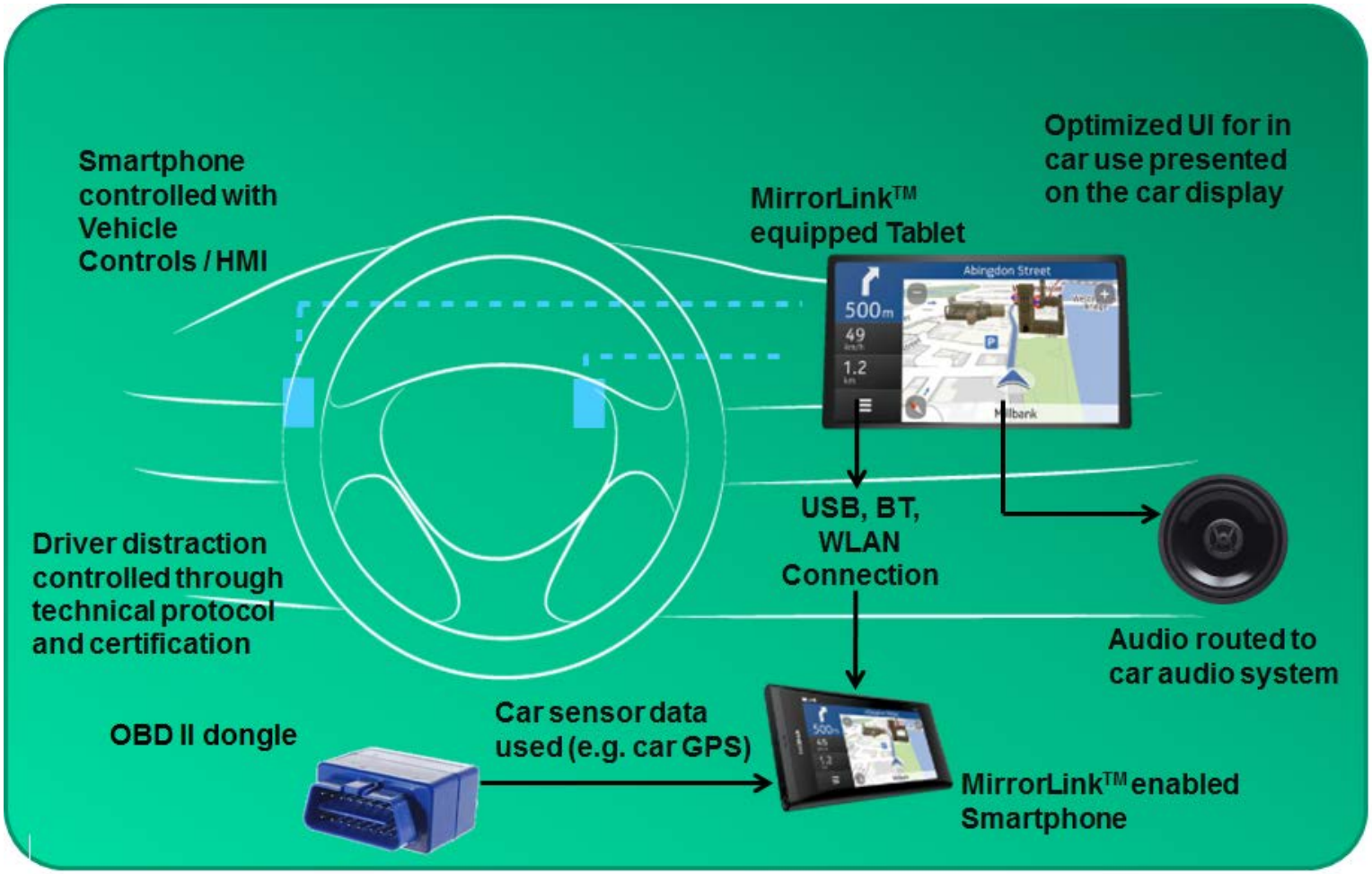
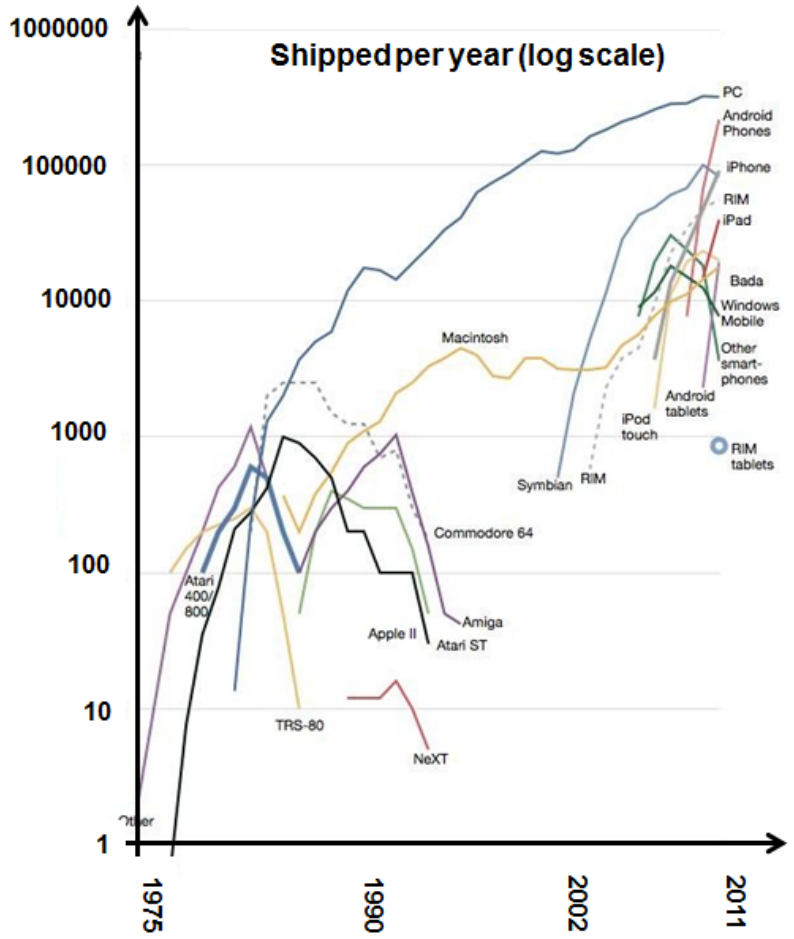


Infrastructure can now support traffic flow management at an unprecedented scale

- **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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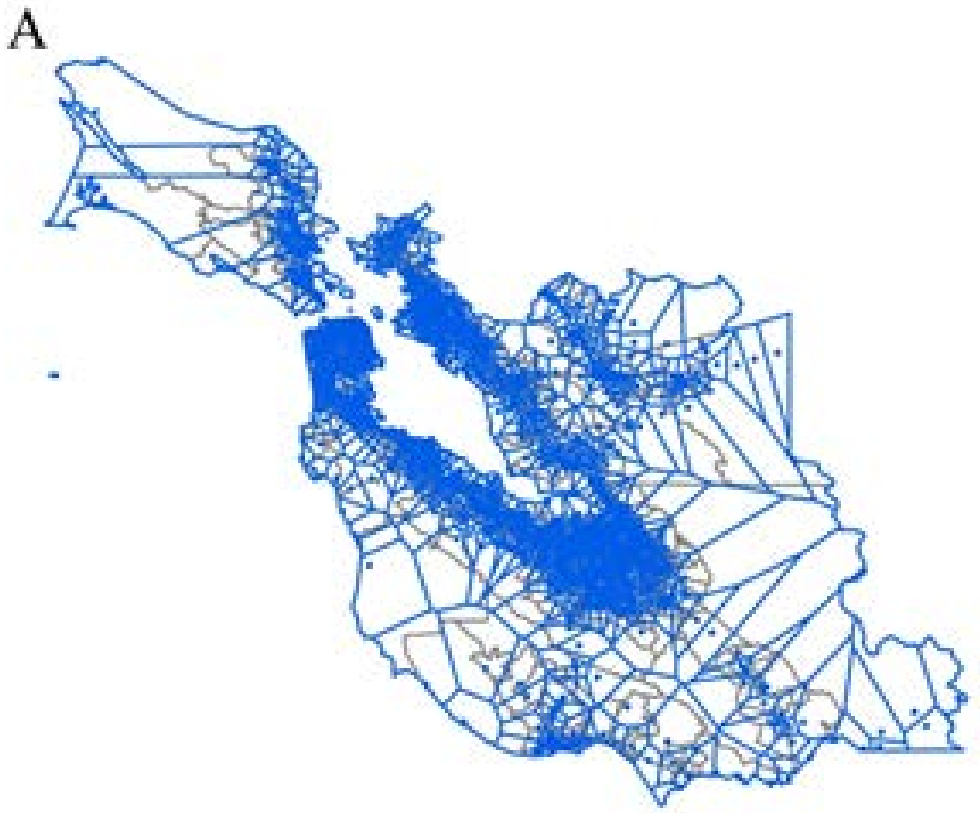
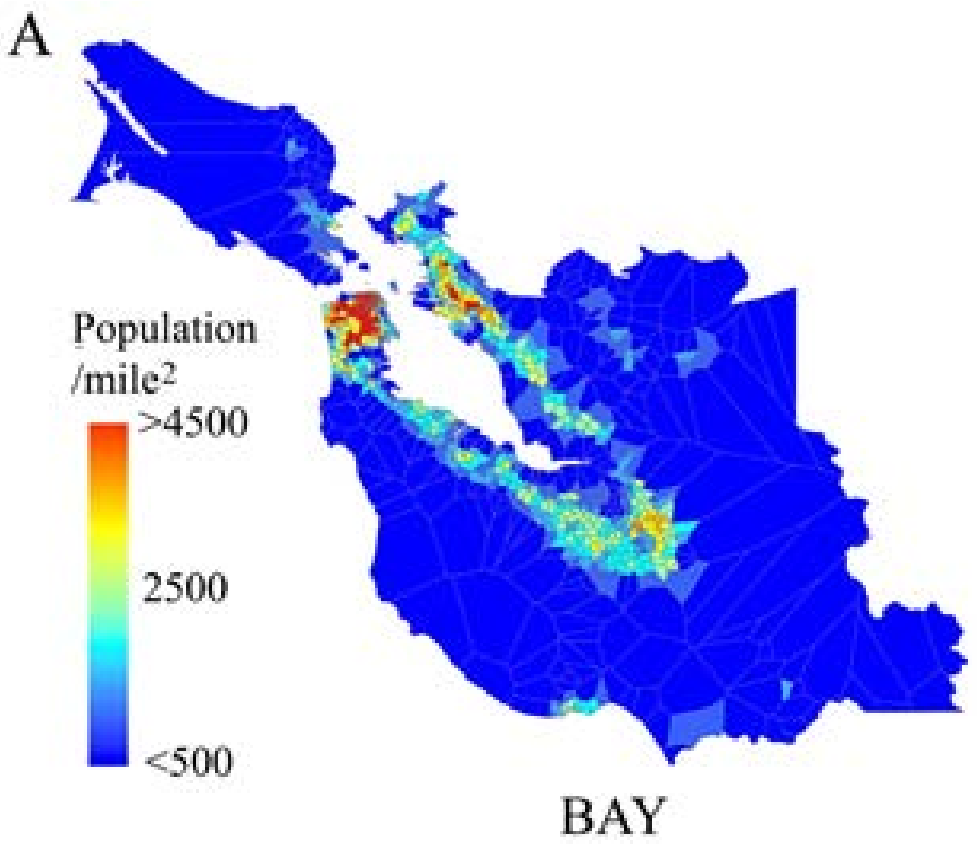


