Intelligent Vehicles and Roads: the VII Program and the SafeTrip-21 Initiative

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Caltrans Improves Mobility Across California

Outline of the Presentation

- What is Vehicle-Infrastructure Integration (VII)?
- What is SafeTrip-21?
- The Mobile Millennium Project
- The Networked Traveler Project

What is VII?

Basic Concept:

- All new vehicles will be equipped with DSRC radios at 5.9GHz, and GPS receivers.
- A nationwide, roadway-based communications network will be created.
- Wireless data will be exchanged between the vehicles and the roadside.
- A “Backhaul” network will transport this roadside data to/from a central location.

Simple VII Block Diagram

Driver

End User

Vehicle Data

Driver Display

Subscriber Applications

On Board Equipment

Backhaul Network

5.9 GHz DSRC

Road Side Equipment

Scope of VII

- 15 Million new vehicles every year will have VII installed by the manufacturer
- A Nationwide Communications Infrastructure
  - A network of 250,000 “Hot Spots” (Similar to Wi-Fi)
  - Interstate & Urban Freeways -- 55,000 miles
  - Major Rural Roads -- 100,000 miles
  - 454 Largest Urbanized areas with Pop. > 50,000
  - Will Serve 70% of Total US Population
- A set of national VII standards for interoperability will be developed

Examples of VII Applications

- Safety
  - Intersection Collision Avoidance
  - Roadway Departure Warning
  - Emergency Brake Lights
  - Cooperative Forward Collision Warning
  - Rail Crossing Warning
  - Emergency Vehicle Signal Preemption
- Mobility
  - In Vehicle Signage
  - Traffic Signal Control
  - Ramp Metering
  - Winter Maintenance
  - Traveler Information
  - Electronic Toll Collection
- Consumer & Commercial
  - Drive-Through Payment
  - Remote Diagnostics
  - Customer Relations Management

A Change in Strategy

- Previous approach
  - Deployment decision by OEMs, US DOT, state transportations agencies in 2010 with synchronized deployments beginning around 2012
  - Key technology for vehicle to infrastructure communications was Dedicated Short Range Communications (DSRC)
  - Expectation that the infrastructure build out could be substantially funded by the Federal government
- Current approach
  - Open up the architecture to allow for non-DSRC technology
  - Work with aftermarket suppliers to enable VII capabilities sooner
  - Demonstrate a subset of capabilities that VII can provide in a few, high concentration operational test sites
  - Support growth in geographic coverage and functionality over time
  - Leverage new technologies and private industry developments
  - Learn from related state and university research

SafeTrip-21 is Phase I of the redefined USDOT VII Program

SafeTrip-21 embraces traditional VII concepts with a new emphasis on:

- Near term possibilities
- DSRC alternatives
- Consumer electronics
- Intermodal integration
- Energy / Environment

SafeTrip-21: New Horizon

- Accelerate VII research into “real-world” experience
- Emphasize near-term VII possibilities that don’t require extensive “build-out”
  - Deliver VII benefits through consumer electronics (quickly, cheaply)
  - Exploit existing communications technologies as pathways to DSRC
- Expose travelers and decision makers to VII benefits in terms of:
  - Safety improvement
  - Congestion mitigation
  - Motor freight operations
  - E-Payment convenience
  - Energy conservation
  - Environmental footprint
- Obtain real world perspectives on VII plans/deployment strategies

SafeTrip-21 Components

- **Information Gathering**
  - ITS America / industry representatives
  - Transportation and transit agencies
  - University Transportation Centers
  - VII research groups / sites
  - Request for Information
- **Field Test and Evaluation**
  - ITS World Congress Launch
  - Year-long test and evaluation
  - Interim findings throughout 2009
  - Summary Results - January 2010
- **Business Model Assessment**

Initial Projects

- “Mobile Millennium”
  - Builds upon the success of the “Mobile Century” Experiment
  - Relies on a “Private Sector” business model
  - Public Sector becomes just another consumer of the traffic data
- “Networked Traveler”
  - A “Gateway” connects the consumer mobile device in the vehicle to roadside infrastructure
  - The Gateway enables new transit services too
    - Several transit agencies are very interested in these services
  - The Public Sector seeks to be the catalyst in triggering additional Private Sector development

Public-Private Partnership

- Public Partners
  - USDOT
  - Caltrans
  - Metropolitan Transportation Commission (MTC)
  - Santa Clara Valley Transportation Authority (VTA)
  - San Mateo County Transit District (SamTrans)
- Private Partners
  - Nokia
  - NAVTEQ
  - Nissan
- Academic Partners
  - California Center for Innovative Transportation (CCIT)
  - Partners for Advanced Transit and Highways (PATH)

Budget

Total Project Budget: $12.4 million

- Federal Share: $2.9 million
- Caltrans Share: $4.2 million
- Nokia Share: $2.5 million
- NAVTEQ Share: $2.0 million
- UC Berkeley Share: $700 thousand
- Nissan Share: $30 thousand

