The USC²T Project

The USC Clever Transportation Project

Traffic Data Management

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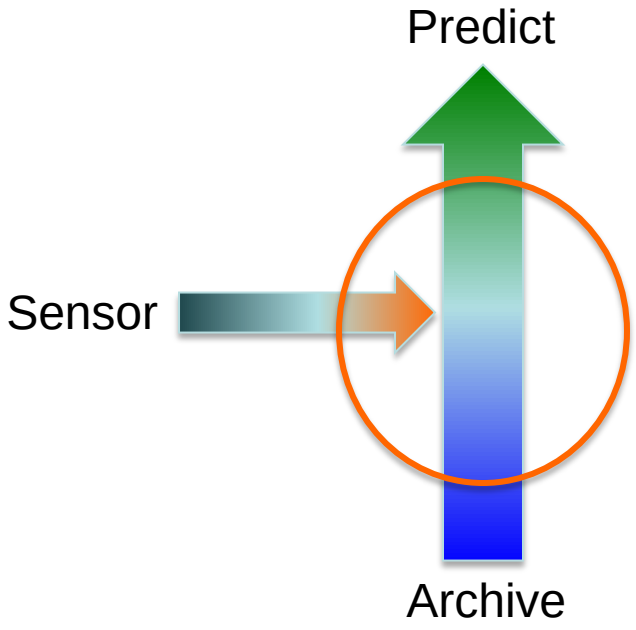
Cloud Futures Workshop 2011
Microsoft, Redmond, WA, 6/2/2011

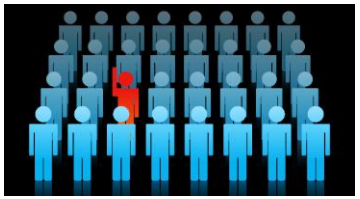
Motivation

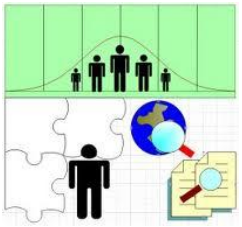
- Data may shed light on many fundamental questions
  - Driver utility function
  - Evaluation of alternatives
- Limited availability of data



Understanding the road network

- How roads behave in different situations (**Road Psychology)**
- How roads affect each other and their surroundings (**Road Sociology)**
- How the effect of break-down in the system spreads (**Road Epidemiology)**





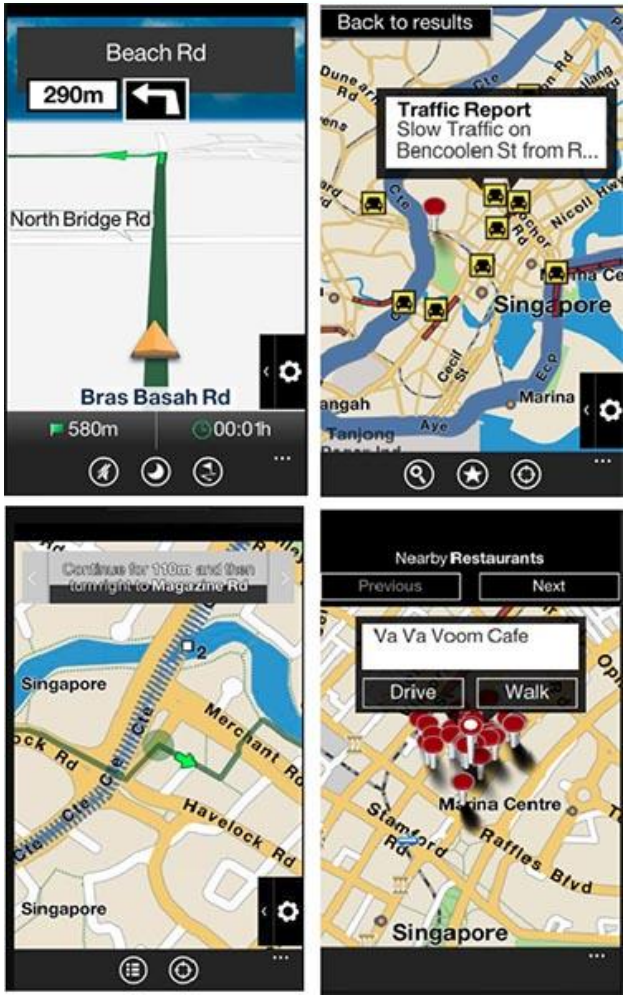
Spatial discrete choice and price elasticity

Congestion pricing and spillovers

Incident Management

Disaster and evacuation study

Client applications



The Goal

Facilitating an infrastructure for **acquiring**, **processing**, **storing** and **querying** real-time and historical data acquired from the transportation system.