People are [part of] the transportation problem

- 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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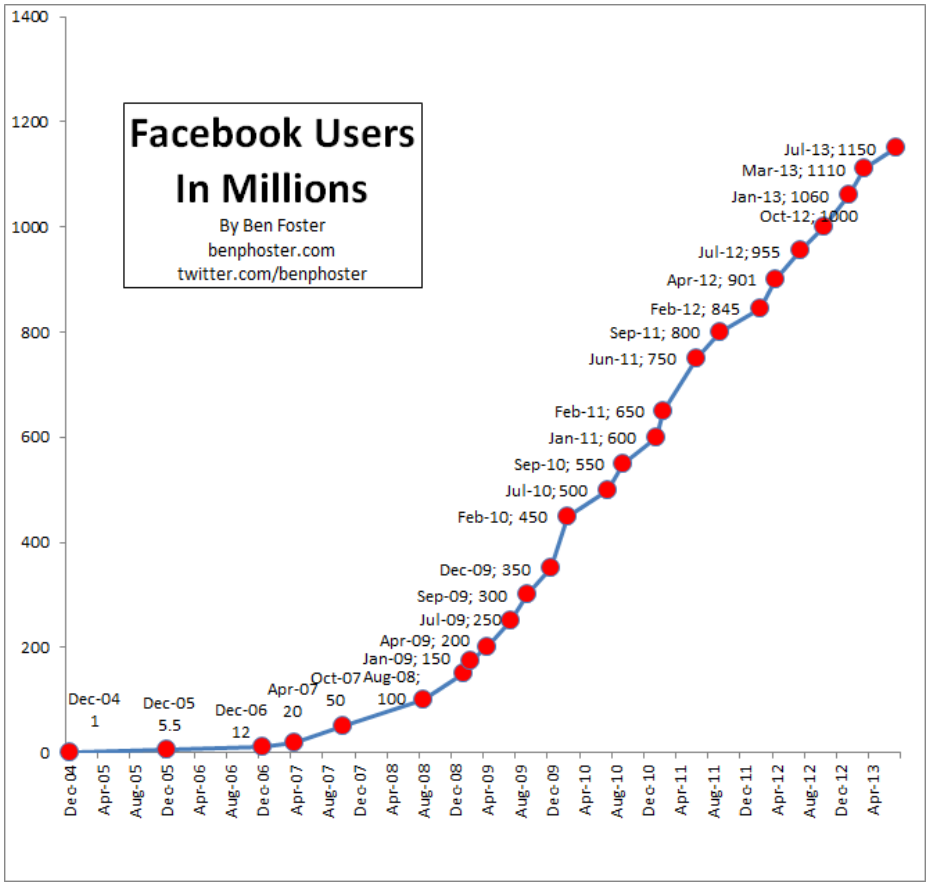

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waze

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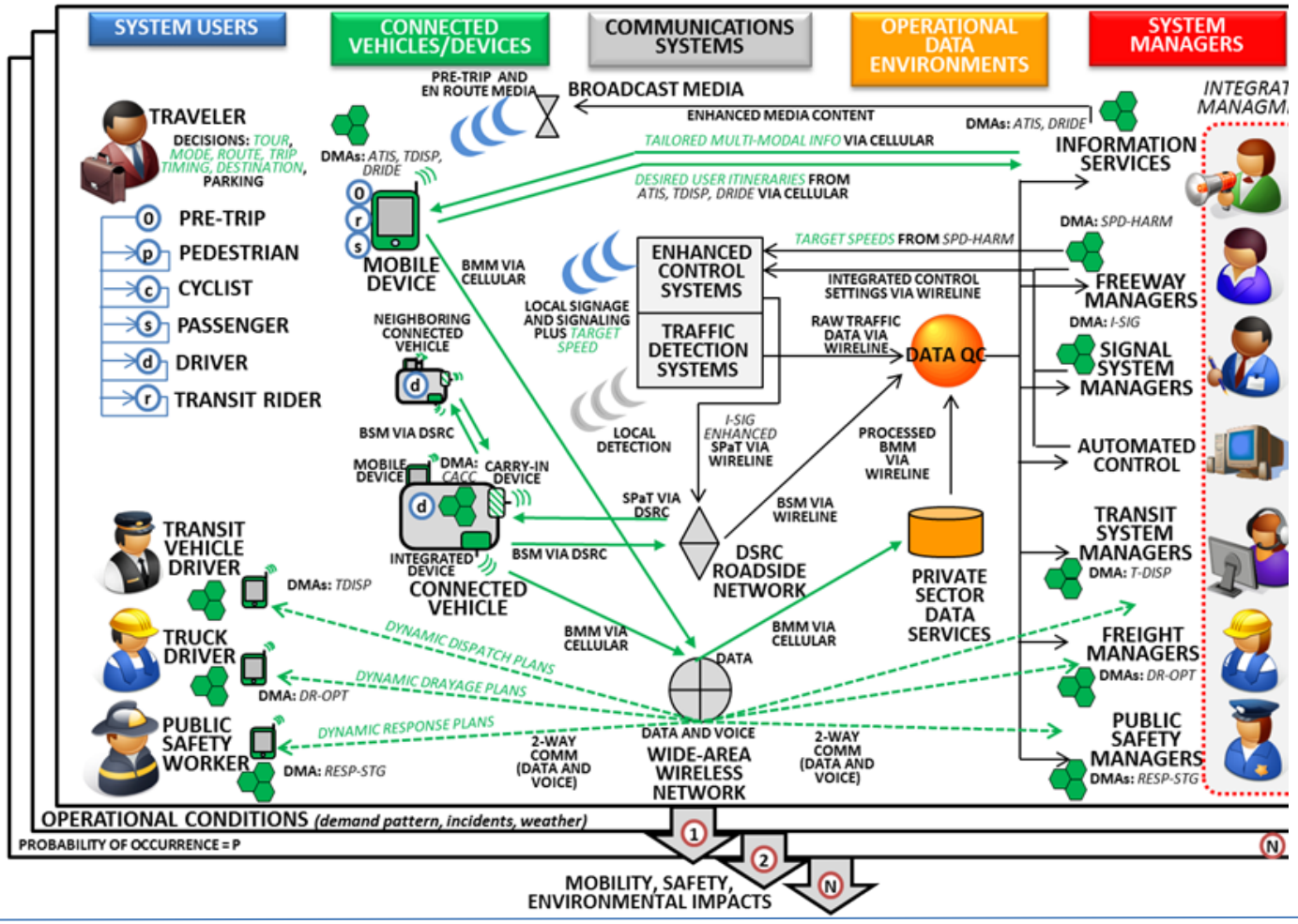
Vehicles, Information and People (VIP): here is how to make it work



Vehicles, Information and People (VIP): here is how to make it work

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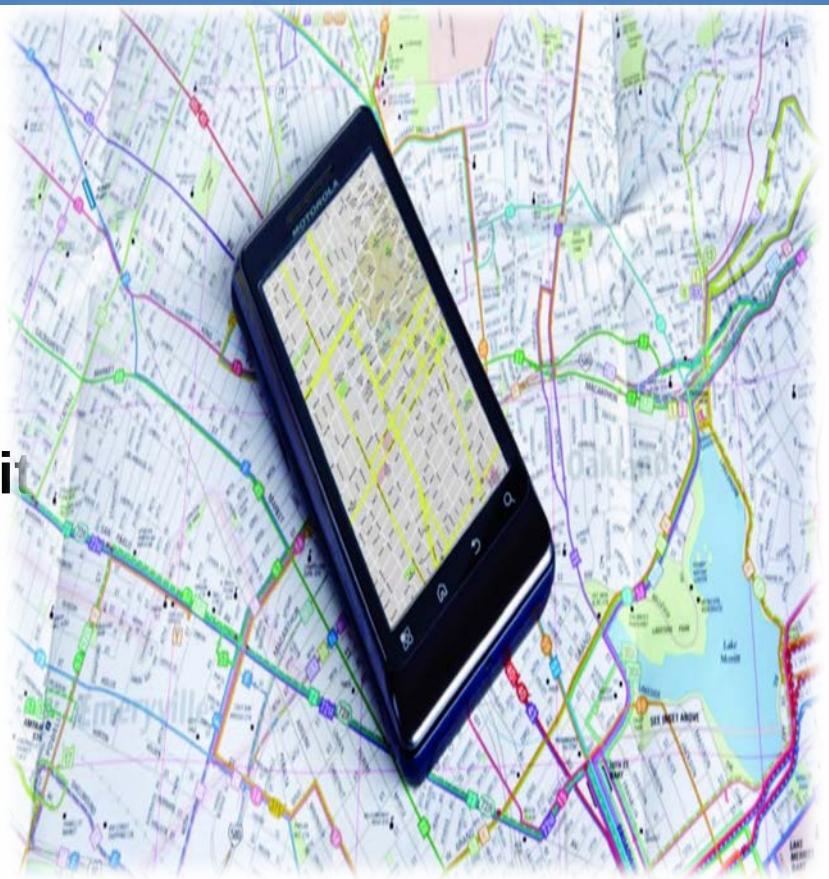
CALIFORNIA PATH