Mobile Millennium: mobility tracking using cellular phones

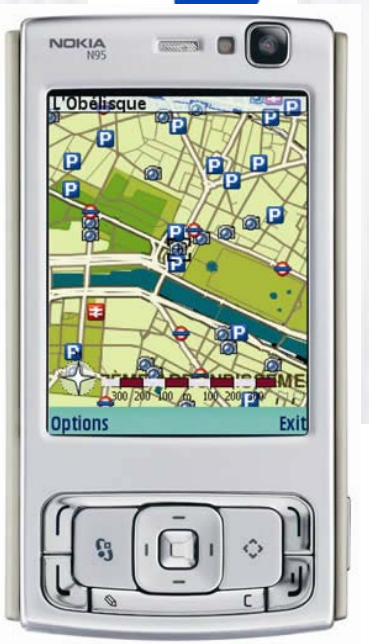
UC Berkeley – CCIT – Nokia – Navteq

Convergence of multimedia, sensing and communication

- **N95 is a good example of the convergence of multi-media, sensing, and communication platforms**
  - GPS
  - MP3 and movie player
  - Multiple sensors (accelerometers, tiltmeter, light)
  - Radio, wireless, Bluetooth, various ports, infrared, etc.
  - 5 megapixel camera

- **Smart phones enable:**
  - Location based services
  - Situational awareness
  - Mobility tracking

- **Ubiquitous Sensing Platform (Nokia)**
  - 3 billion mobile devices by 2009
  - 1.5 million devices per day



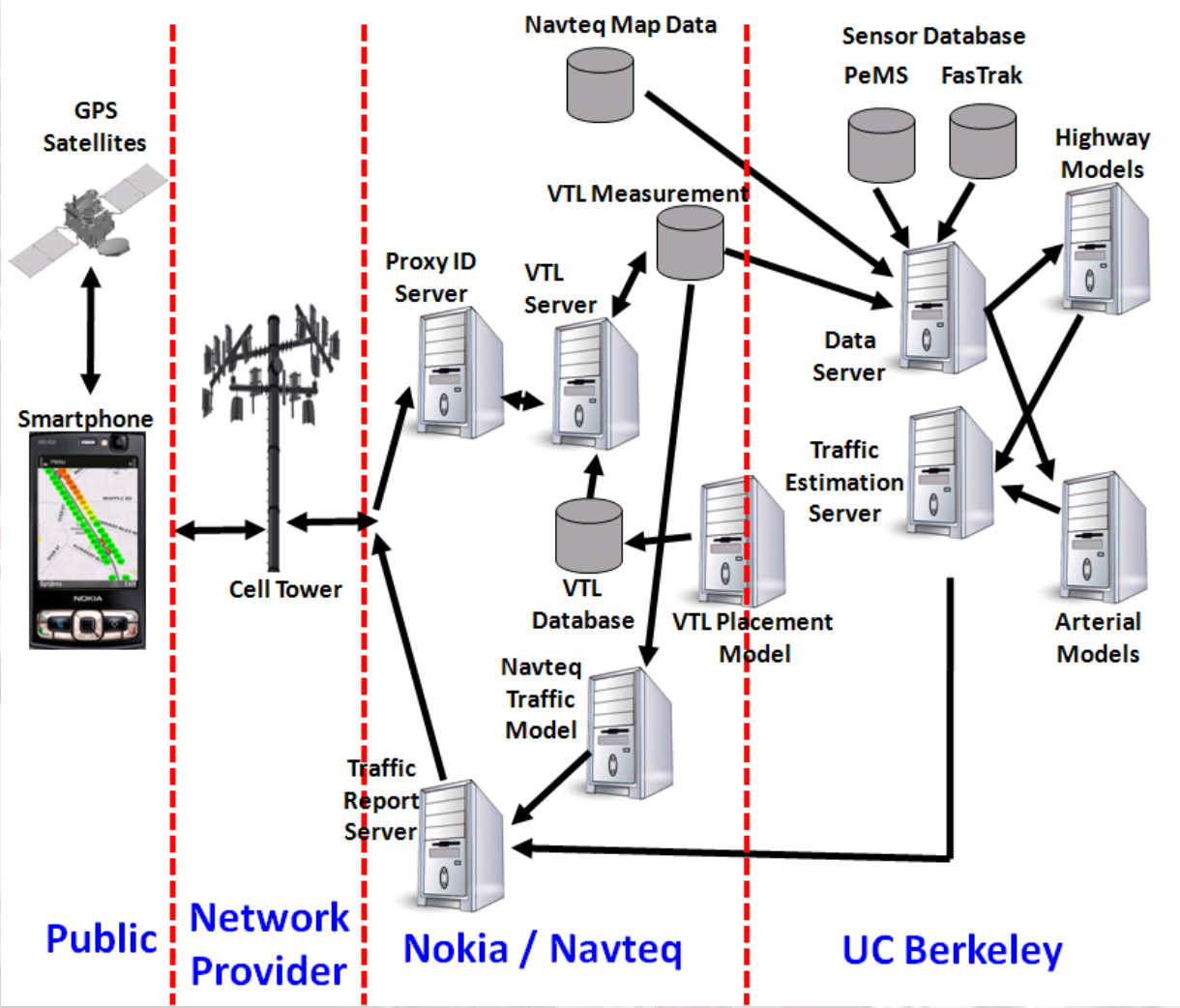
Mobile Millennium

- **Project Description**
  - For a six-month period, equip thousands of cars on a roadway network, including arterials
  - Participating drivers agree to share position and speed data
  - Collect unprecedented traffic data, covering 500+ miles of freeway and arterials
    - Demonstrate the added value of this traffic data on freeways, and especially on arterials that are not currently monitored
  - Drivers receive real-time traveler information through a map application on their phone
  - Demonstrate privacy protection
  - Mobile Millennium is the precursor to a real, mainstream product

