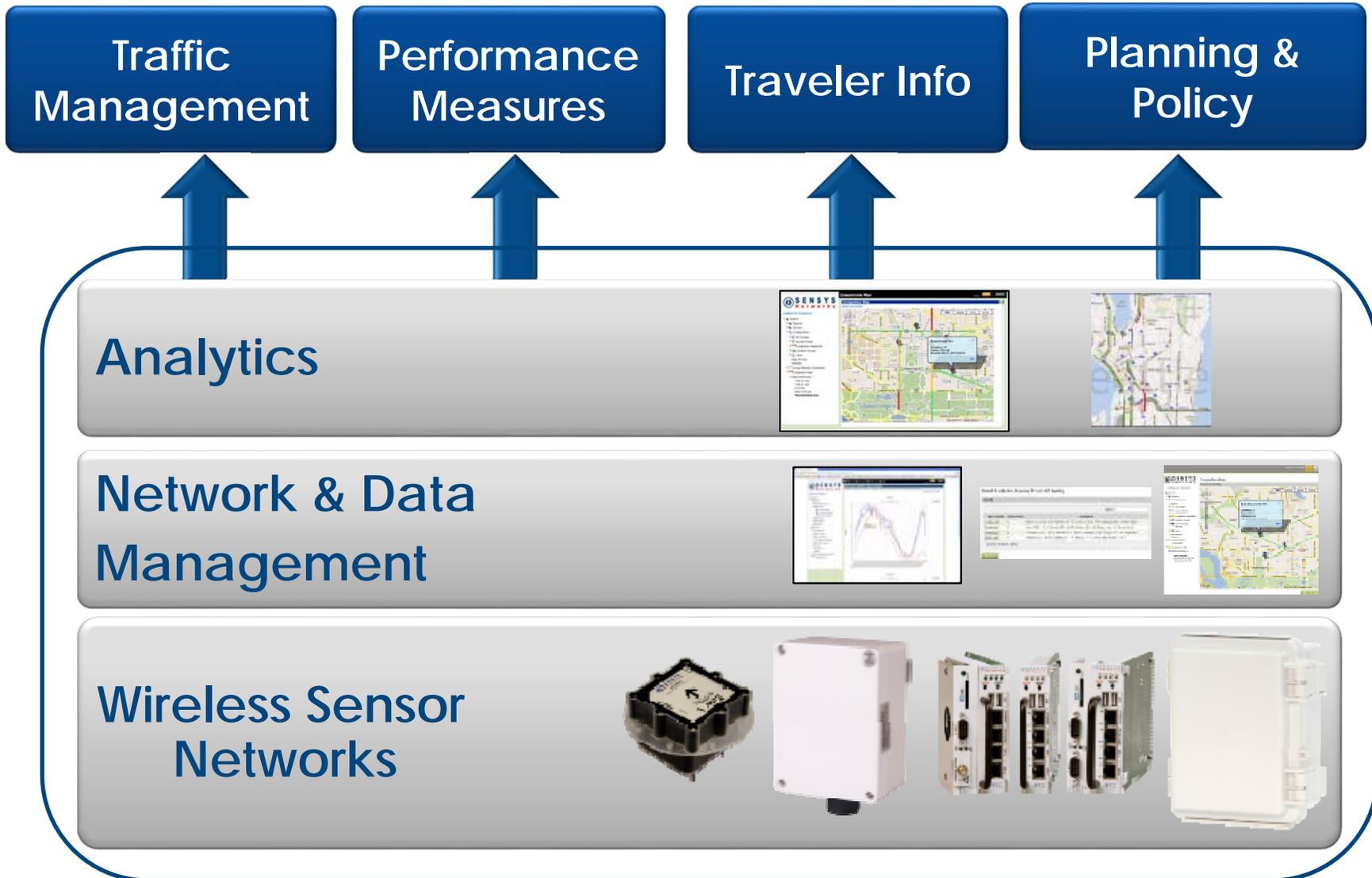




Sensys Networks Travel Time Signature

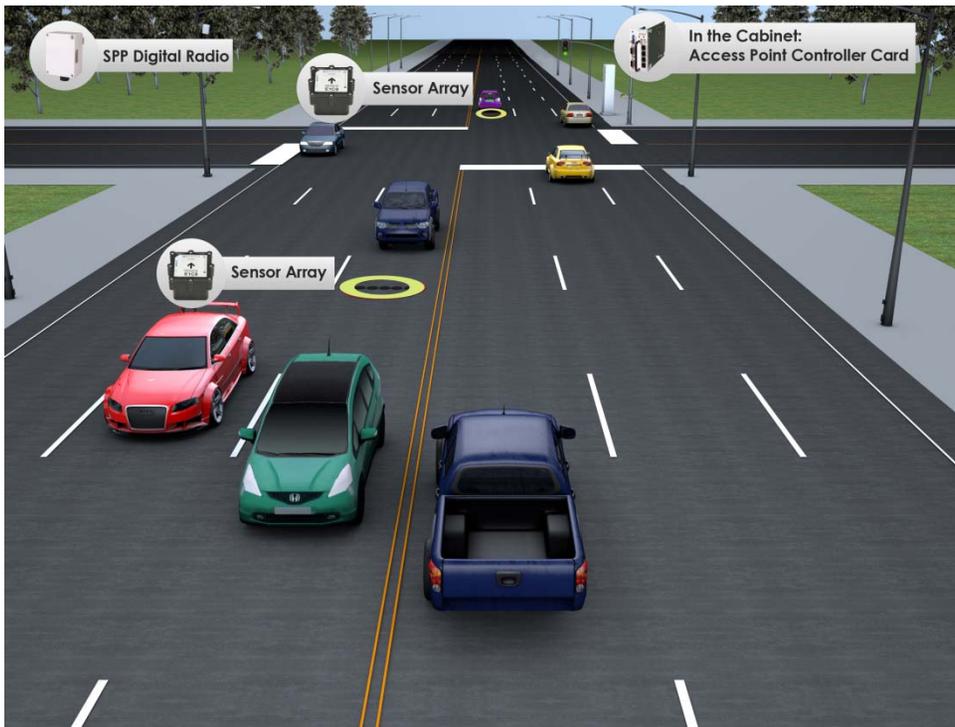
Analytical Foundation for Smart Cities



Travel Time for Arterials and Freeways



Magnetic Re-identification Travel Time System



Designed to:

- Optimize arterials during peak times
- Provide traveler information
- Monitor adaptive control performance
- Load balance arterials & freeways
- Adjust for freeway construction

Features:

- Re-identify vehicles anonymously
- 98% accuracy
- Measures speeds up to 80 mph

Applications

Traveler information and information service provider