California Connected Corridors Vehicles, Information & People (CC-VIP) Pilot

- **Enable existing transportation infrastructure and vehicles to work together in a highly coordinated manner**
- **Deliver improved corridor performance (safety and mobili**
- **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

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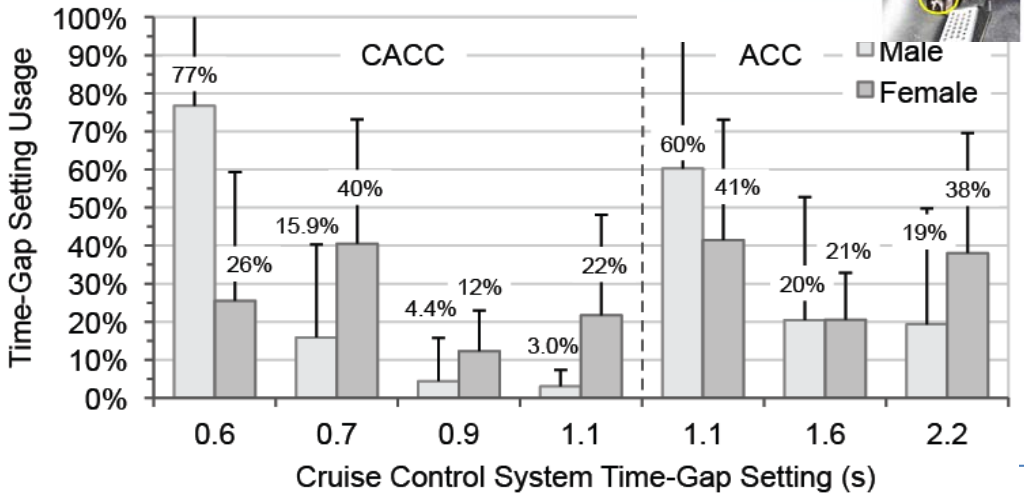
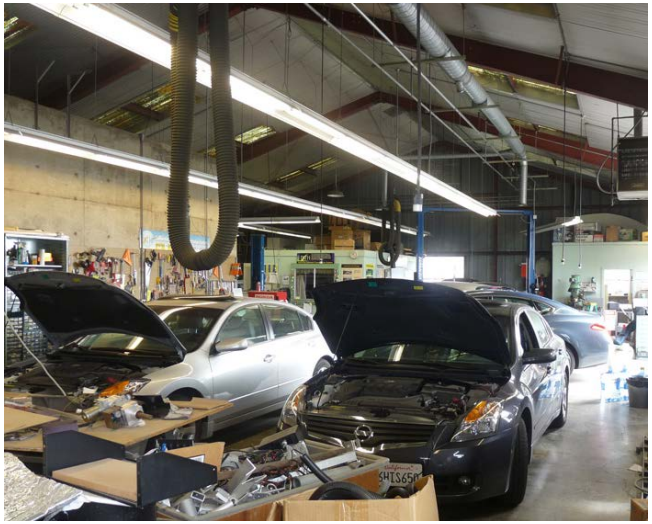
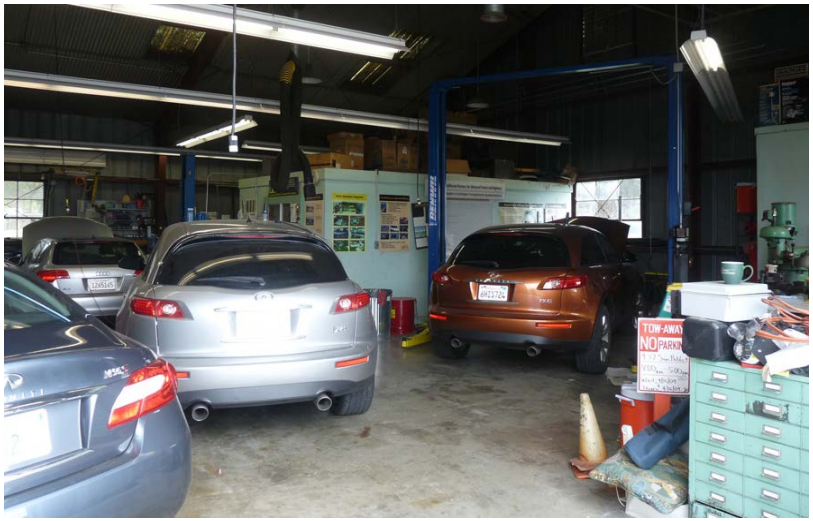
CALIFORNIA PATH

Cooperative adaptive cruise control

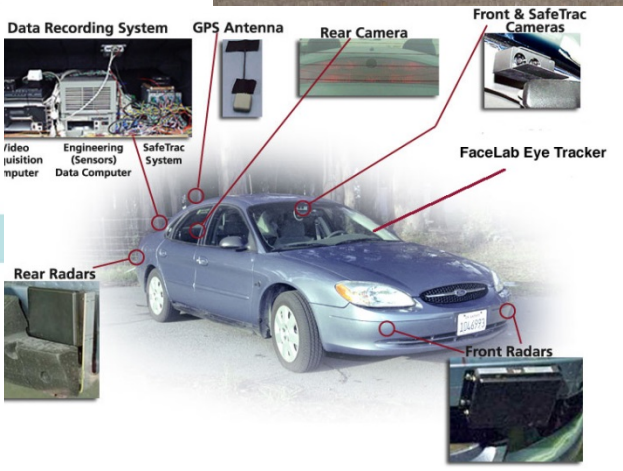


Shop space for vehicle development





Experimental vehicles



Silicon Valley

Caltrans CALIFORNIA PATH

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**

Tolling

Metering

Variable speed limits

Special lane use

HOT

Intersection control

ICM Element Examples

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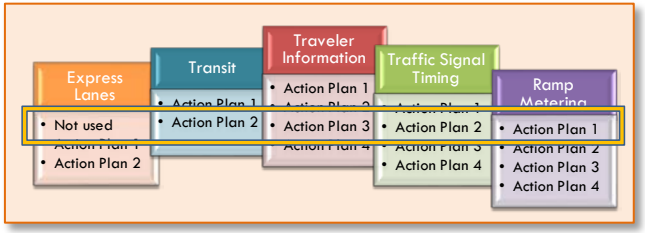
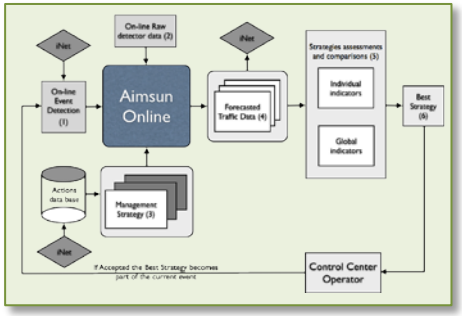
  - Information service provider access to select datasets
- **Freeway operations**
  - Traffic-responsive ramp metering
  - Coordination of ramp meters with arterial traffic signals
  - Dynamic HOV/HOT restrictions
  - Ramp queue warning
  - Variable advisory speeds
  - Dynamic Lane use control, dynamic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

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.