The CT Project

Delcan
TRANSPORTATION • INFORMATION TECHNOLOGY • WATER

New Insights

METRANS
Transportation Center
USC | CSULB

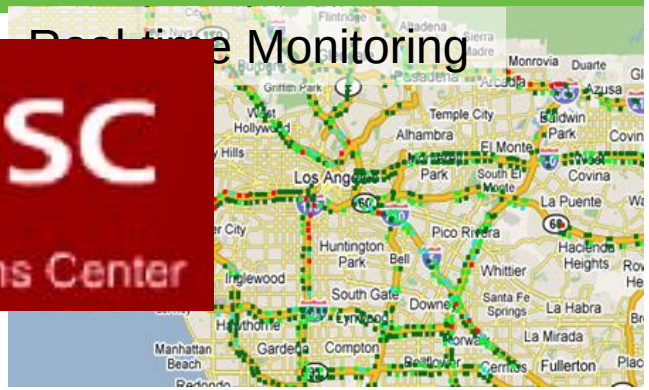
Real Impact

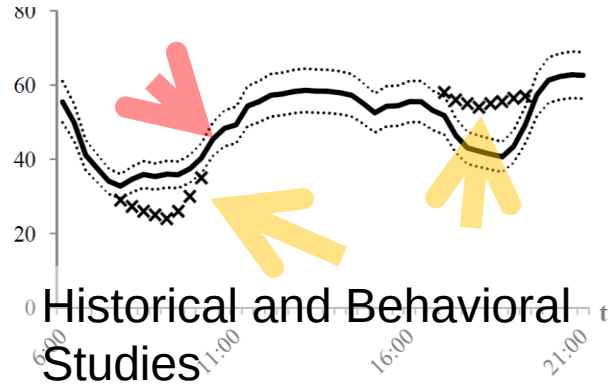
Los Angeles County
Metropolitan Transportation Authority
Metro

REGIONAL INTEGRATION OF ITS PROJECTS
RIITS
LOS ANGELES COUNTY

USC | IMSC
Integrated Media Systems Center

Real-time Monitoring





Historical and Behavioral Studies

On & Off the Cloud Considerations

- Working with the cloud costs money.
- The charging is based on (12/2010)
  - Transactions ($0.10 per GB in, $0.15 per GB out)
  - Storage (SQL Azure costs $75 per Month)
- Sums up to $387,500 per month
- Retrieved data contains lots of ~~g@rb@g3~~ not that useful information.

  (No point in uploading it to the cloud)

Architecture

StreamInsight Server

Traffic Data
Transit
Events
CMS
8 Different Agencies

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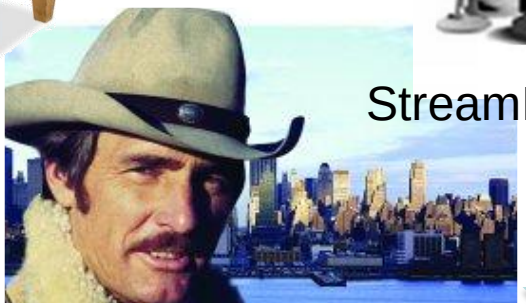
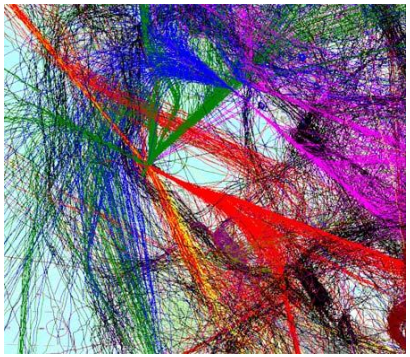
StreamInsight Server



