The Downtown Seattle Bus Monitoring System

Collecting and Analyzing Transit Travel Time Data

2011 ITS Washington Annual Meeting

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King County

- Project Background
- Data Sources: AVL, APC & AVI
- Data Processing & Reporting
- System in Action
- Lessons Learned

Seattle Bus Monitoring System

BACKGROUND

History

- Enhanced Travel Time Monitoring Need
  - 2005-2007: Bus Tunnel Closure
  - 2009-2016: Alaskan Way Viaduct
- Uses
  - Scheduling/Funding
  - Identifying Problem Areas
  - Planning for the Next Impact

Current Focus→ AWV

Source: WSDOT

- Alaskan Way Viaduct
  - Long-term detours
  - Reduced capacity
- *Enhanced Transit Services* Agreement
  - WSDOT provides funding for transit
    - Added trips
    - Schedule Maintenance
  - Expand Monitoring System

Seattle Bus Monitoring System

DATA SOURCES

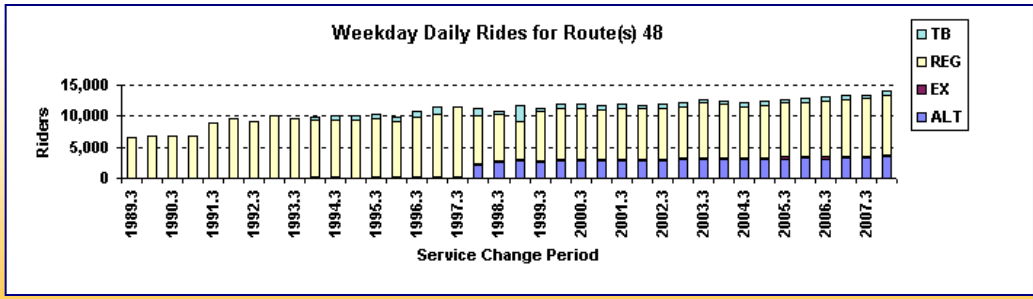
AVL System

- *AVL = Automatic Vehicle Location*
- Signpost/Odometer based system
- Travel time between timepoints only!
  - Route specific
  - Off-route buses not tracked
- Data available System-Wide

AVL Data feeds *OneBusAway*

APC System

- APC= *Automated Passenger Counter*
- Sampling Method
  - 20% of Fleet APC-Equipped
  - Data Available *After* Service Change
- Other Data Collected
  - Travel Time between Bus Stops
  - Dwell Time



APC Data used to Track Ridership Trends

AVI System

- AVI = *Automatic Vehicle Identification*
- Roadside RFID tag readers
  - Legacy TSP tags
  - Tags logged regardless of Route/Schedule
- Strategic Locations