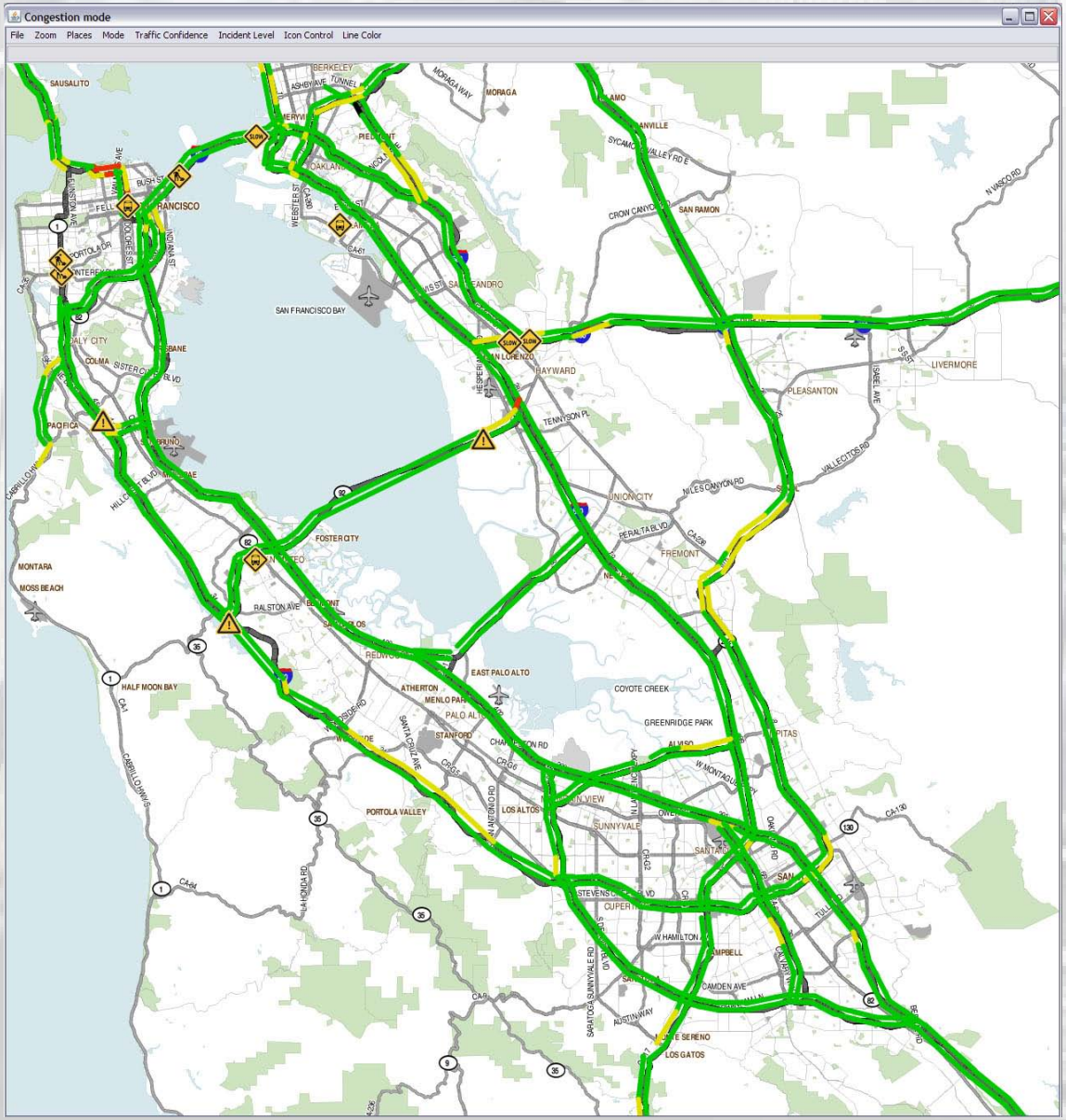
- **SafeTrip-21 Demos**
  - ITS World Congress: Live broadcast of Mobile Millennium capabilities, and [tentative] subset of Mobile Millennium technology directly showcased for New York arterial network.