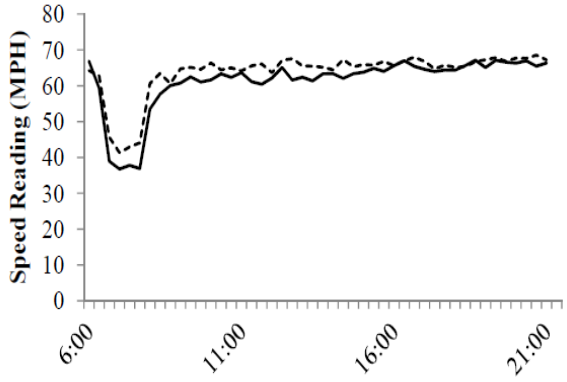
StreamInsight Server

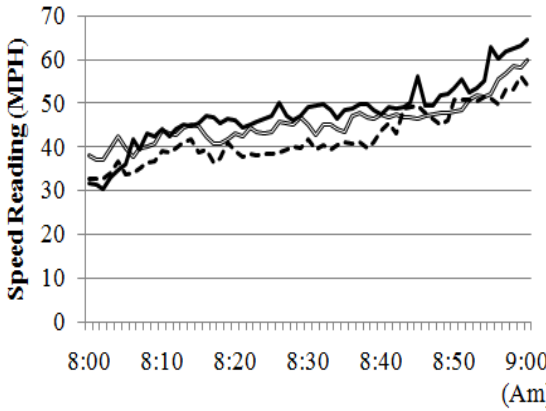
Microsoft SQL Azure



Research - Pattern Extraction

- Data is redundant
  - In time
  - In space

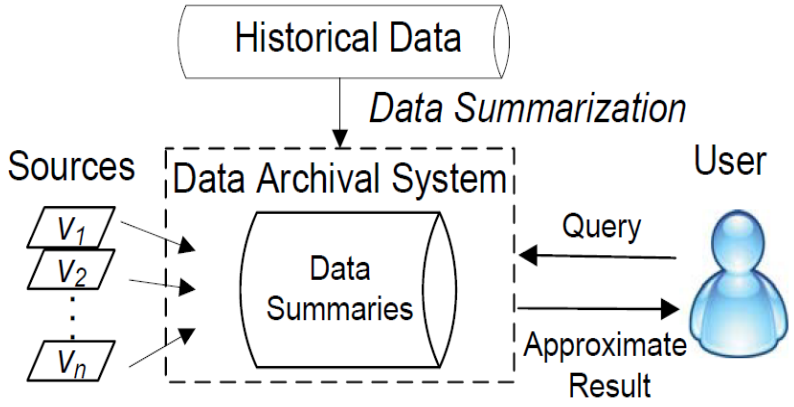


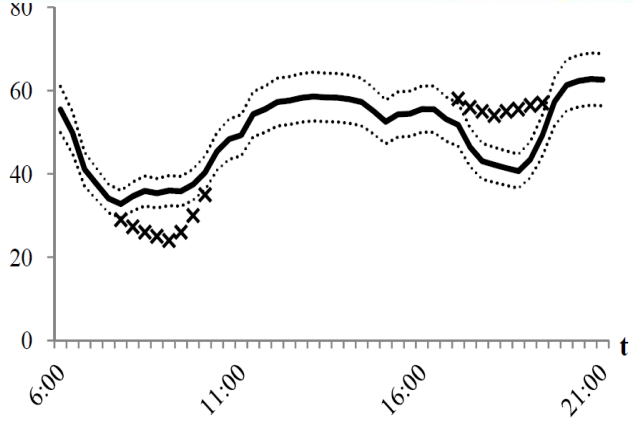


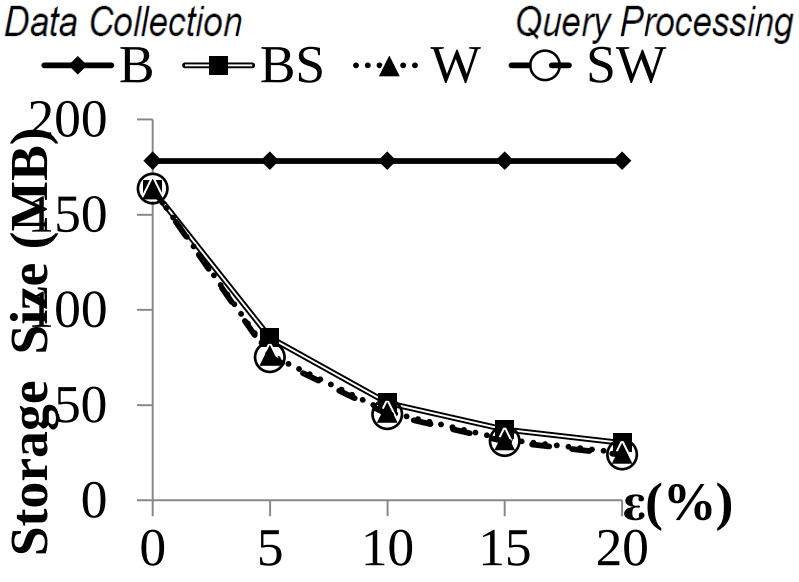
- Represent the data so it is compactly and efficiently stored
  - Compactly – Storage space
  - Efficiently – Query times