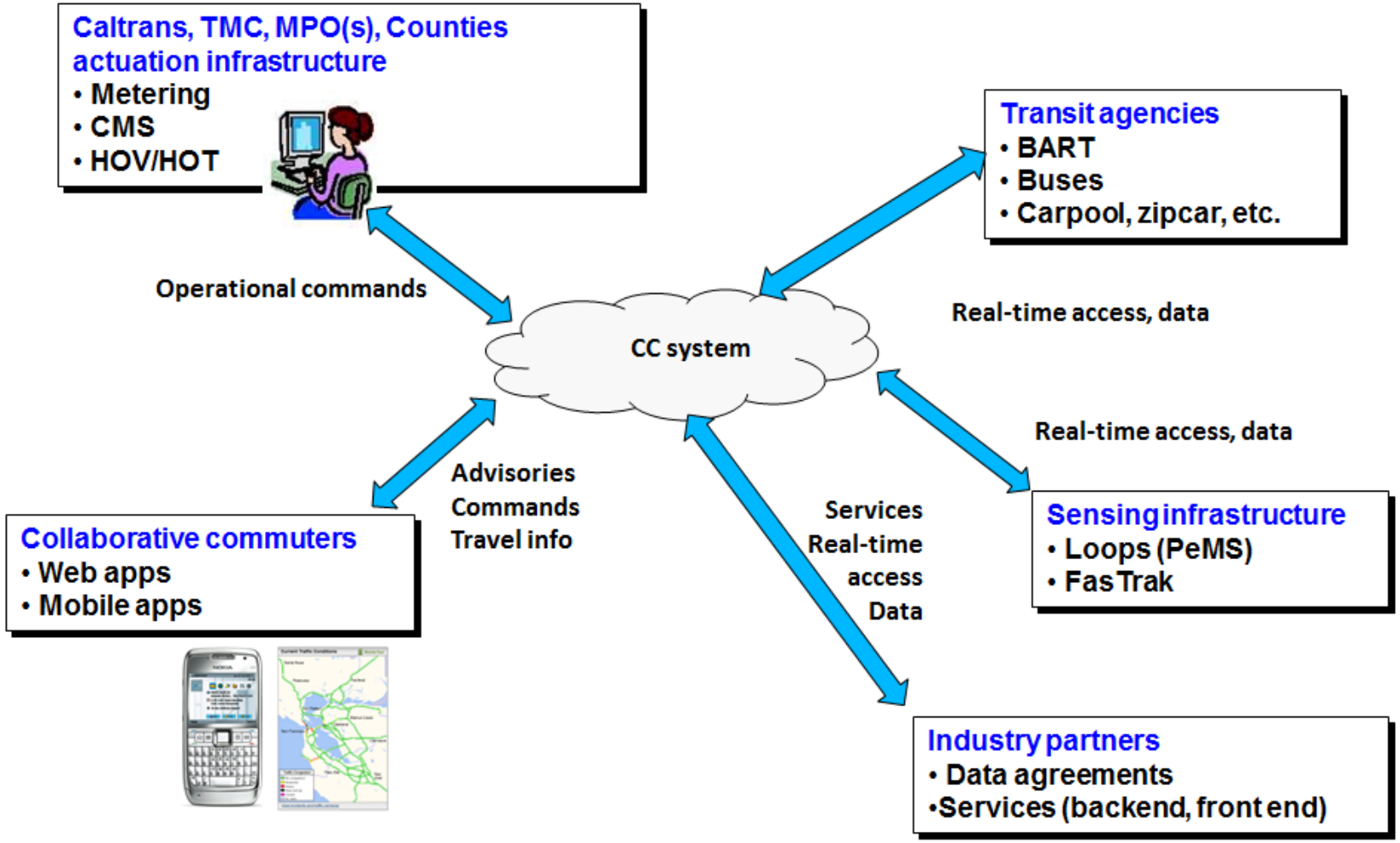
Operational Integration

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

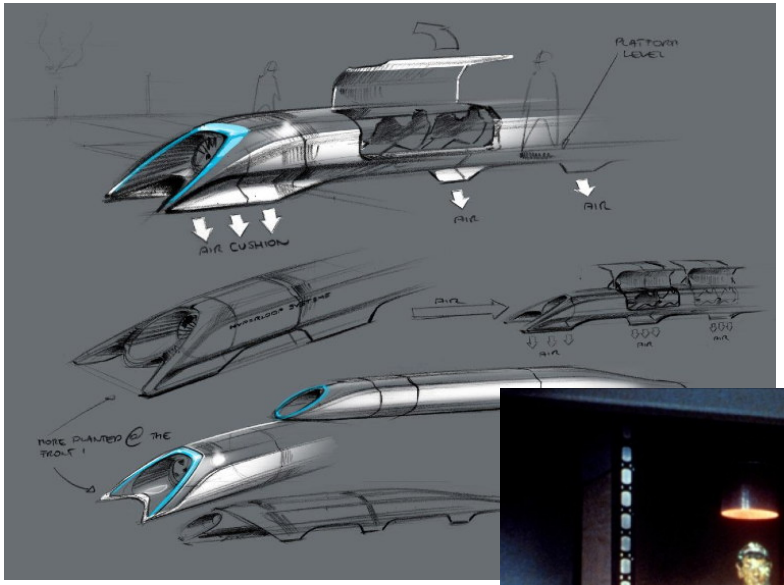
Technical Integration

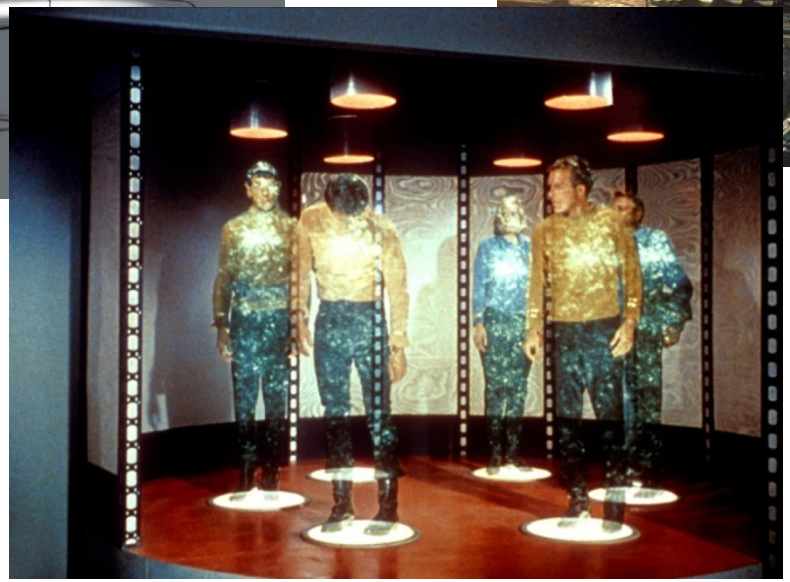
Sharing and distribution of information, and system operations and control functions to support the immediate analysis and response.