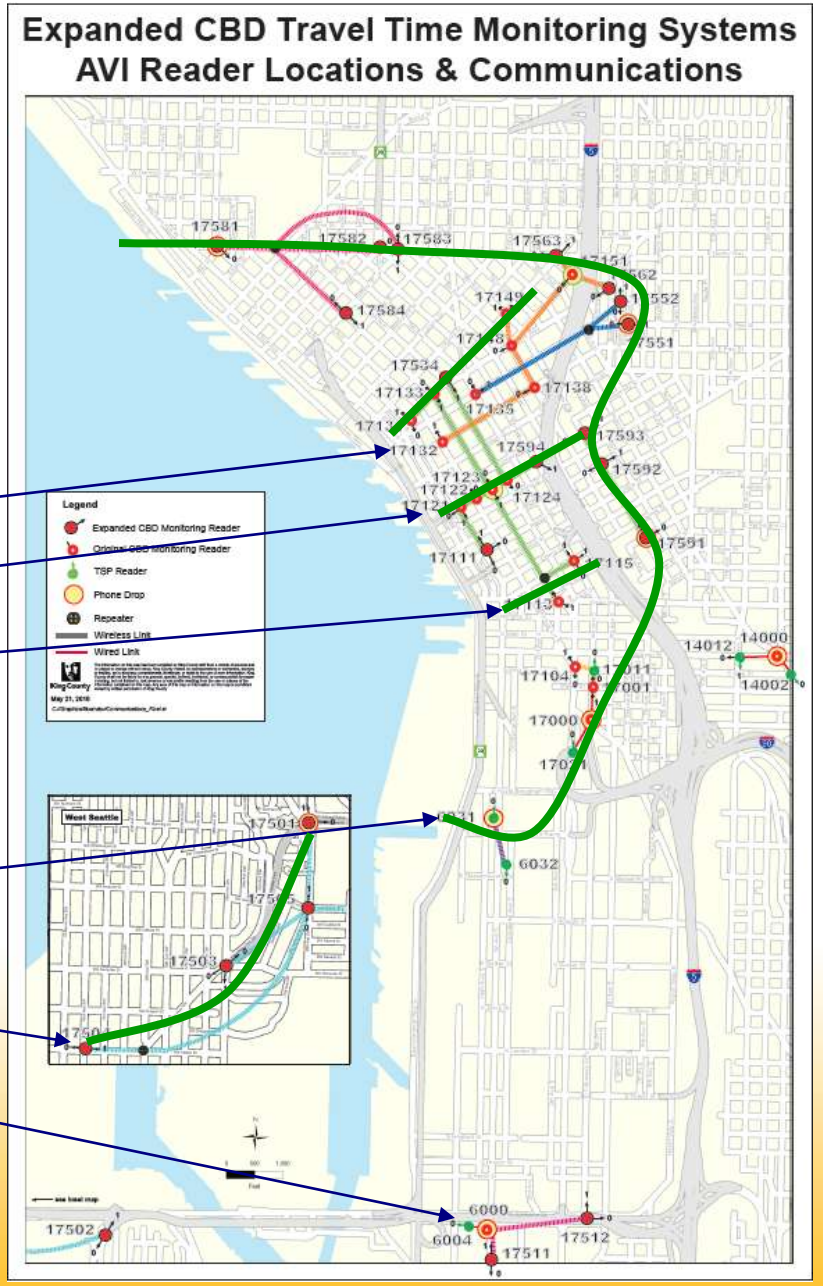
AVI Reader →

←TSP Tag

AVI Reader Locations

Original AVI System
- North CBD Screenline
- Central CBD Screenline
- South CBD Screenline

Expanded AVI System
- Outer CBD Screenline
- W Seattle Screenline
- Other Key Locations