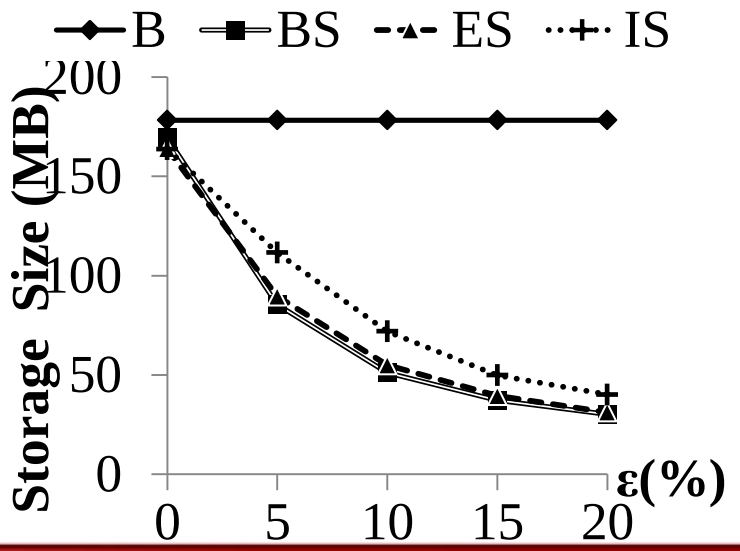
B. Pan, U. Demiryurek, F. Banaei-Kashani, and C. Shahabi, **Spatiotemporal Summarization of Traffic Data Streams**, ACM SIGSPATIAL, IWGS, San Jose, CA, November 2010