Institutional / technical Integration

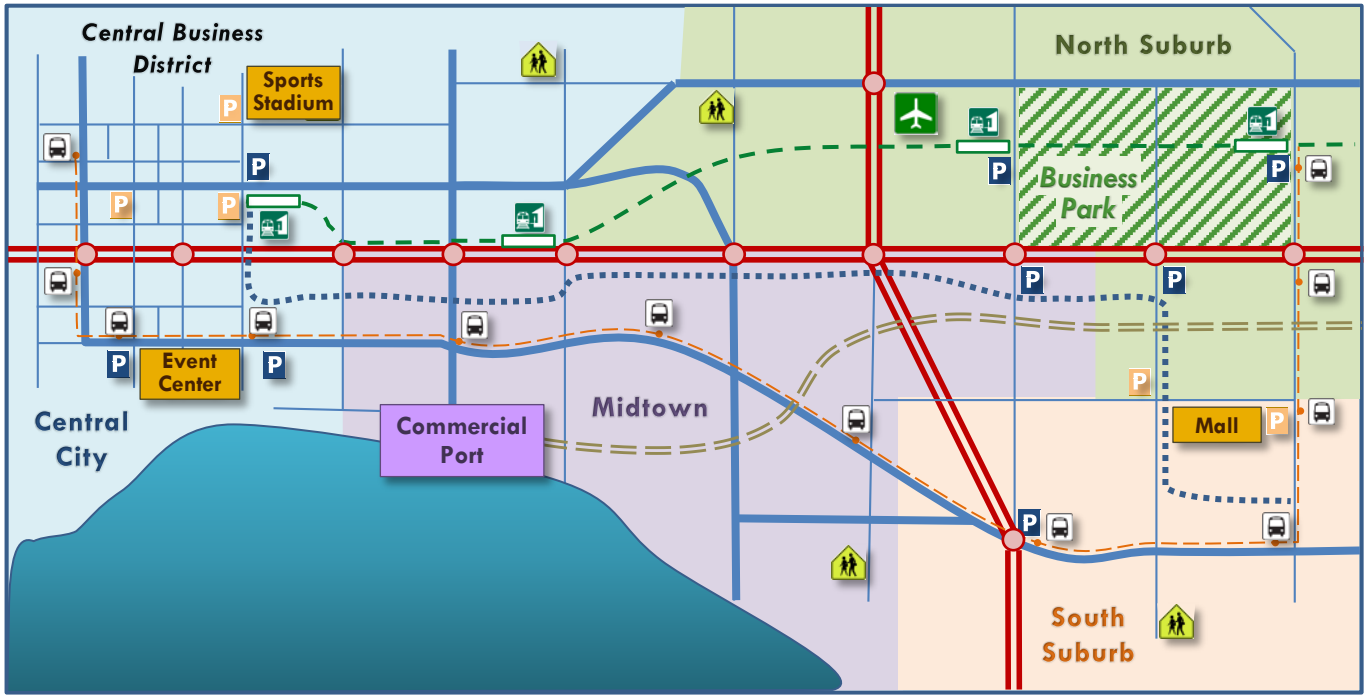


Next 5-10 years goals





A typical ICM



Stakeholders

State DOT – Freeway Management

Local Jurisdictions – Arterial & local traffic management

Transit Agencies – Bus, rail and other public transportation

Parking operators

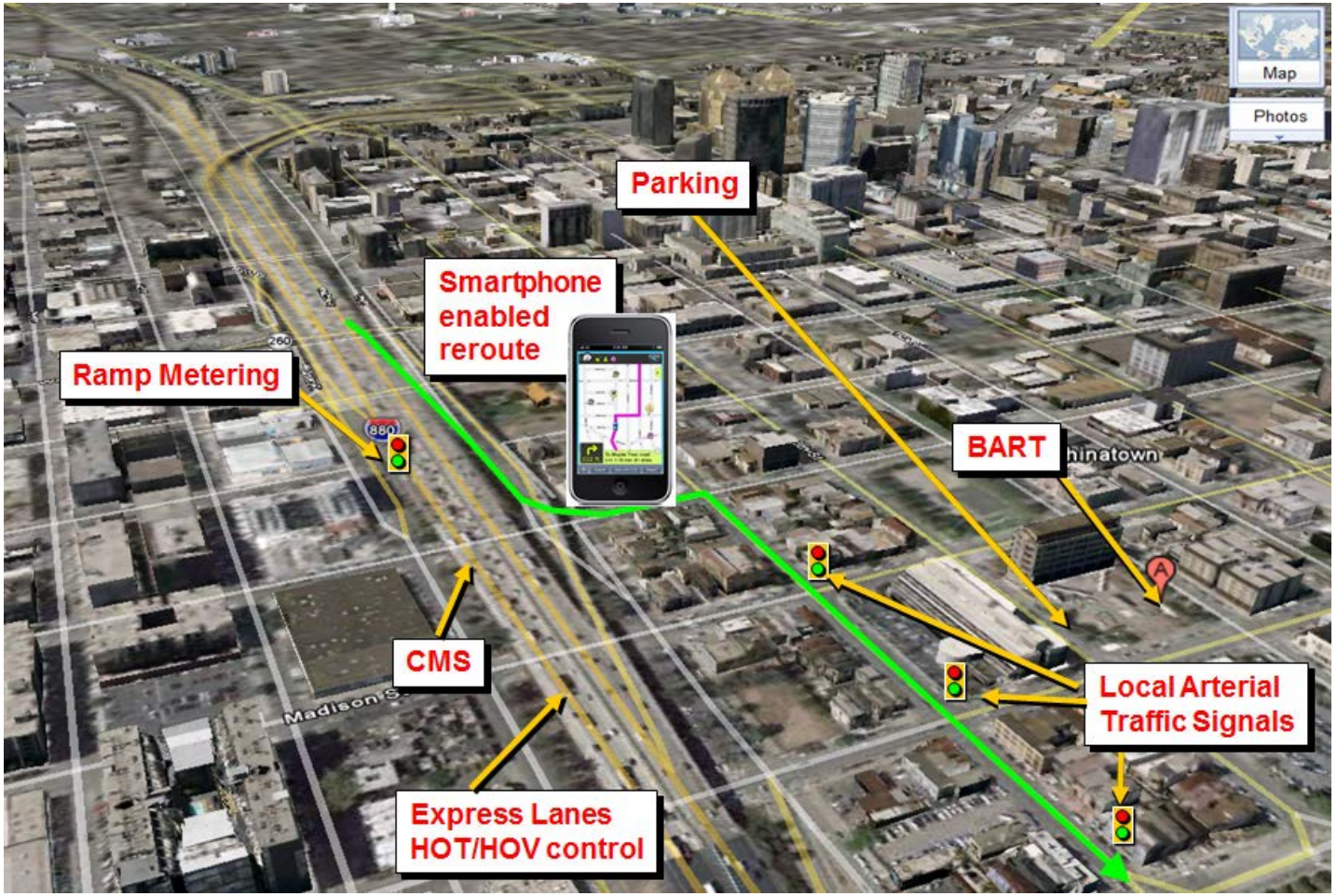
Information service providers

Potentially many mores…

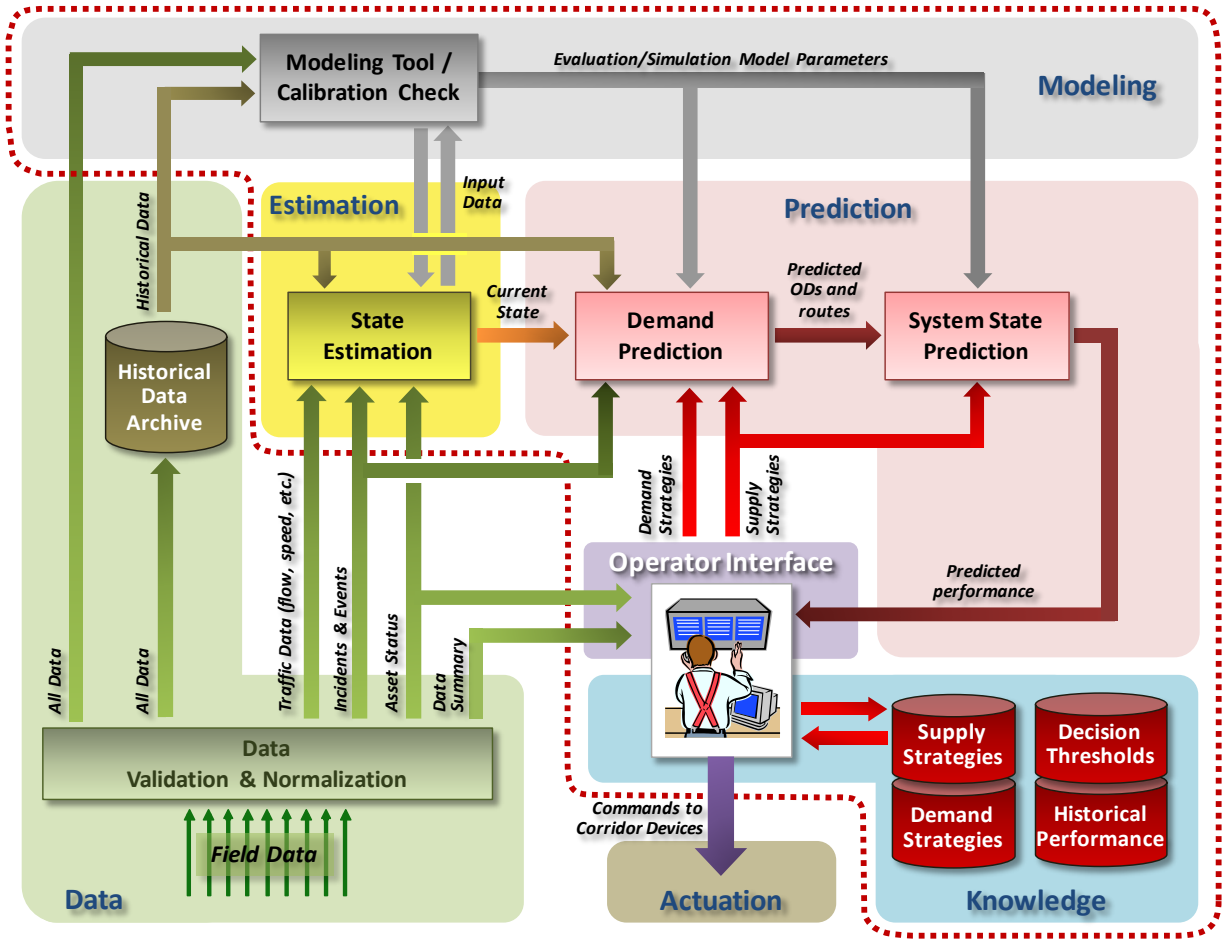
- Publicly operated parking
- Privately operated parking
- Bus stop
- Light rail station
- Airport
- Freeway
- Interchange
- Primary arterials
- Secondary arterials
- Rail line (freight)
- Bus route
- Commuter rail line (light rail or heavy rail)
- Bike path
- School

Travel Alternatives

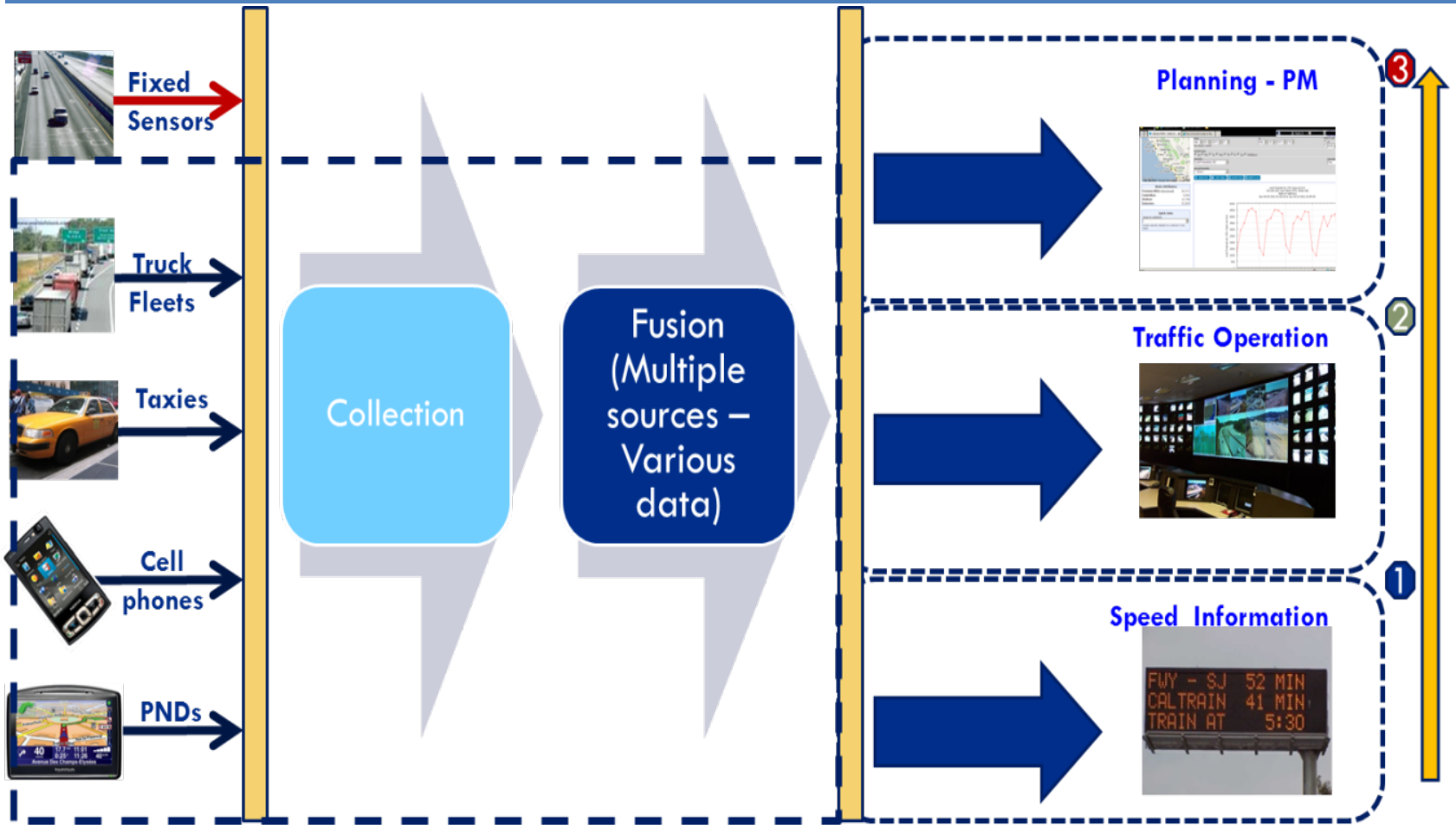
What does this mean for technology?