Architecture for global traffic monitoring

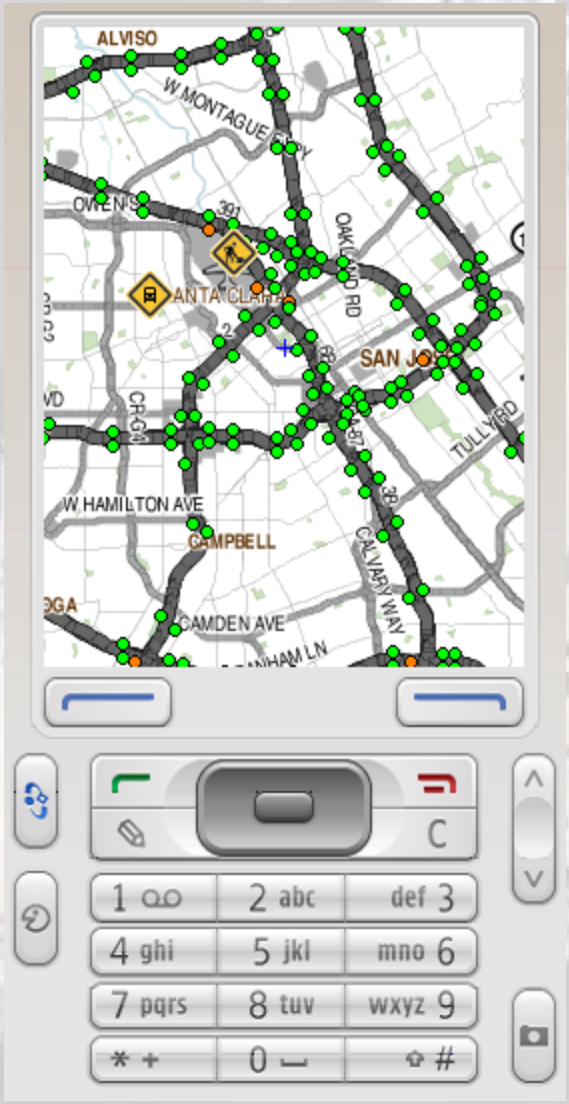
- **Architecture for global traffic monitoring**
  - Public (phones)
  - Network provider
  - Nokia / Navteq
    - Data collection
    - Traffic.com
    - Historical data
    - Maps
  - UC Berkeley
    - Highway traffic models
    - Arterial traffic models
    - Travel time, congestion, weather, accidents...