Pattern Extraction

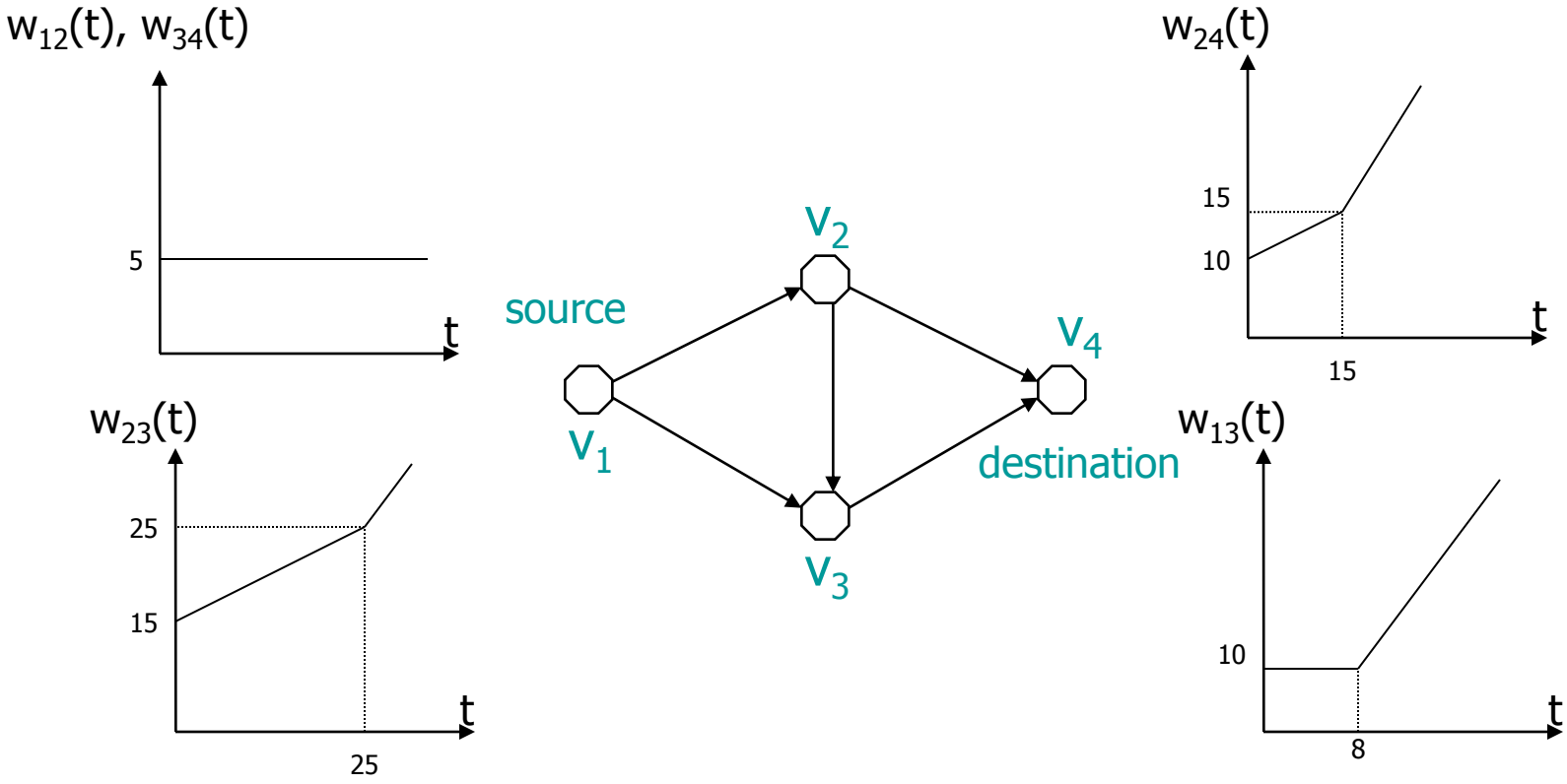








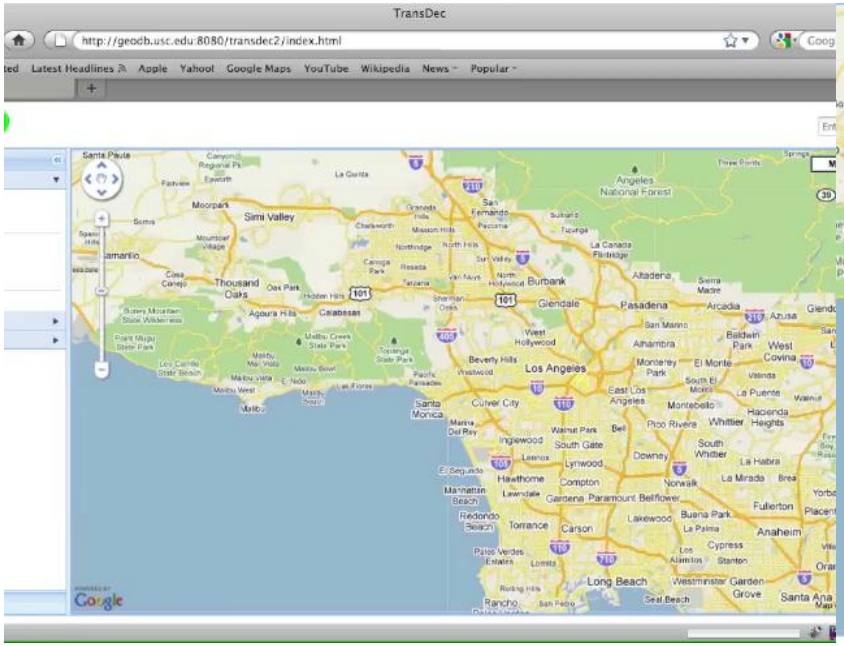
Time-dependent Spatial Network



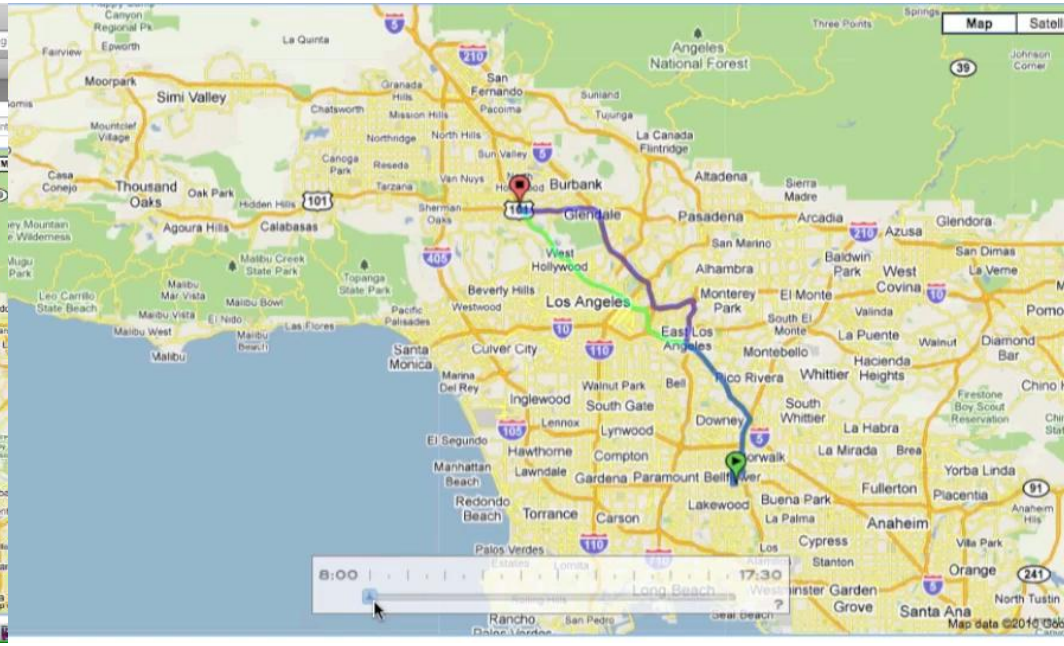
G(V,E,T): For every edge $e(v_i; v_j)$, there is a cost function $w_{ij}(t)$ which specifies the cost of traveling from v_i to v_j at time t.

Research – Patterns Utilization

Monitoring



Time Dependant Shortest Path



U. emiryurek, F. Banaei-Kashani, and C. Shahabi, **TransDec: A Spatiotemporal Query Processing Framework for Transportation Systems (Demo)**, 26th IEEE International Conference on Data Engineering (ICDE 2010), Long Beach, California, USA, March 2010

Regional Monitoring

National Science Foundation
Engineering Research Center

USC | IMSC
Integrated Media Systems Center

Questions ?