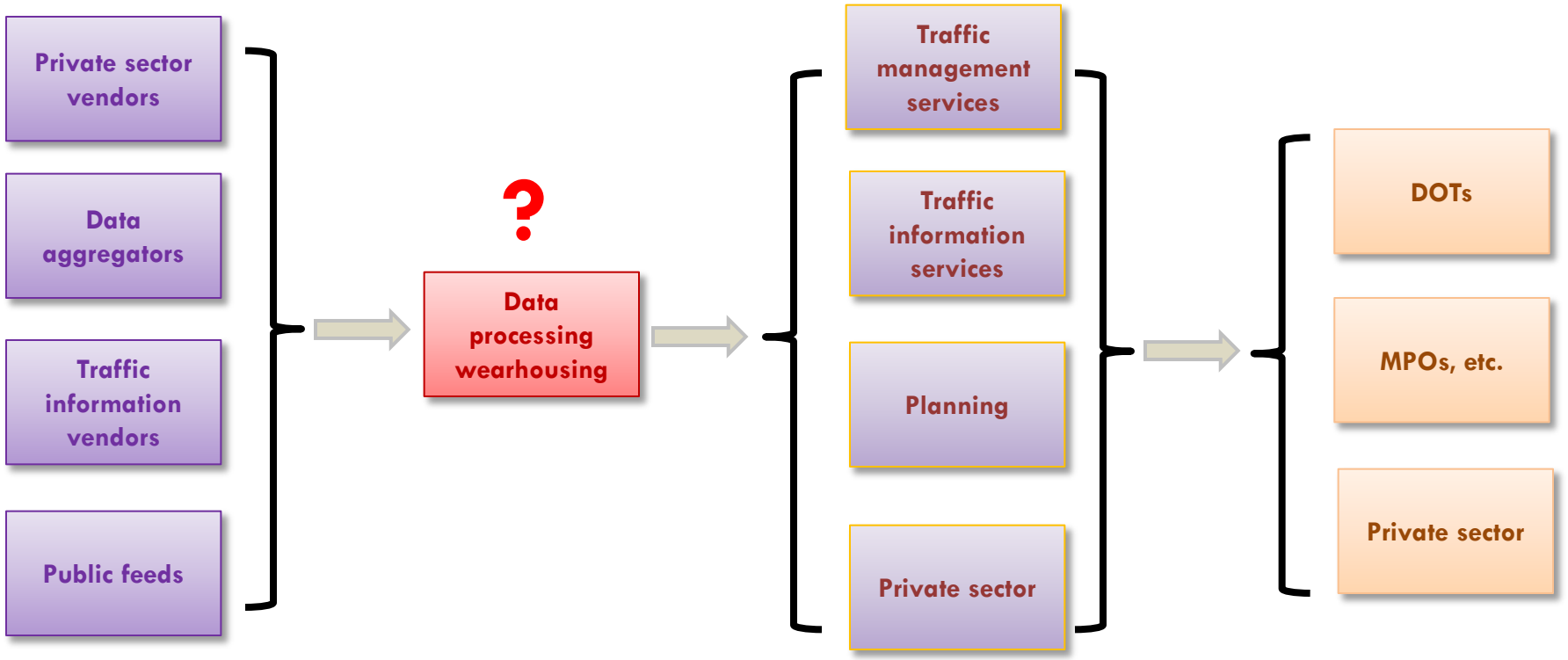
Decision Support System



Next Gen Model



What does this mean for data?



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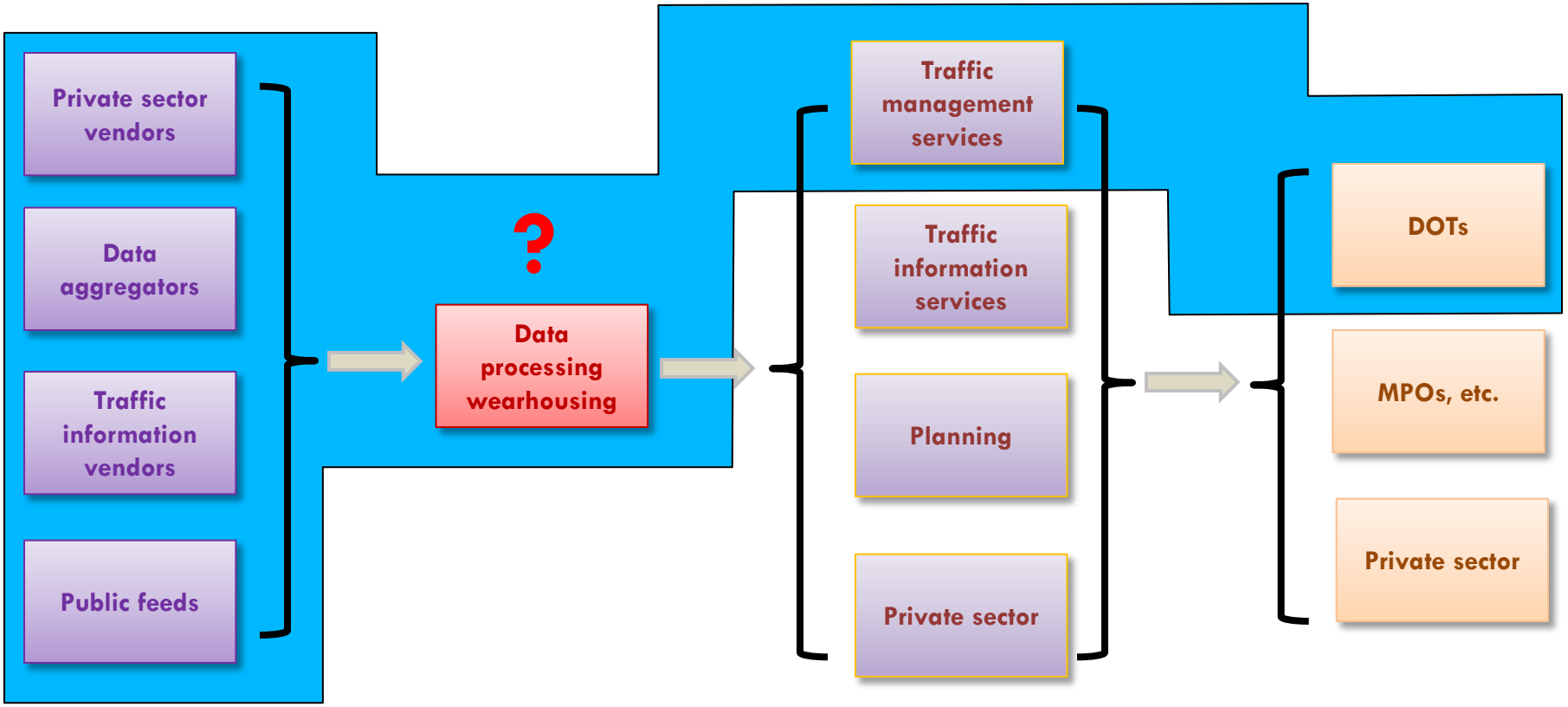
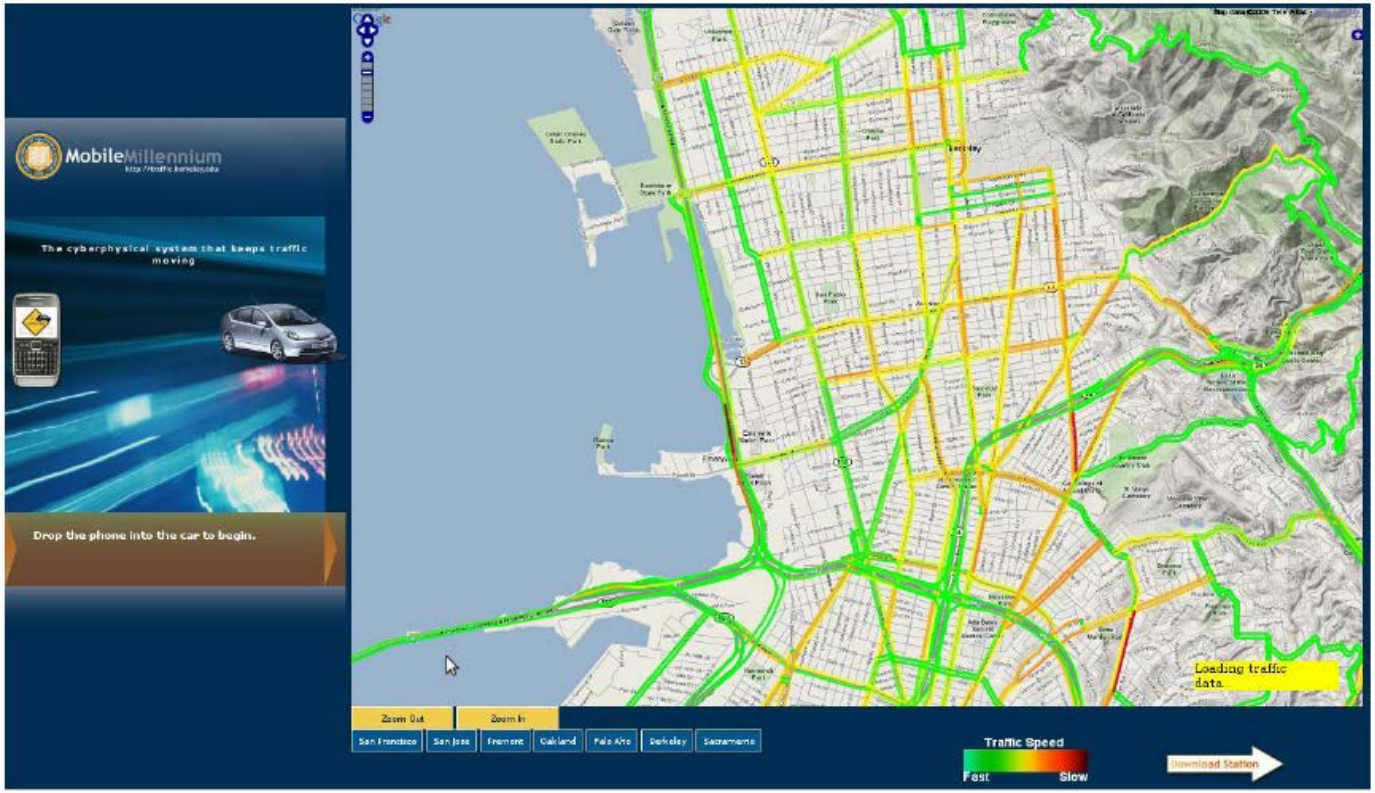