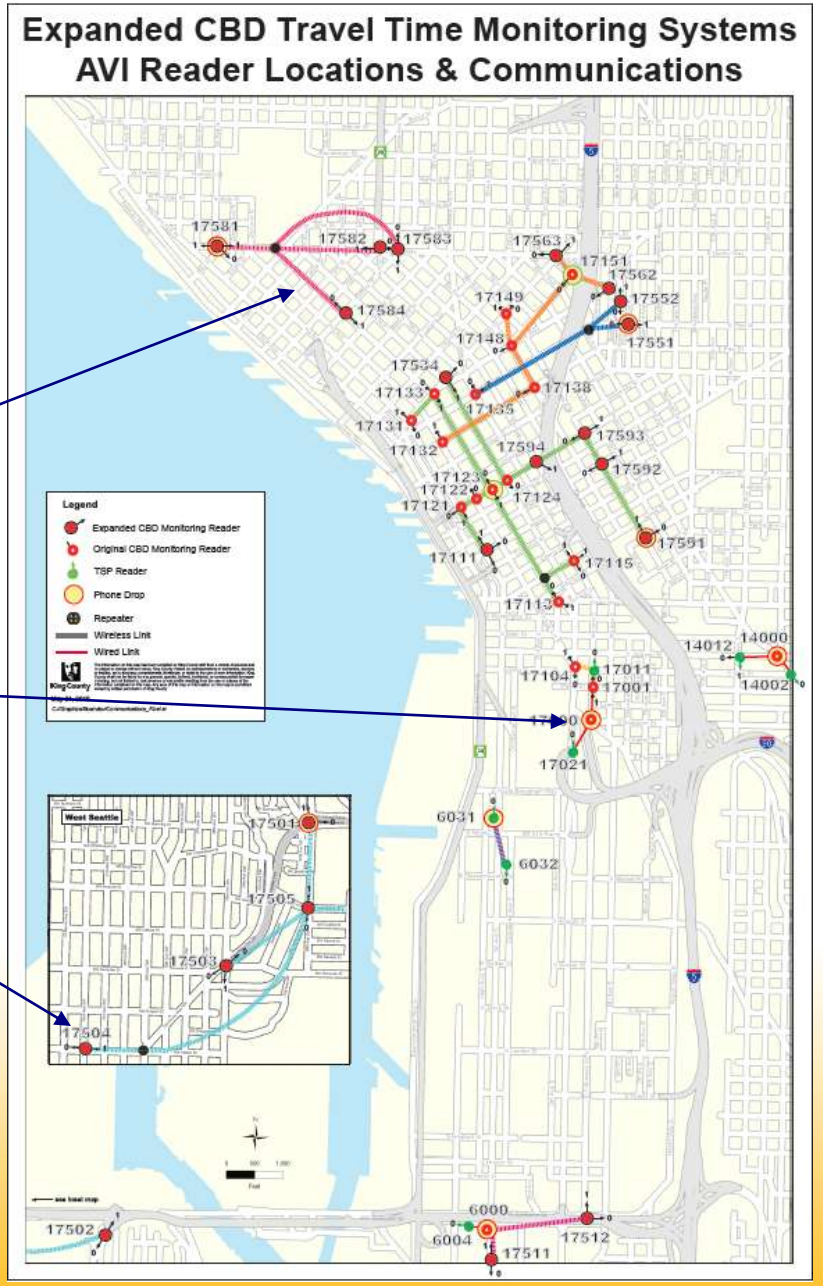


AVI Reader Communication

Readers communicate using Spread-Spectrum Wireless

Phone drops provide backhaul to KC server

Each reader has unique Node #



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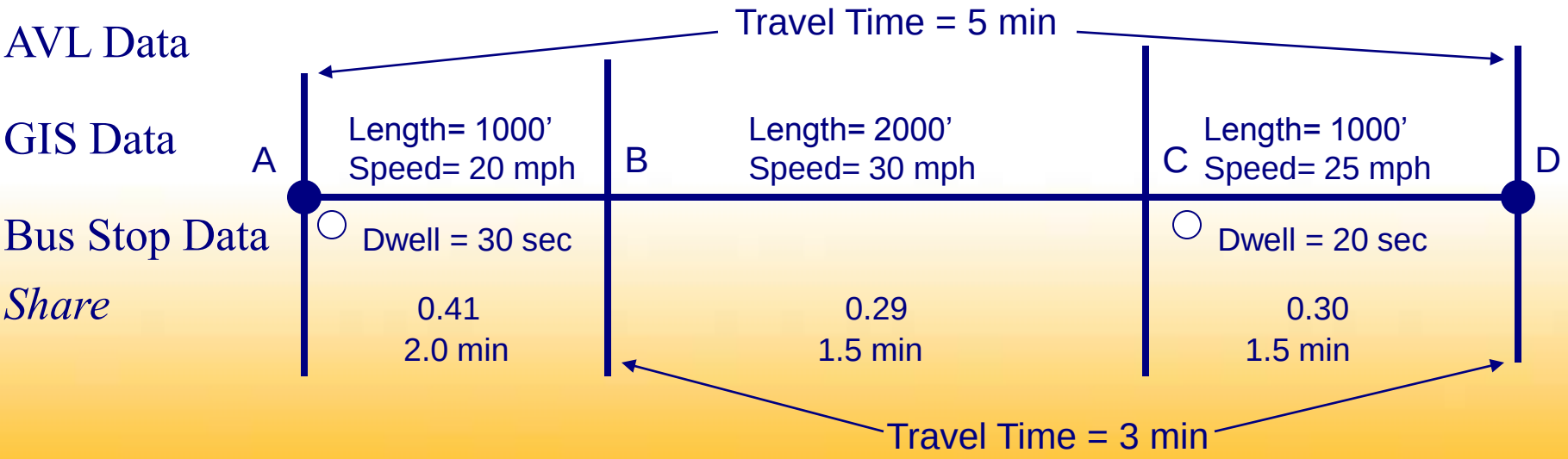
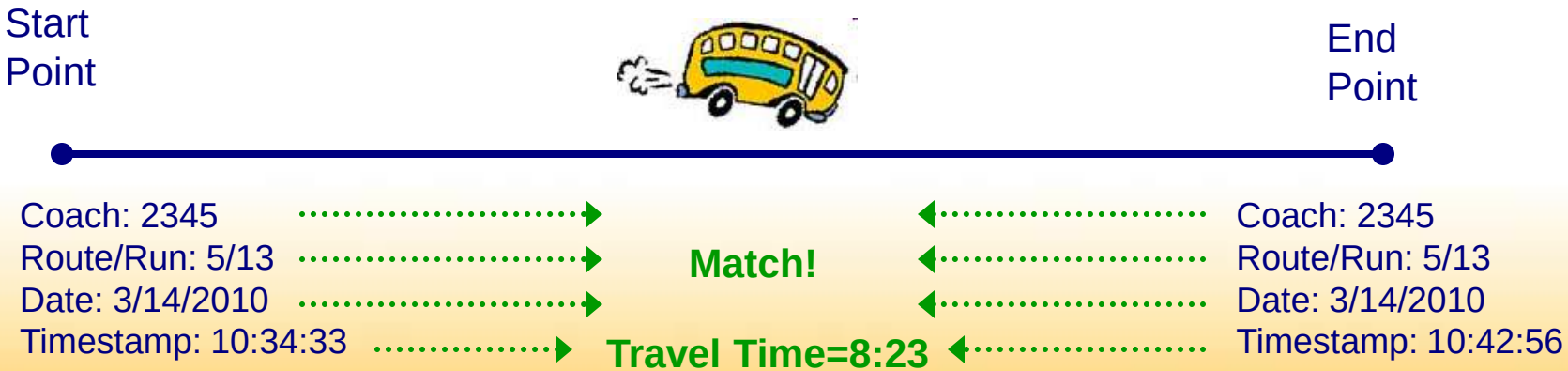
DATA PROCESSING & REPORTING