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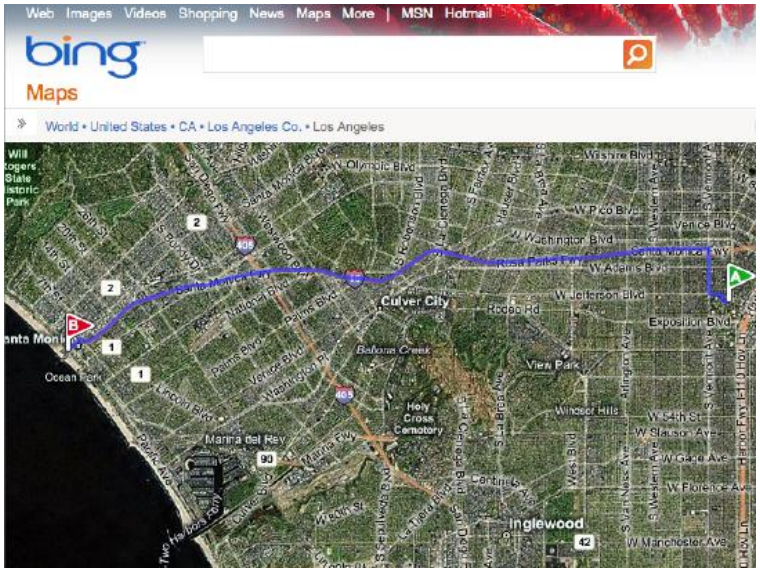
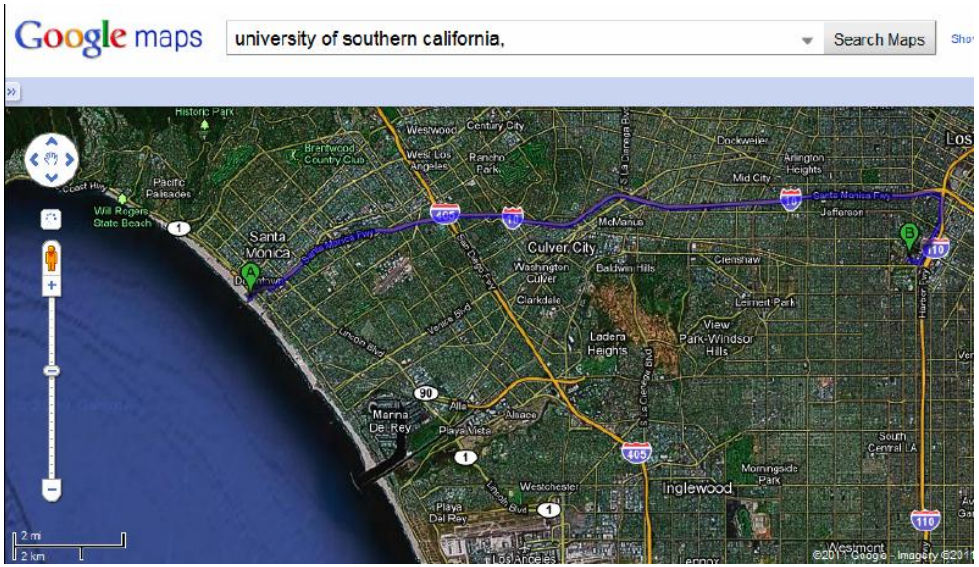
Current Systems