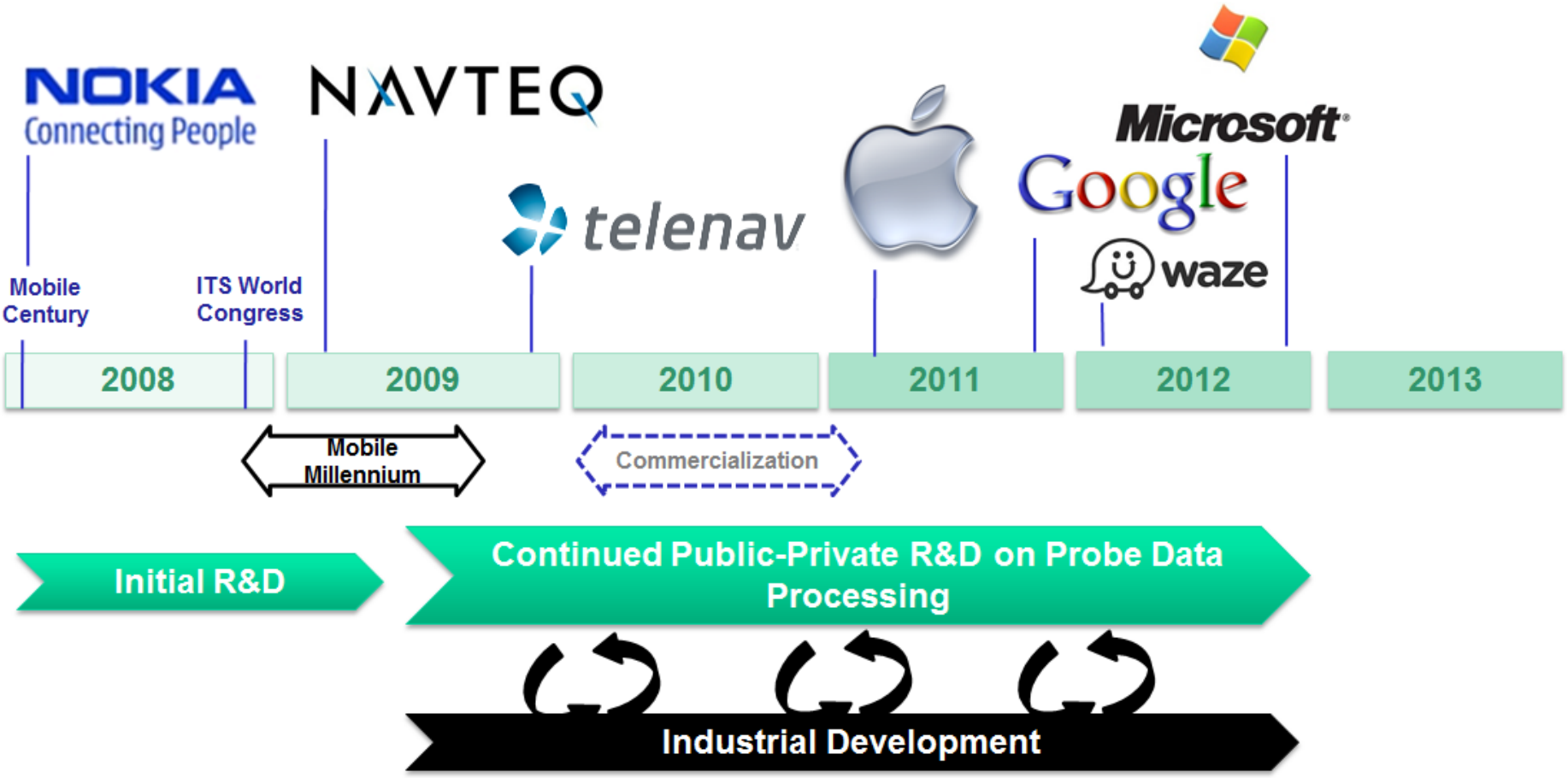
From Mobile Millennium to data procurement

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



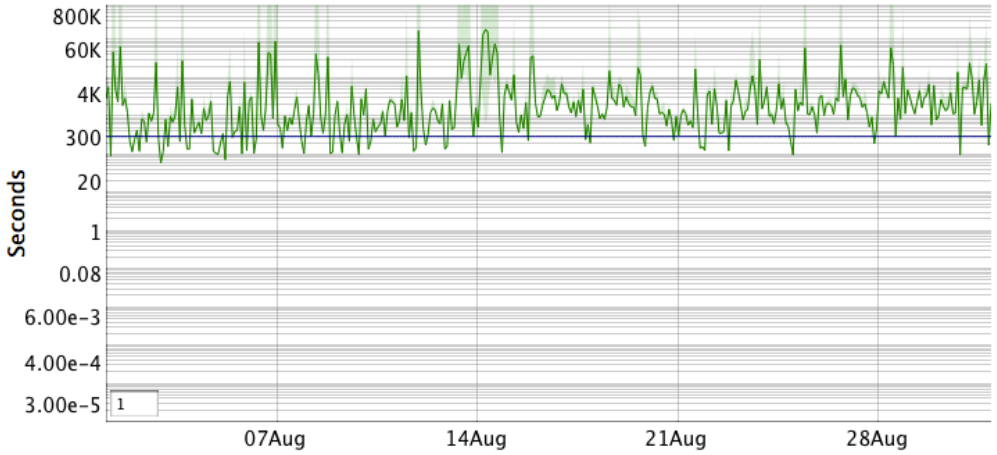
Leveraging Hybrid Traffic Data

The public agencies will use novel types of data

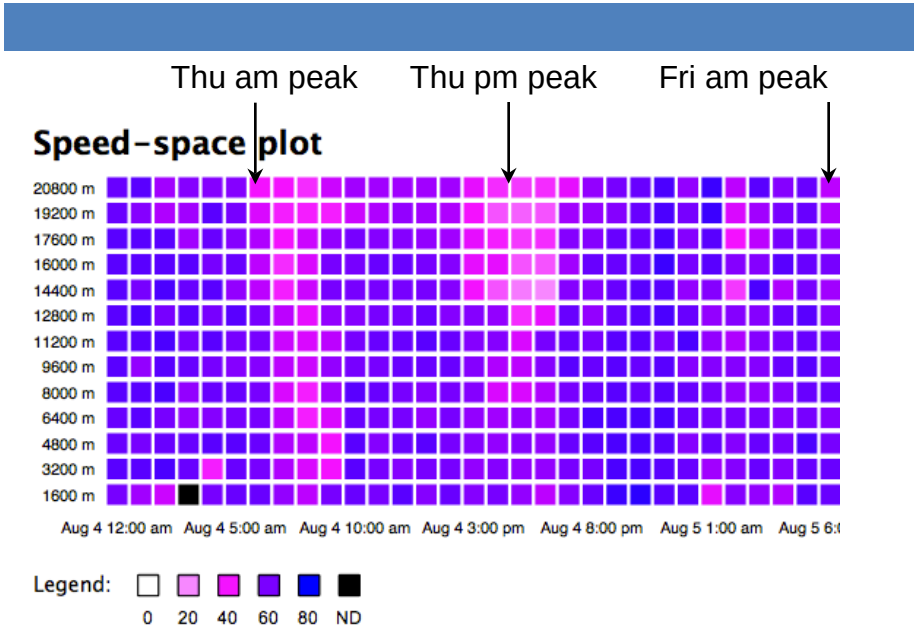
- Unprocessed data ("dust", "raw") probe data
- Data can be used to enhance traffic information and management
- Procurement procedures unknown until 2010 in California
- Pricing schemes unknown until 2010 in California