- Huge amount of data!
  - MS Access and SQL Server
- Make AVL data more useful
  - Interpolate timepoint data into street segments
  - GIS and Bus Stop data → Estimate travel time *share*



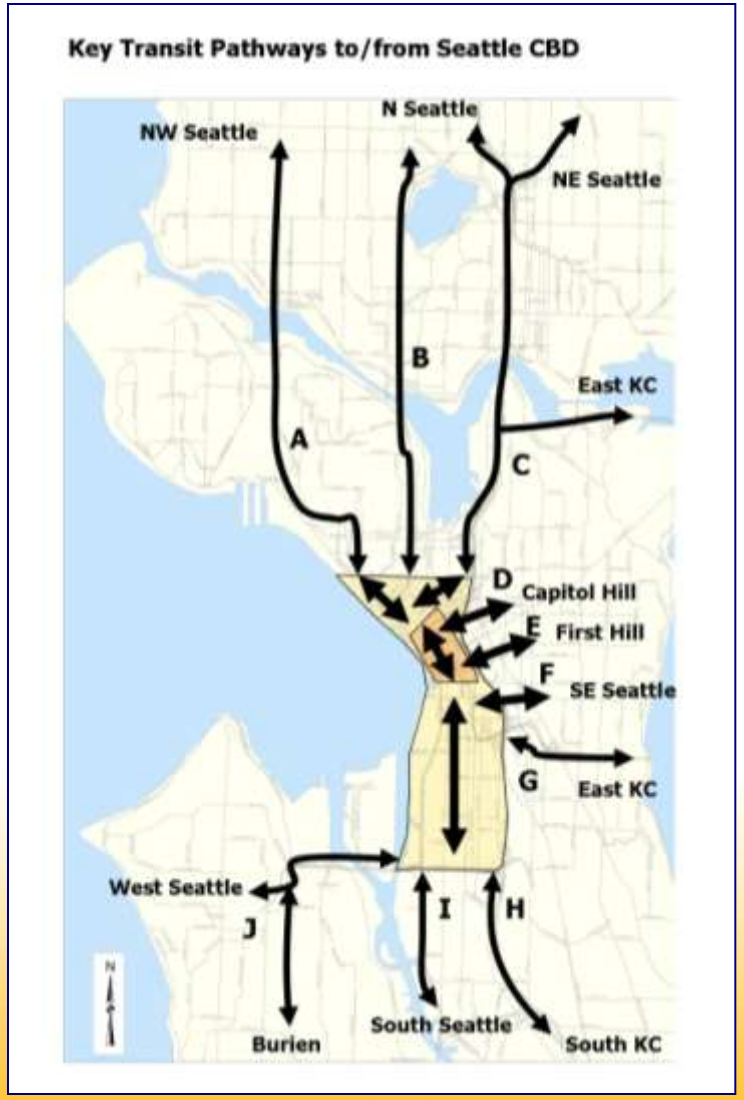
Matching

- Need to combine AVL & AVI Data
  - AVI → CBD and selected locations
  - AVL → Outlying points
- Travel Times calculated by matching
  - Coach ID, Route, Run, Date, [Time]