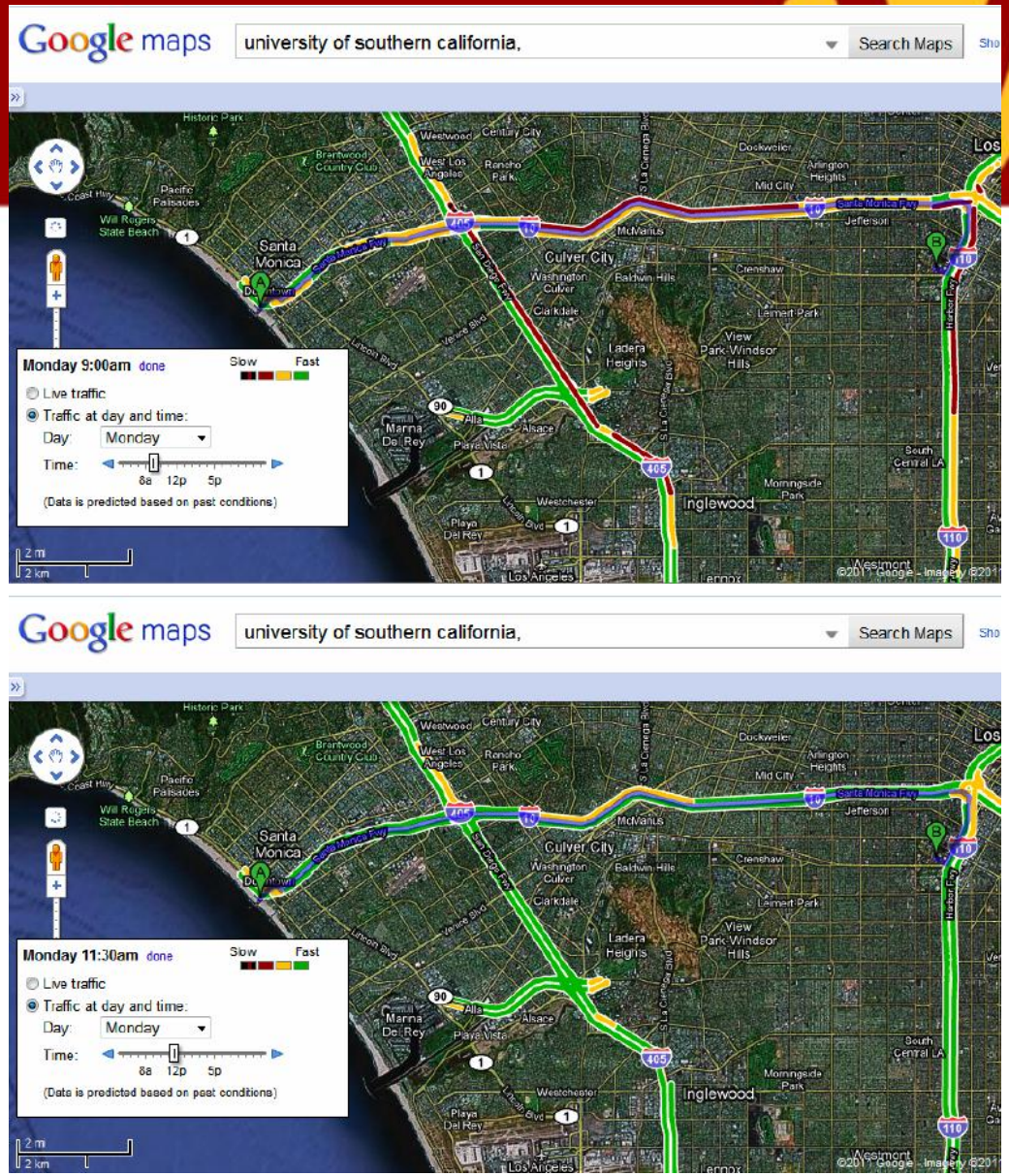
- The immediate Suspects





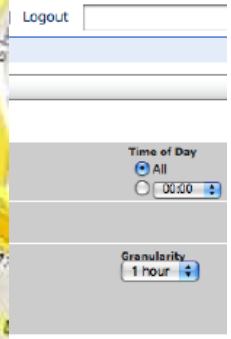
End user systems

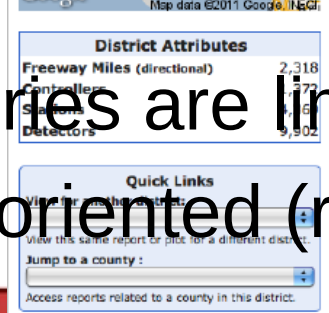
- Provide the user with
  - suggested routes
  - data about the traffic conditions
- Limited historical data granularity