Agencies share data with other agencies – you own the data
Open system - XML feed – don't buy another software package
Integrate into the software package (ATMS) you've already purchased.

Performance measures for Traffic Operations

Are my signals optimized? Is congestion at peak times minimized?
Does my adaptive control system reduce travel times?
Before / after studies from your desktop

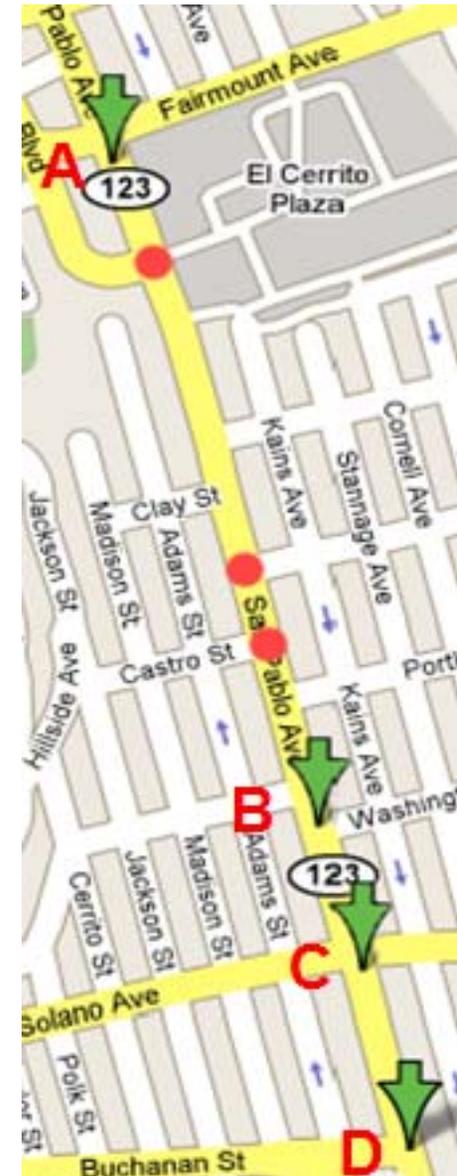
Maintenance and construction management

Real time, active traffic re-routing
Parallel arterials – balancing the load during construction
Giving travelers a choice with VMS