Hybrid Traffic Data – Data Quality Metrics

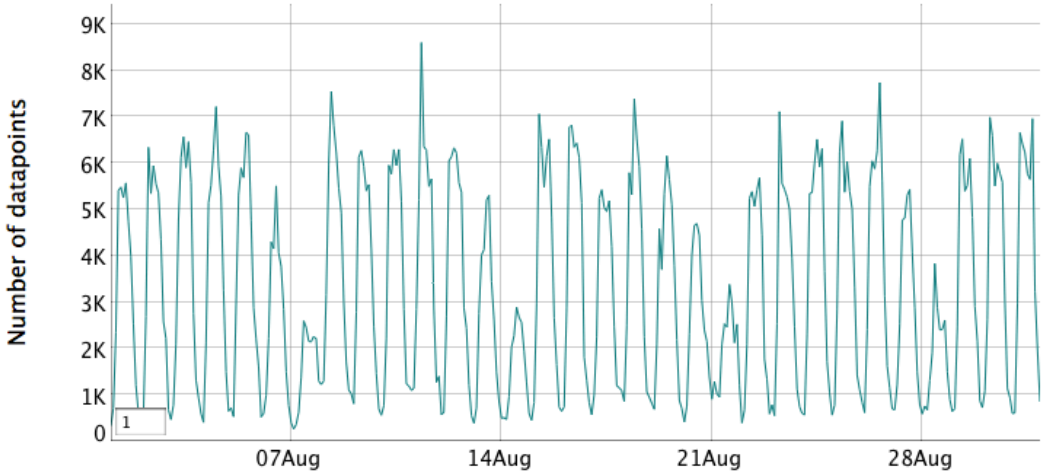
Transmission delay



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

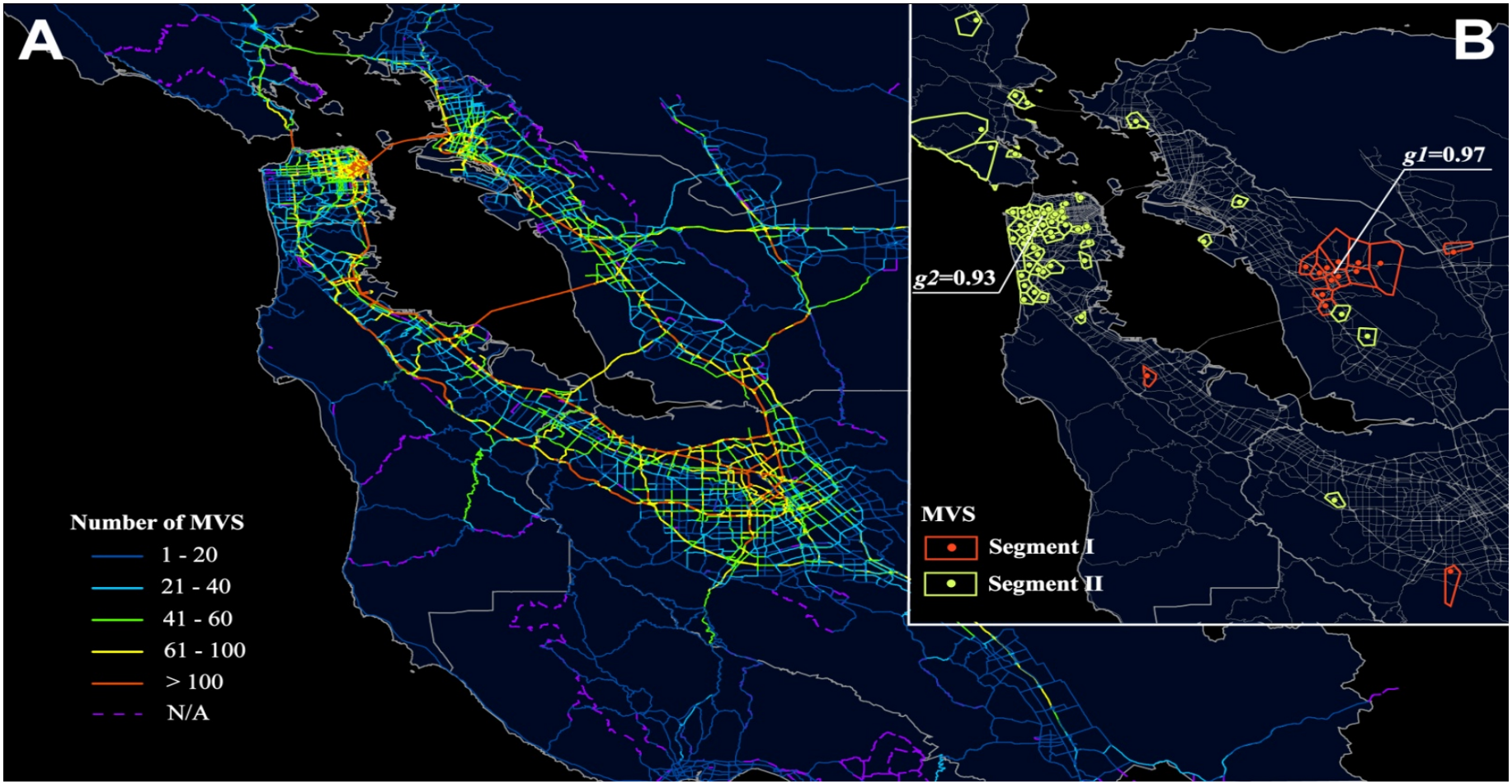


The total number of data points at the time specified on the *x*-axis. Data aggregated every two hours.

Provide public agencies with quality metrics, including:

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

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?

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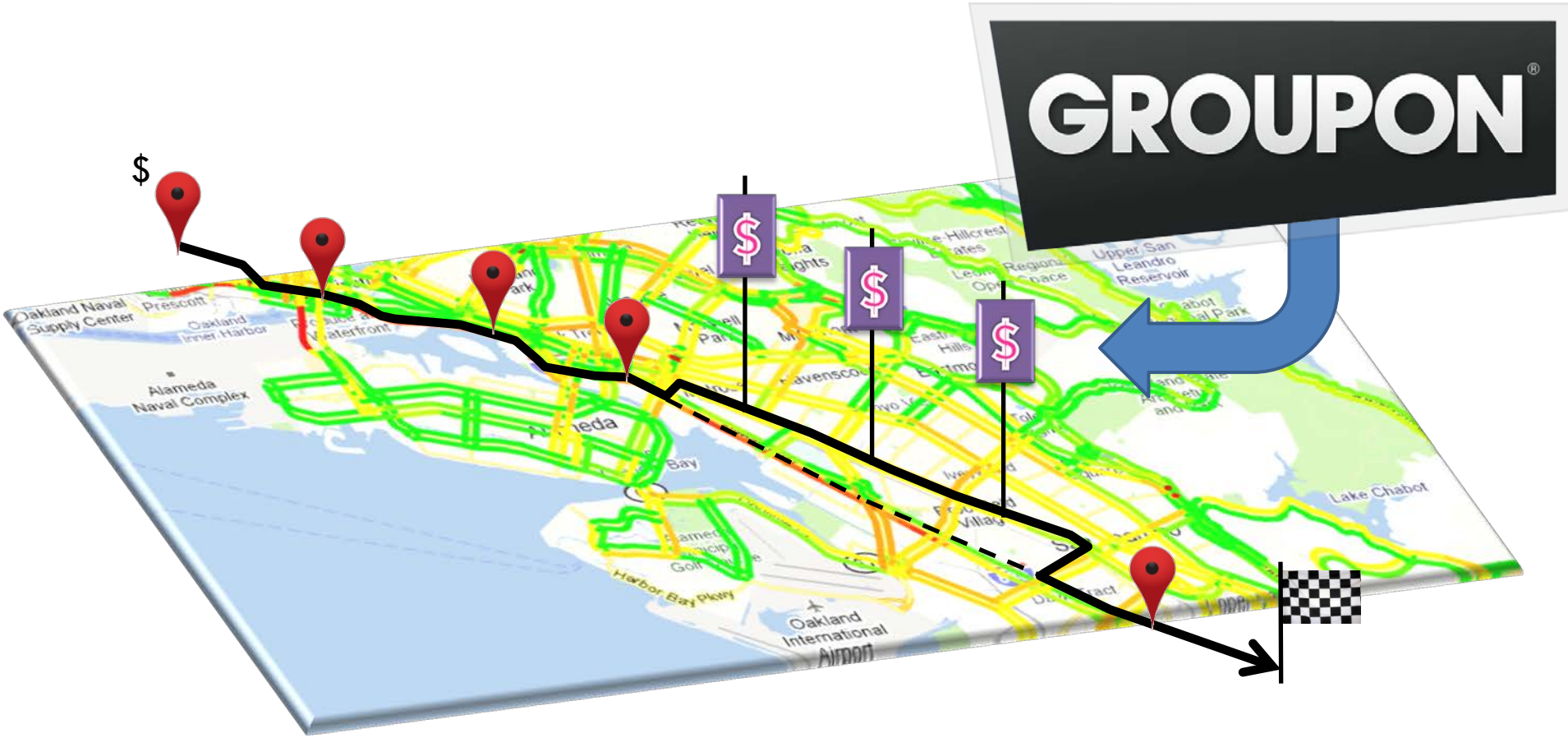
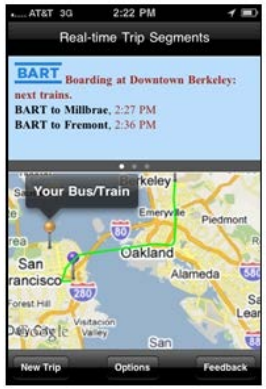


But the question is: How to target them?

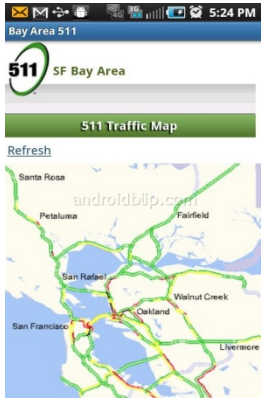
But the question is: How to target them?

Because the boundaries between radio, social network, connected devices are porous

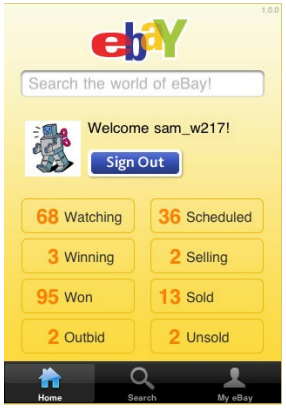
Routing info



Transit info



Traffic info



Incentive cashing

Personal tracker

Social interactions

Questions?

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