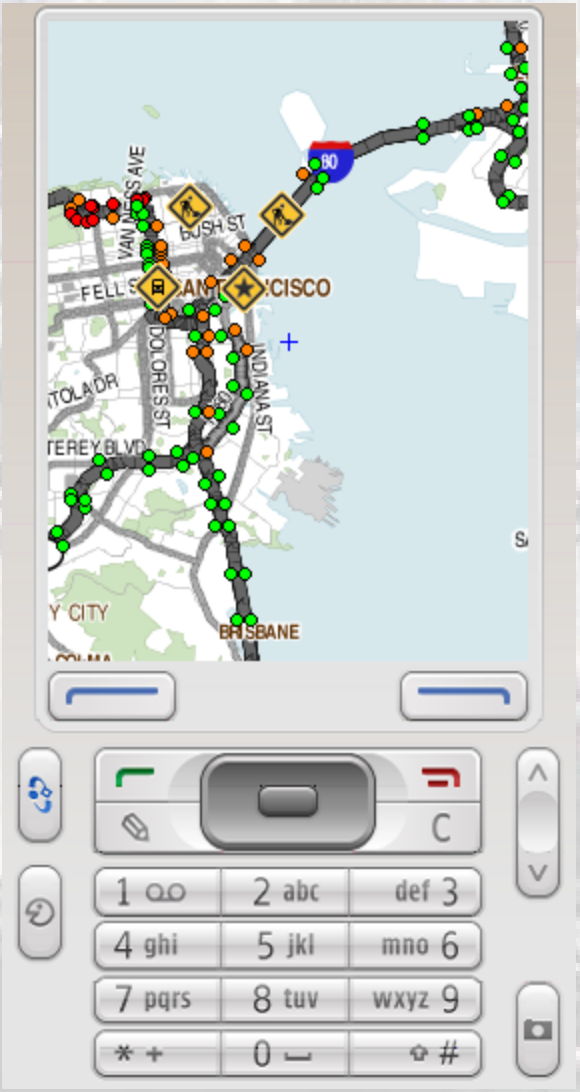


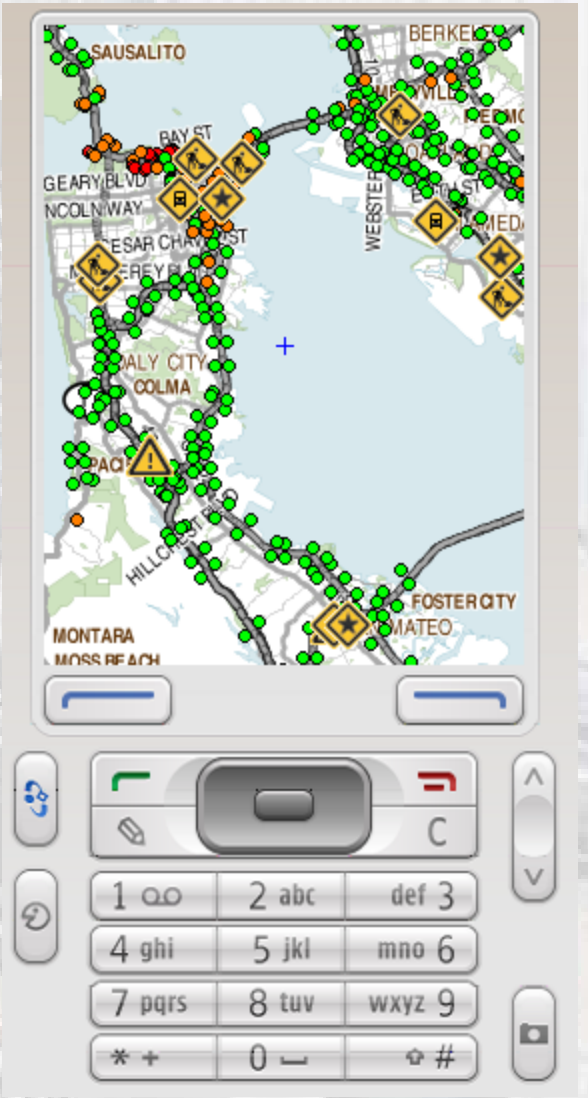
Interactive maps



Software client on the phone



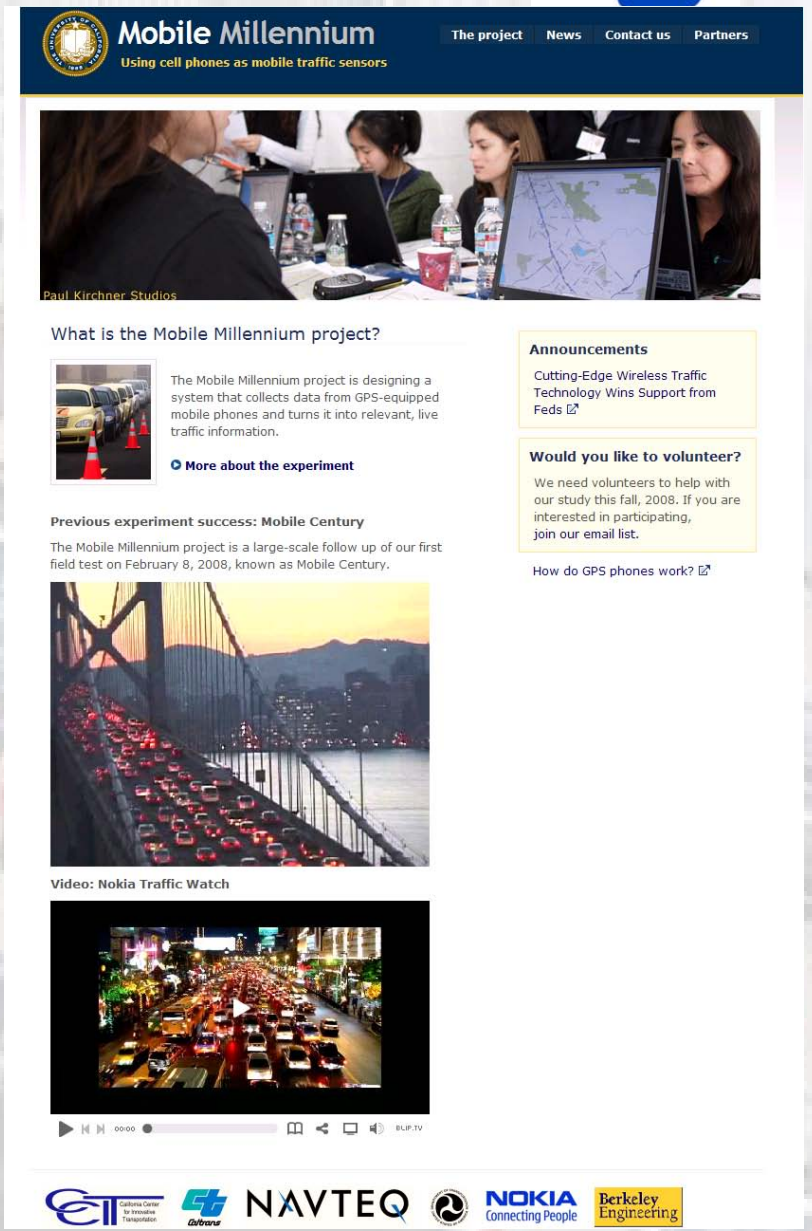




http://traffic.berkeley.edu

- **Mobile Millennium website**
  - Presentation of the project
  - Background material
  - Videos (previous experiments)
  - Media report (more than 100 entries)
    - CBS, NBC, ABC, CNET, BBC...
    - NPR, KGBO
    - Chicago Tribune, LA Times, San Francisco Chronicle, San Jose Mercury News.
    - More than 100 web outlets.
  - Team, milestones, contact

- **Upcoming**
  - Live data feed
  - Software upload



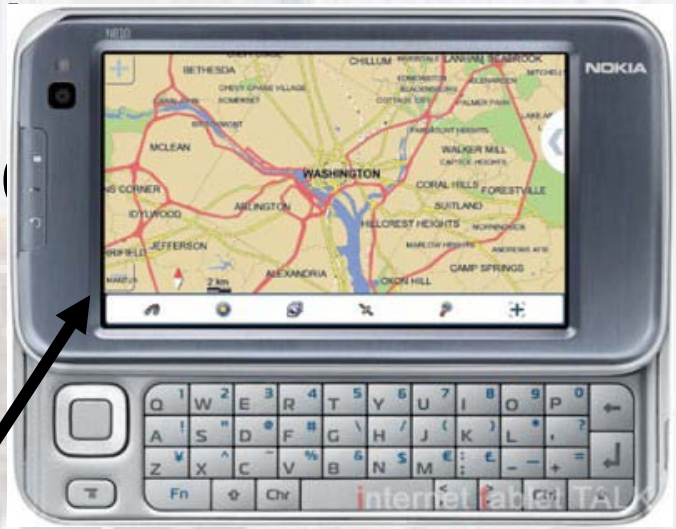
Networked Traveler

- **Provide real-time traveler information for safety, multi-modal mobility, parking, etc.**
- **Services can be easily downloaded from a web site into a “smart” mobile device**
- **Gateway uses multiple communications modes, such as cell phone network, Wi-Fi, and DSRC, to connect the traveler to the information**
- **Independent of vehicle type**

Multi-Networ
Multi-Devic

I want *some* safety alerts.
Hmm… I want *a lot of* transit connection information, too.