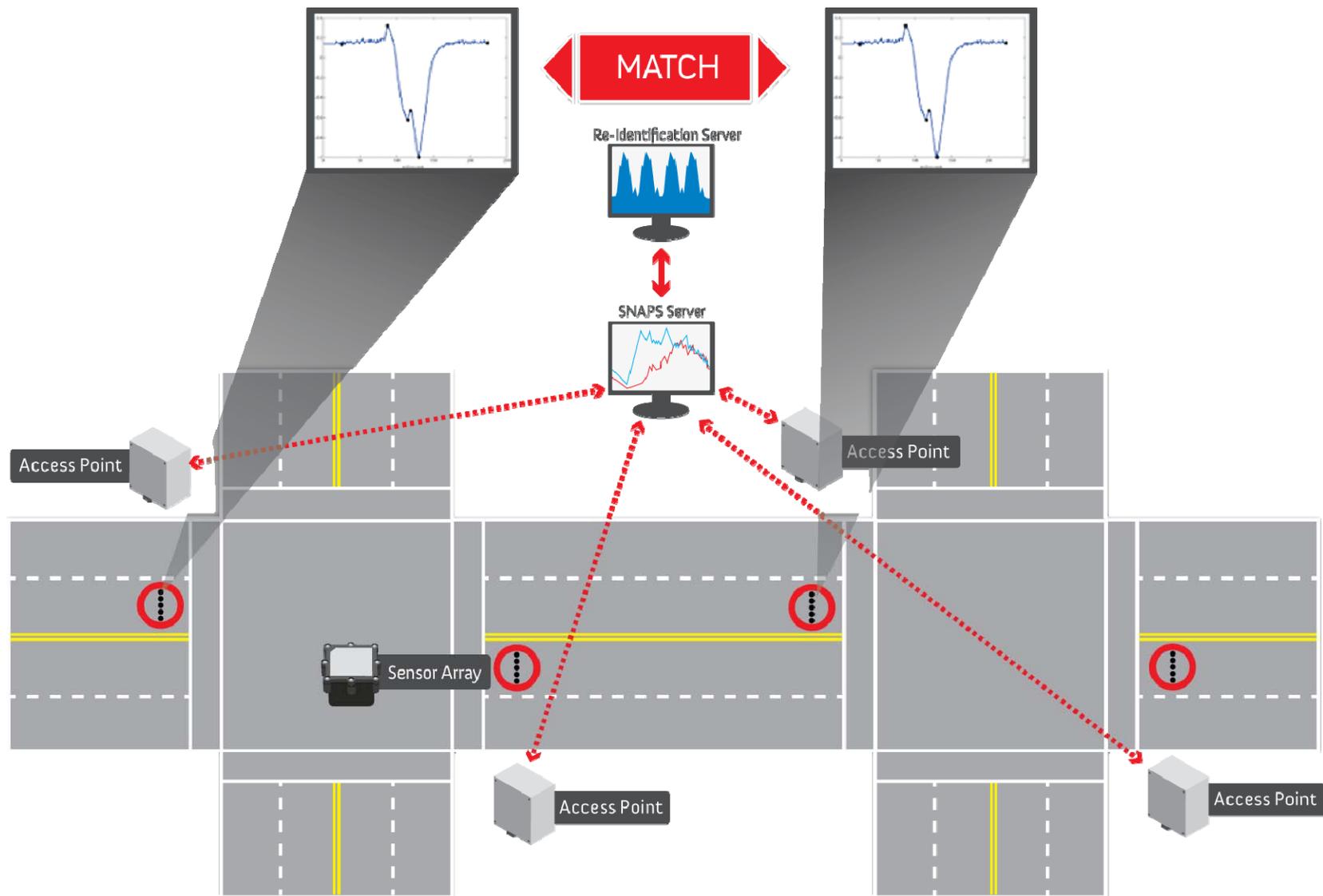
Magnetic Re-Id Overview



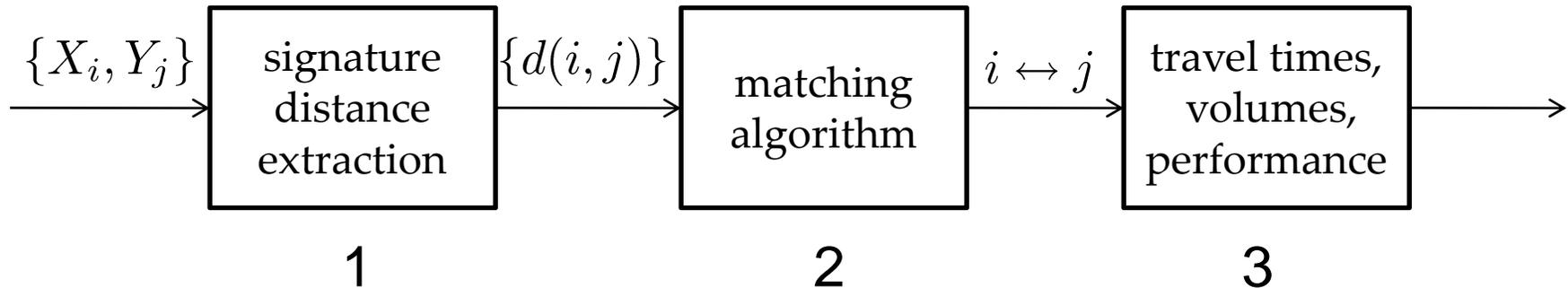
- **Patented technology called magnetic re-identification to provide arterial performance measures and travel times along signalized corridors.**
- **Matching done anonymously with no privacy invasion or tracking of specific vehicles.**
- **The Arterial Travel Time System provides:**
 - Complete distribution of travel times
 - Medial Travel Time (sec)
 - 80th & 90th percentile travel times (sec)
 - # of Vehicles in segment
 - Level of Service
 - Option for Volume & Speed