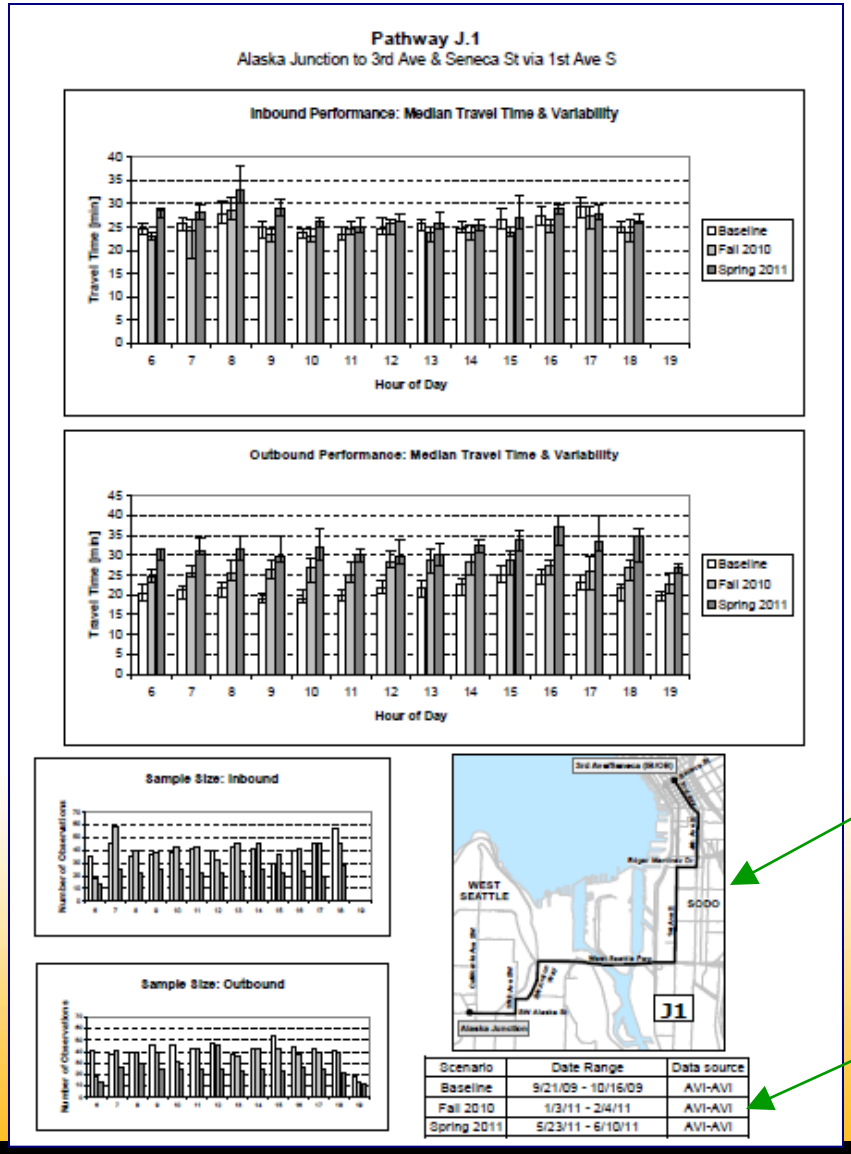


Types of Reports

- Regular Reporting
  - Specific Pathways
    - Defined by roadway infrastructure
    - Grouped by Market Coverage Area
  - 3x/Year Service Change
- Ad-hoc Reporting
  - Special cases
  - As needed basis