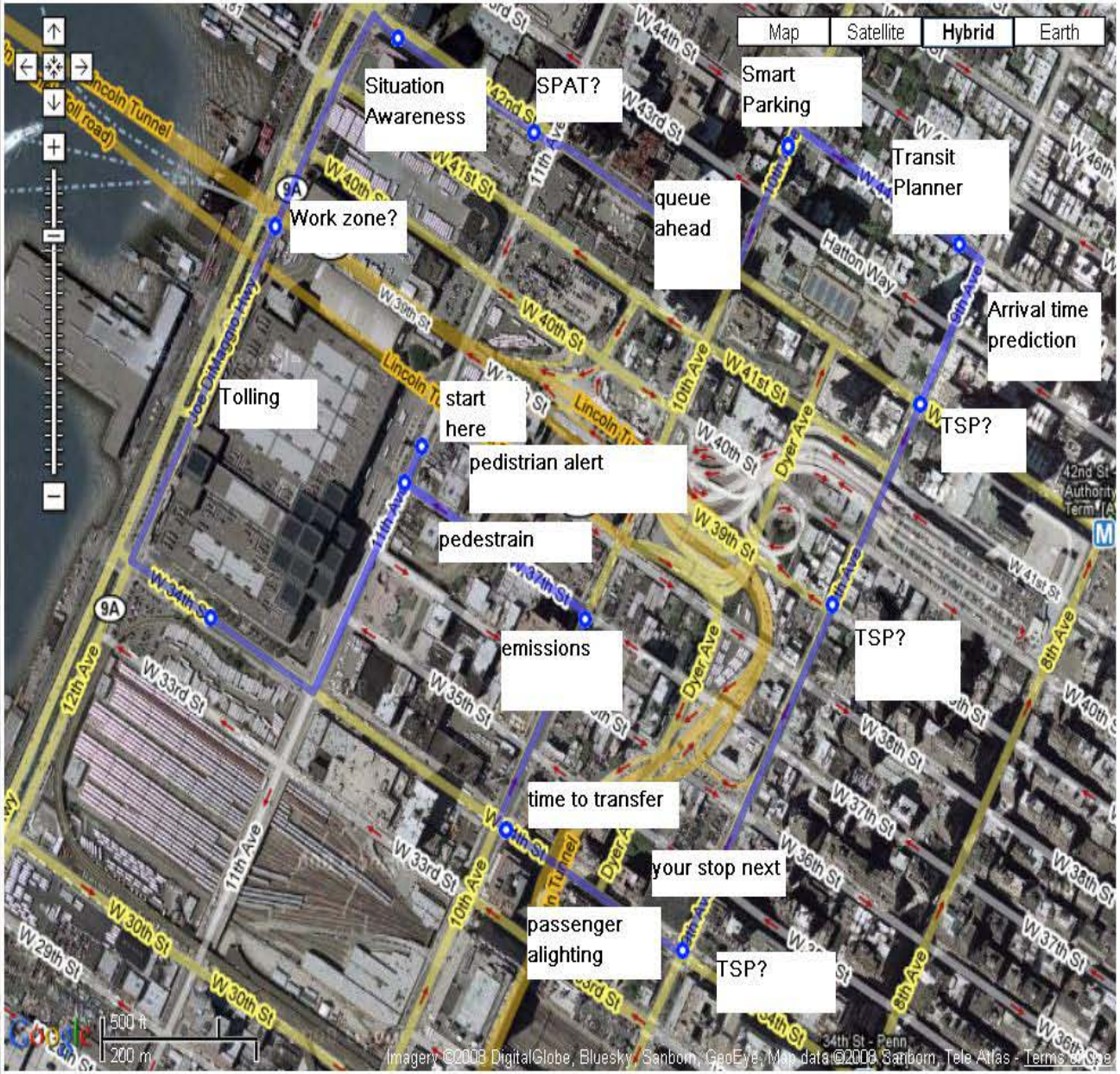
Browser based



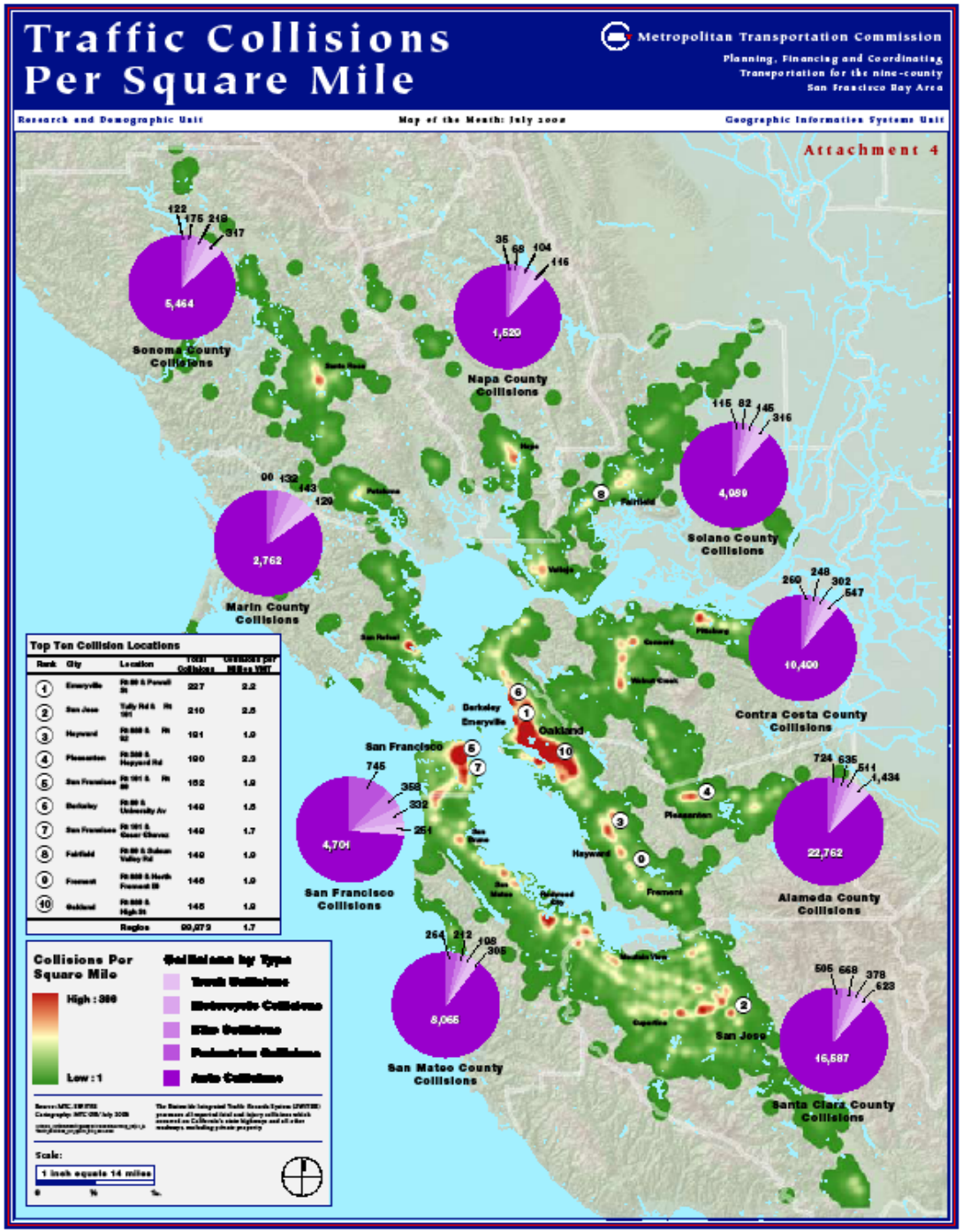
www.connected-traveler.org/tellmeaboutmytrip
www.connected-traveler.org/tellmeabouttheroad
www.connected-traveler.org/watchoutforme

Networked Traveler Services
Will be demonstrated in NYC

- **Tell me about my trip**
  - *Trip Planner (cell phone with Internet connectivity; multimodal services)*
  - *Dynamic Route Advisory*
- **Tell me about the road**
  - *Traffic Signal Countdown (as a safety and information enabler)*
  - *Public Signage – Situational Awareness*
  - *Pedestrian Assistant (location and other apps)*
- **Watch out for me!**
  - *Heartbeat/watch out for me (confederate driver near the bus; situational awareness, left/right?)*
  - *Pedestrian Assistant (safety apps)*