Re-Identification Technology

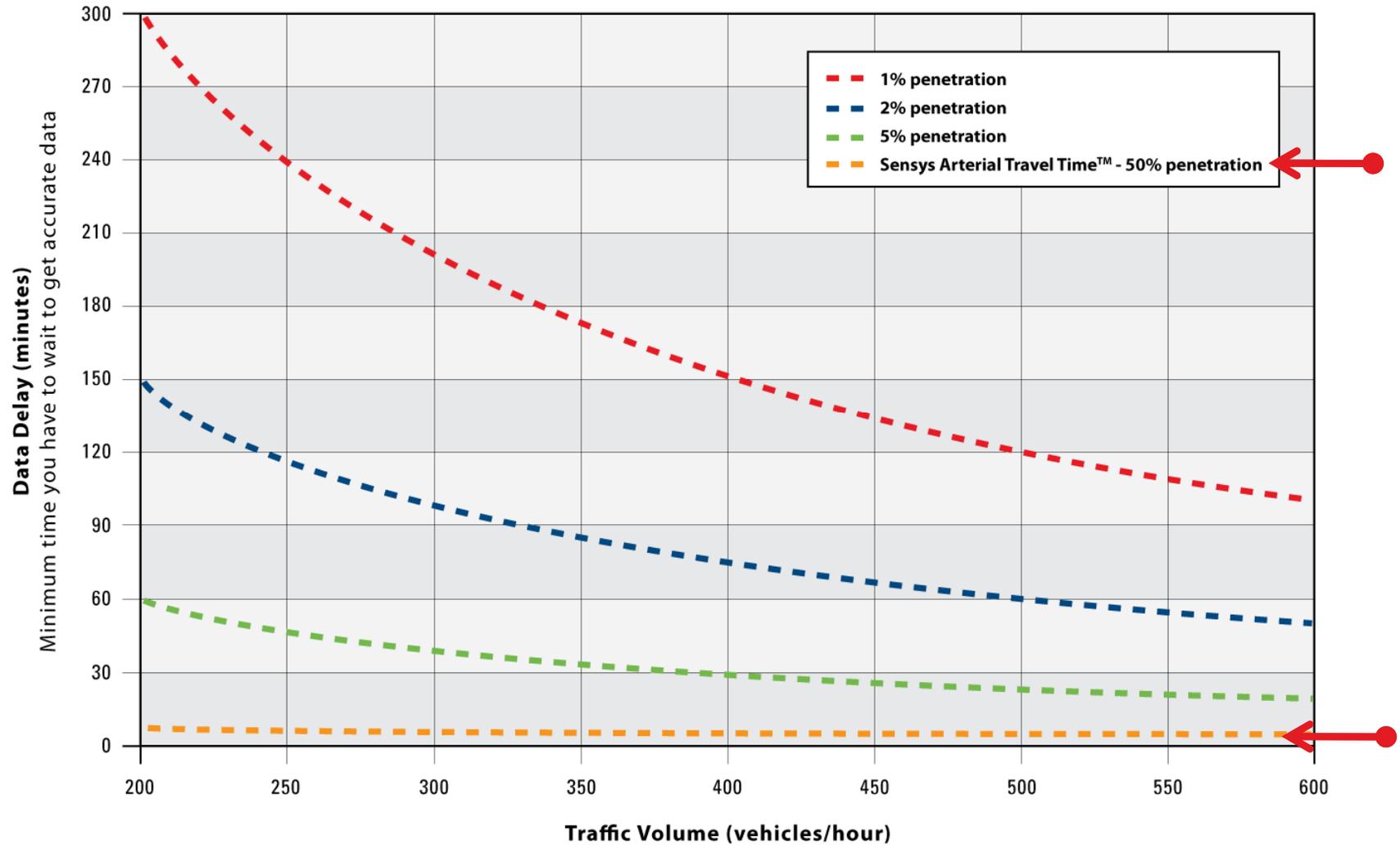


Vehicle Re-Id Algorithm



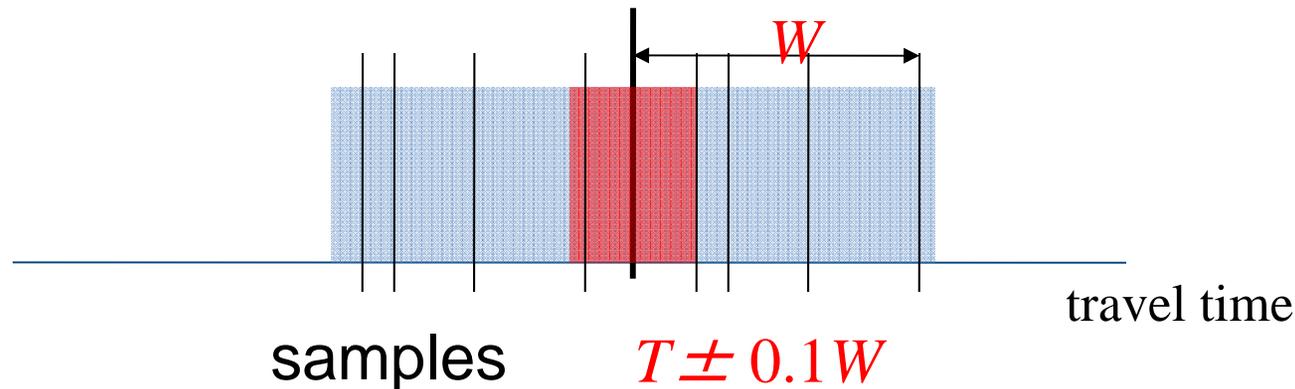
1. Measure magnetic features of vehicles as they pass two points on the road.
2. Comparing the features of pairs of vehicles (one from each point) using a speed-independent, real time algorithm to determine a confident match measure between all vehicle pairs.
3. Picking the best set of vehicle pairings, or additions or deletions, maximizing the global match probability over the entire sequence of vehicles, using an efficient, real time algorithm.

Sample Size Matters



The magic number is 25

- How many individual vehicle travel time samples does one need?



- To estimate the median travel time $T \pm 10\%$ spread with **68% confidence you need $N = 25$ samples**; for 95% confidence you need $N = 100$.

Sample size consequences

- A street with flow of V vph needs sample penetration rate of $p = 25/V \times 100\%$
 - If $V = 400$, $p = 6\%$
 - If $p = 2\%$, you must wait 3 hours for a reliable estimate
- Suppose 10,000 GPS (or Bluetooth)-equipped vehicles in Bay Area record their trip times. What kind of penetration is achieved?

With 4.7m Bay Area vehicles making 18m trips daily, **10,000** vehicles making 38k trips achieve $p = 0.2\%$. The resulting estimates will be unreliable.

Timing is everything

- The sample size requirement of ($V = 400, p = 6\%$) , ($V = 100, p = 25\%$) assumes that **travel times do not change over the course of one hour.**
- If during congestion, conditions change in (say) 30 min, the sample size requirements will be doubled ($V = 200, p = 12\%$), ($V = 50, p = 50\%$).
- Of course, travel time estimates are most useful when conditions change.