Pathway Report



Two Directions, Two Charts

Sample Size: Indication of Data Quality

Pathway Map

Scenario Info

Pathway MOE's

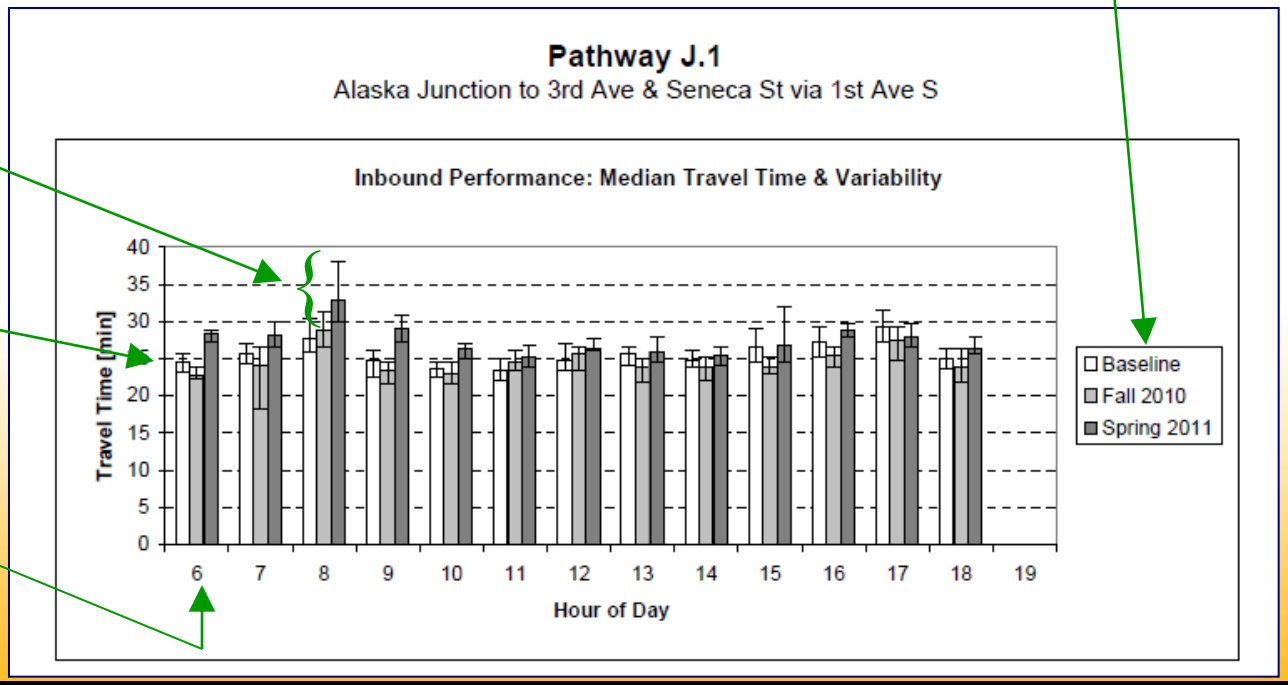
- Slice data into hour intervals
  - Median Travel Times (Average)
  - 25th – 75th Percentile (Reliability)