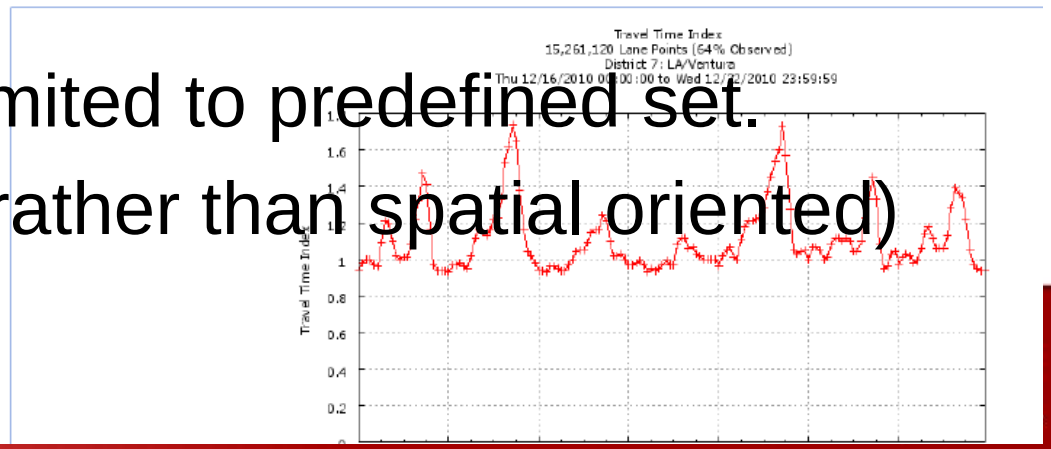


The distant suspect

- Th freeway Performance Measurement Project
  - –
  - –
- Co

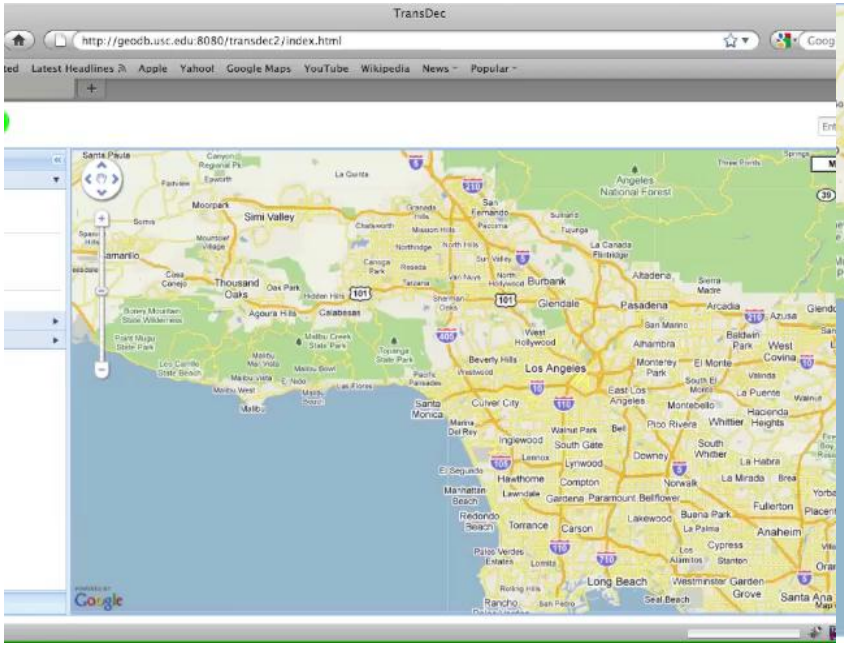


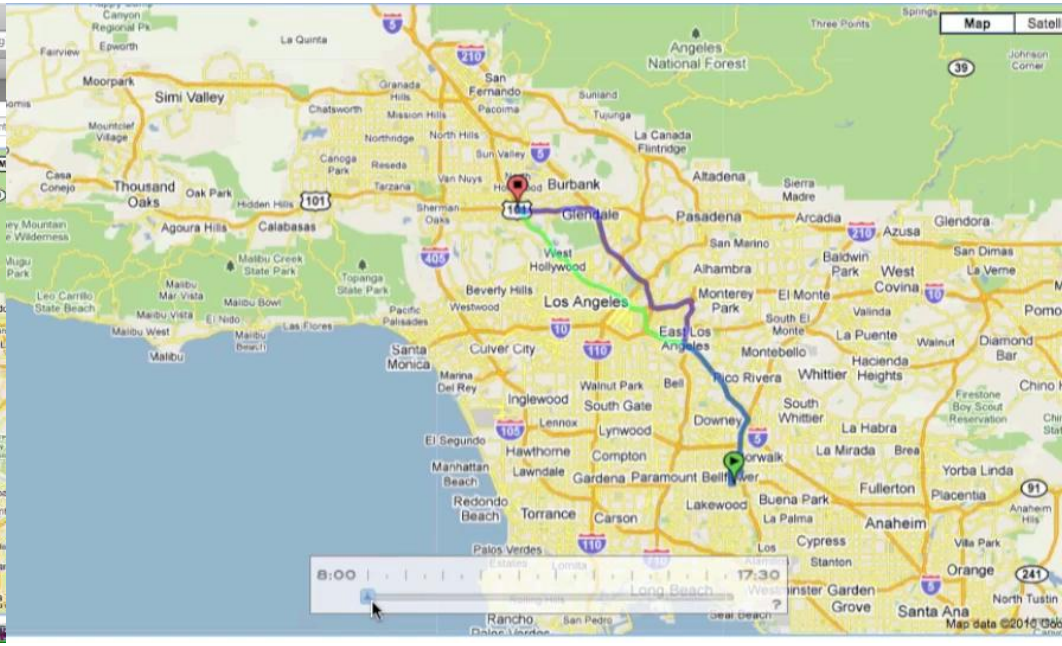




- Data queries are limited to predefined set.
- Network oriented (rather than spatial oriented)

What one can do with a little memory





U. Demiryurek; F. Banaei-Kashani, and C. Shahabi; "**TransDec: A spatiotemporal query processing framework for transportation systems**"; Proc. of 26th IEEE Intl. Conf. on Data Engineering, pp. 1197-1200, 2010