Benefits of Real-time updates



Real-Time Travel Information & Active Traffic Re-routing

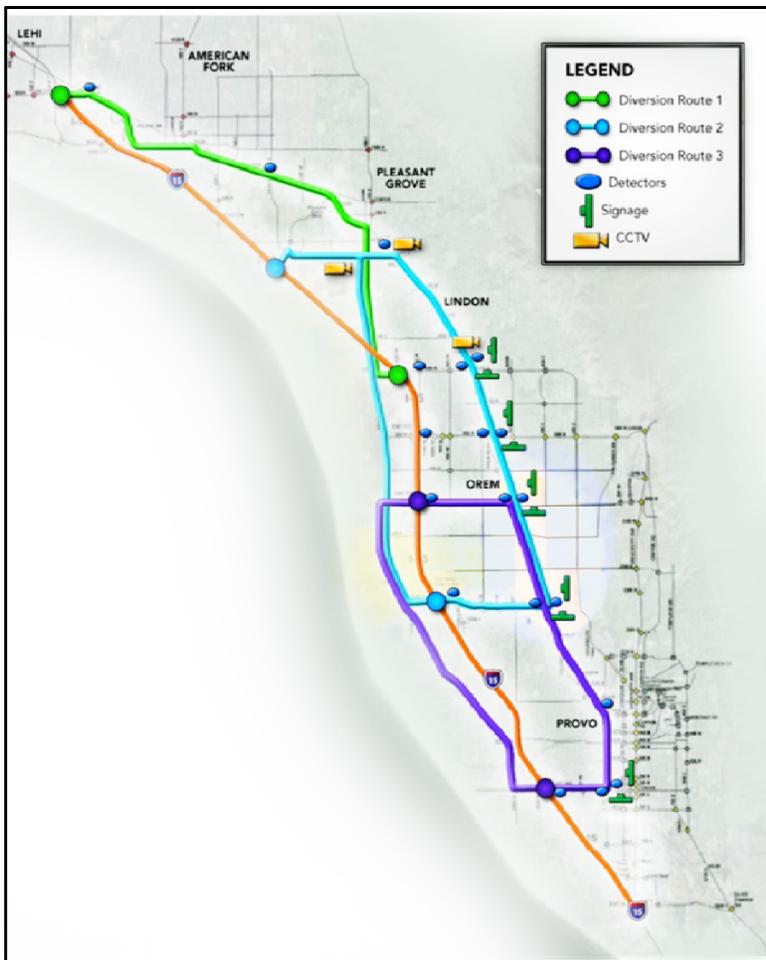
- Portable DMS provides traveler choice of routes
- Current, up-to-minute data
- Penetration rate determines updates
- Open XML feed allows:
 - Neighboring agencies share data
 - Public access to travel times / 511



Utah DOT — I-15 ICM



Real-time travel times during major freeway construction rerouting



Problem:

Freeway construction required extensive traffic rerouting between Provo and Lehi.

Solution:

Sensys Networks Arterial Travel Time, deployed along three major arterial routes provided:

- Volume
- Occupancy
- Real-time travel times for 14 VMS
- Travel time distribution
- Level of Service
- Vehicles in segment (queue detection)

Benefit:

24 Arterial Travel Time stations deployed in record time (<2 weeks) mitigated significant congestion and kept traffic moving smoothly throughout the region.

San Diego Region ICM/TLSP



Accurate, real-time data for regional roadway optimization



Problem:

Primary artery between Los Angeles and San Diego (with reversible HOT lanes), carries near constant heavy traffic.

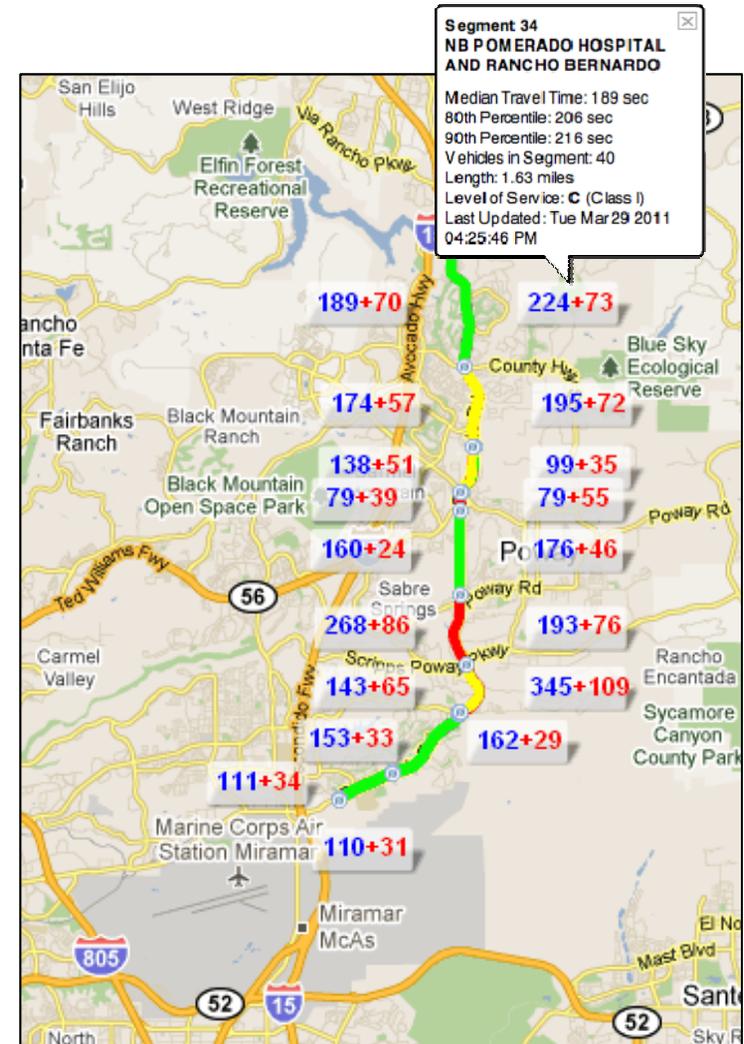
Solution:

Sensys Networks' integrated solution provided accurate performance measures including:

- Volume
- Occupancy
- Real-time travel times for VMS, 511
- Travel time distribution
- Level of Service
- Vehicles in segment (queue detection)

Benefit:

Enhanced corridor management across the shared network provided accurate data for traveler information and decision support systems for optimized regional mobility.



Introducing SensMetrics:

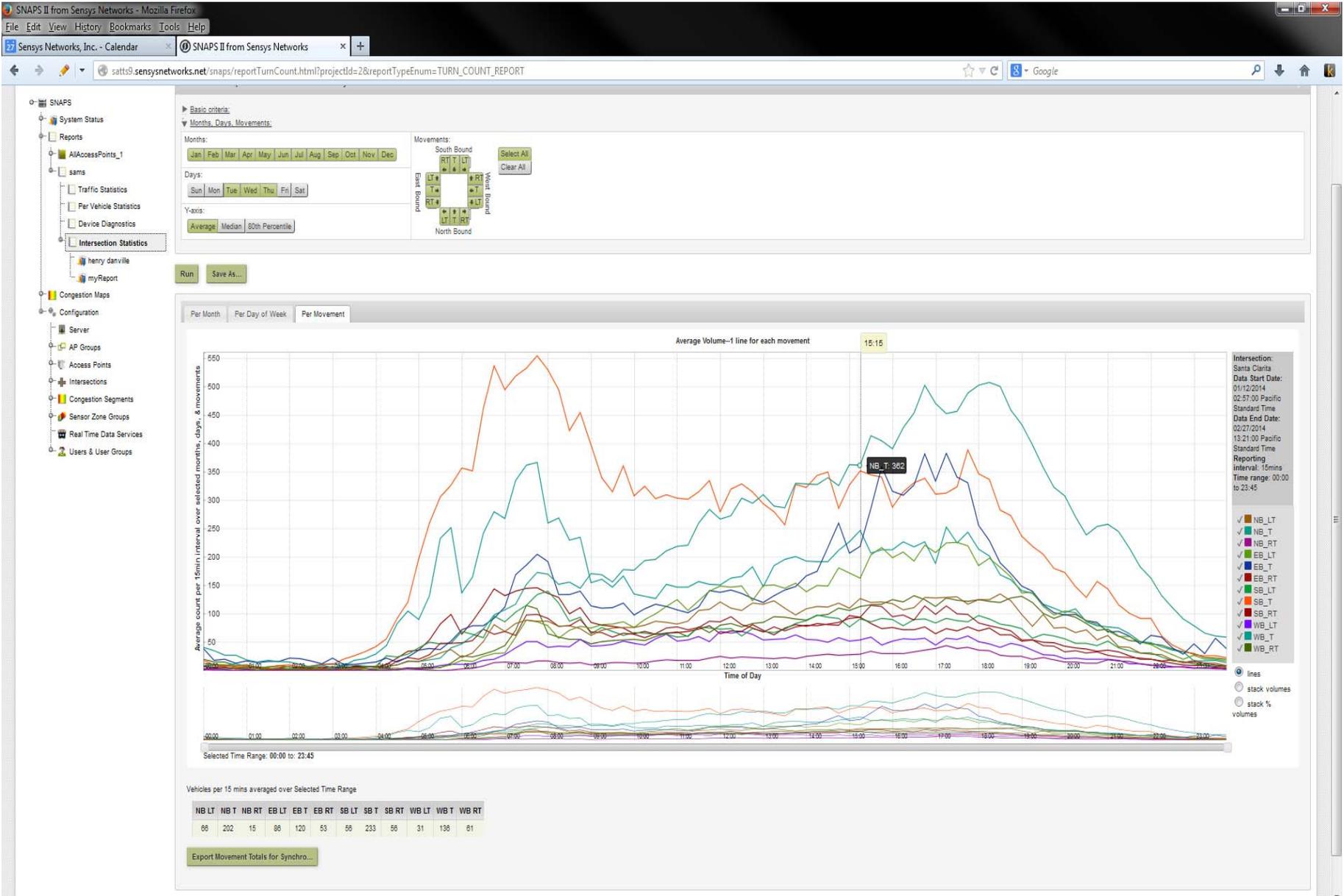
Intersection Measures:

- ✓ Automatic turn movement counts
- ✓ Saturation rate: max flow in green
- ✓ Intersection Waiting Times
- ✓ Percentage vehicles arriving on green
- ✓ V/C ratio: Volume to capacity
- ✓ Phase utilization: Percent green time used during cycle

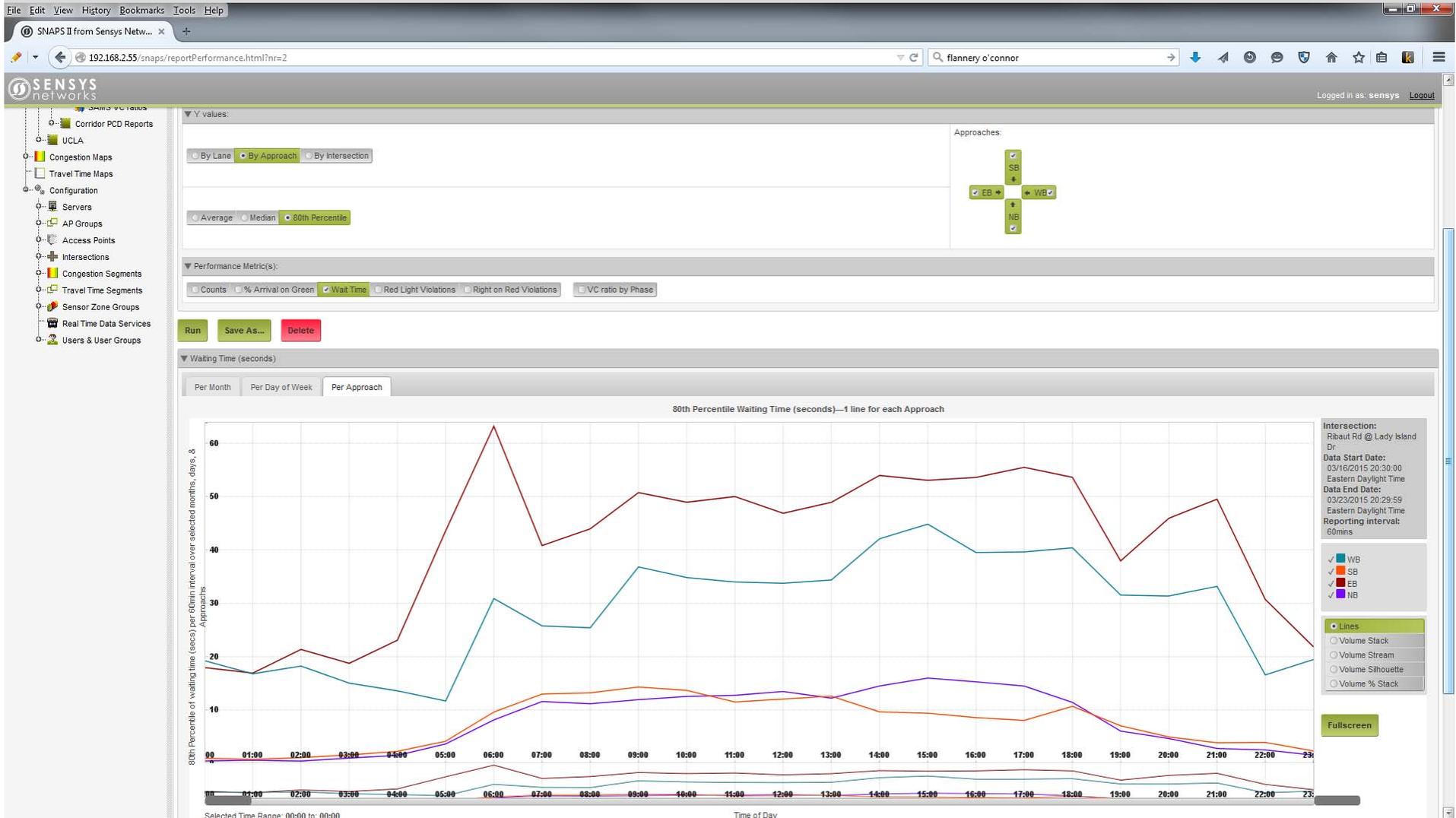
Network Measures:

- ✓ Travel time: Either link or trip based
- ✓ Progression quality: Purdue Coordination Diagrams (PCDs)
- ✓ Environmental measures – Measuring GhG on key arterials

SensMetrics – Turn Movement Counts



SensMetrics – Waiting Times



SensMetrics - V/C Ratios



Questions?



THANK YOU!

Katherine Mertz

kmertz@sensysnetworks.com