- **System Operator / Agency Applications**
  - *Transit Signal Priority (LCD on bus with signal phase countdown)*
  - *Dynamic Passenger Information (On-board display, arrival countdown, and bus station, arrival time)*



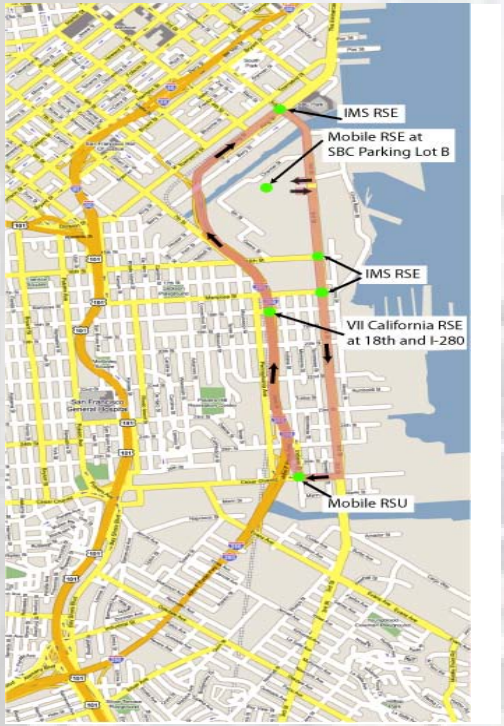
Marker	Latitude	Longitude	Distance
11th Ave	40.758020	-74.000330	0
W 34th St	40.756450	-74.003580	439
12th Ave/RT-9A	40.760040	-74.002580	507
W 42nd St	40.761760	-74.000680	289
W 42nd St	40.760890	-73.998580	202
W 42nd St	40.759730	-73.995710	276
10th Ave	40.760760	-73.994660	166
W 44th St	40.759870	-73.992020	265
9th Ave	40.758410	-73.992620	200
9th Ave	40.756571	-73.993971	234
9th Ave	40.753420	-73.996280	402
W 34th St	40.754530	-73.999010	266
10th Ave	40.756440	-73.997800	249
W 37th St	40.757690	-74.000580	279



Networked Traveler

Next Year:

Field Test and Evaluation of Safety (Situational Awareness) and Mobility Applications in the San Francisco Bay Area



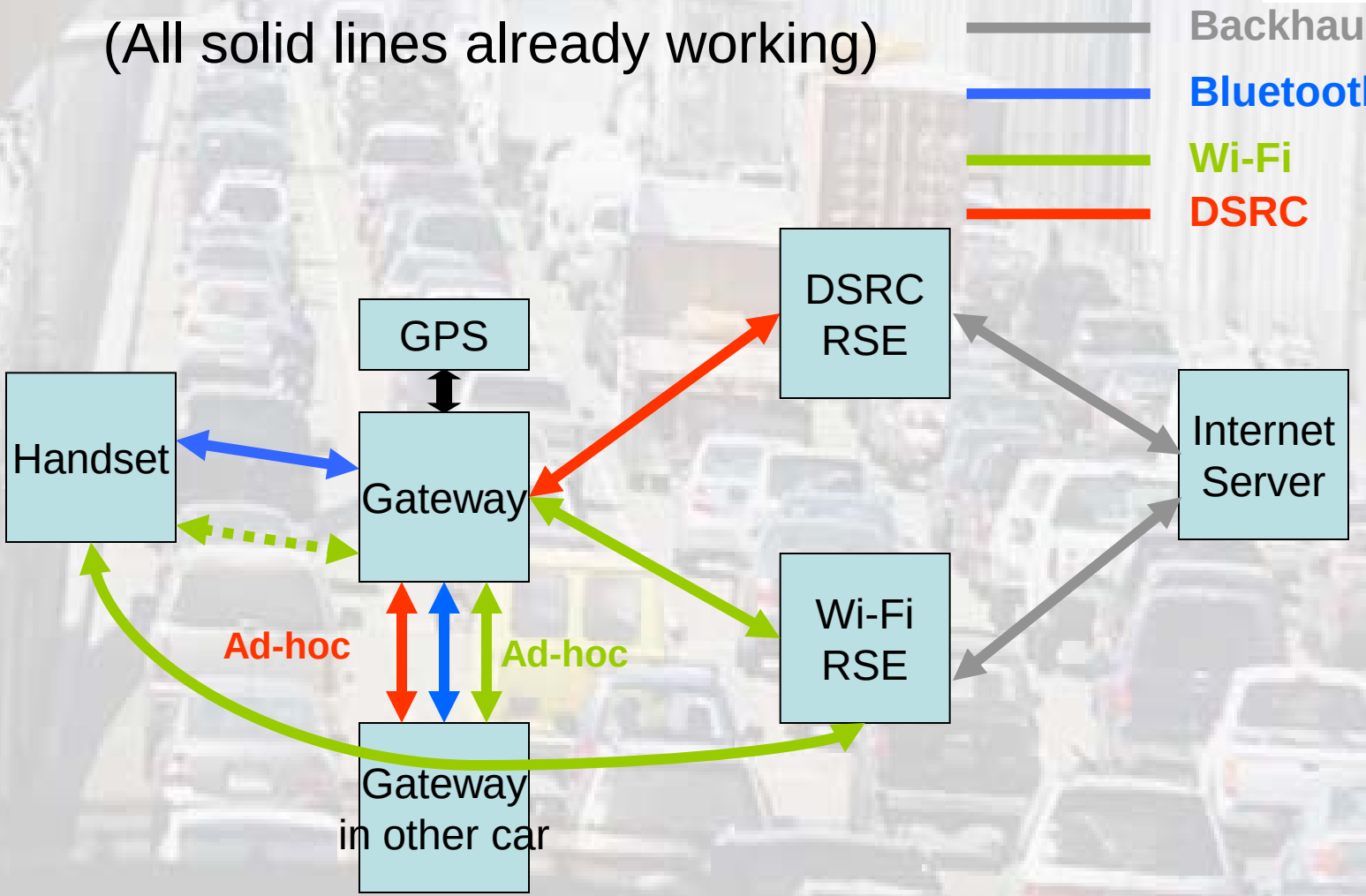
Thank You!

Please refer to:
viicalifornia.org

Caltrans Improves Mobility Across California

Multi-Network

(All solid lines already working)



Multi-Network Gateway

- Gateway has Wi-Fi and DSRC radio interfaces
- Also has Bluetooth interface to cell phones