Compare scenarios side-by-side

25th & 75th Percentile

Median Travel Time

One Bar represents one hour of data



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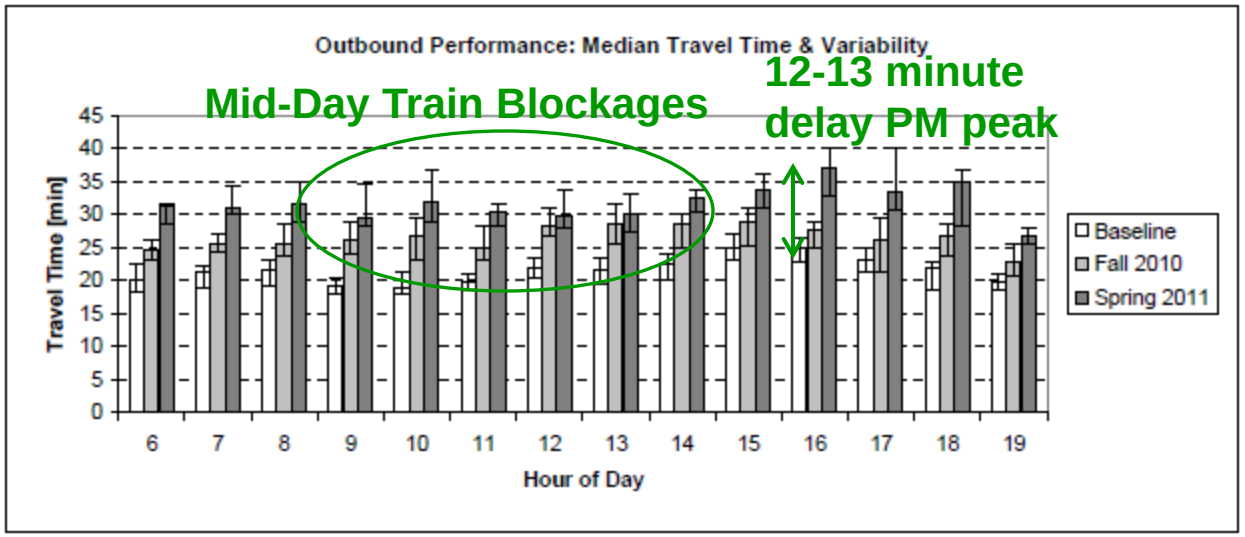
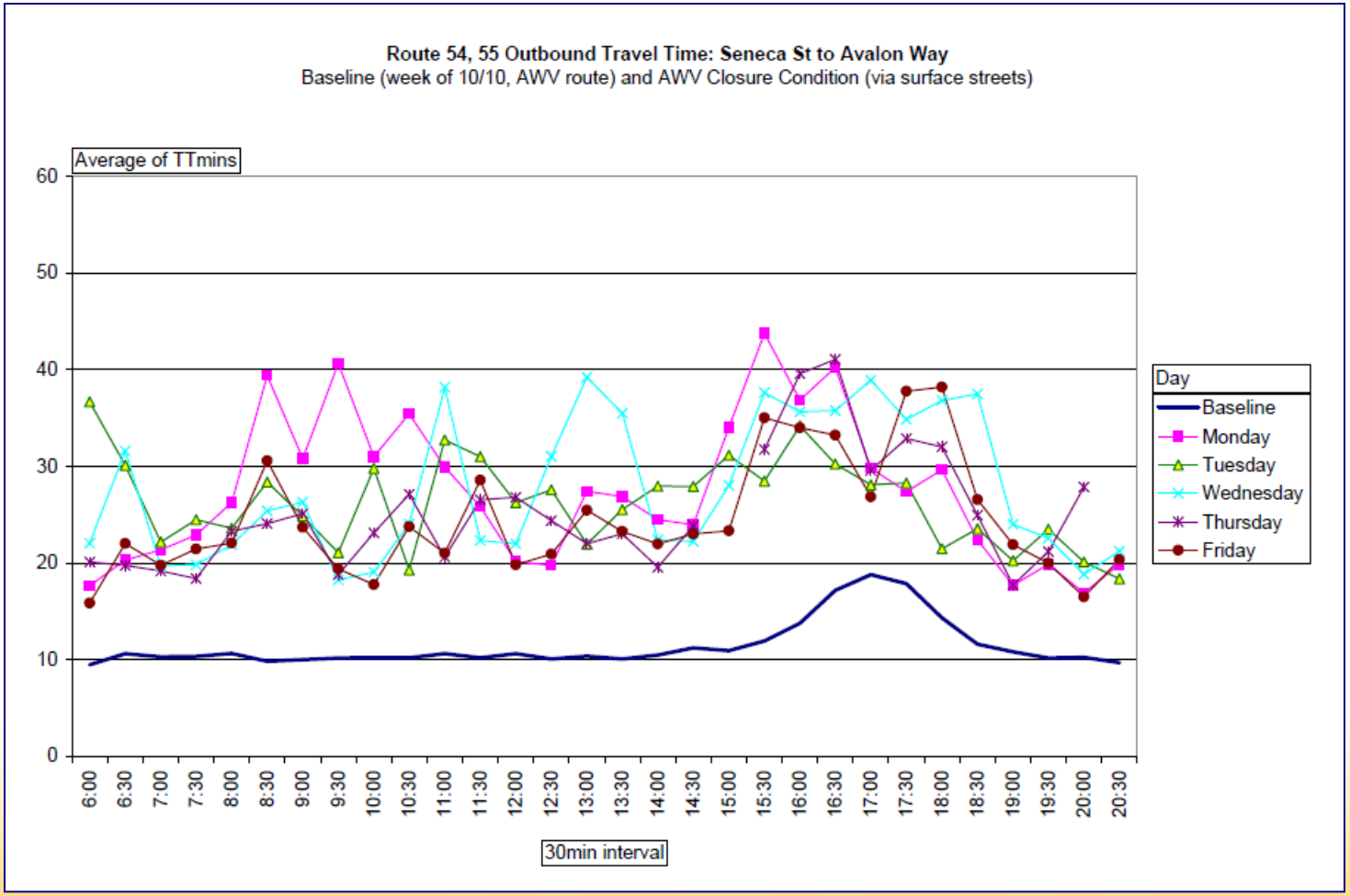
SYSTEM IN ACTION

Monitoring tells a Story



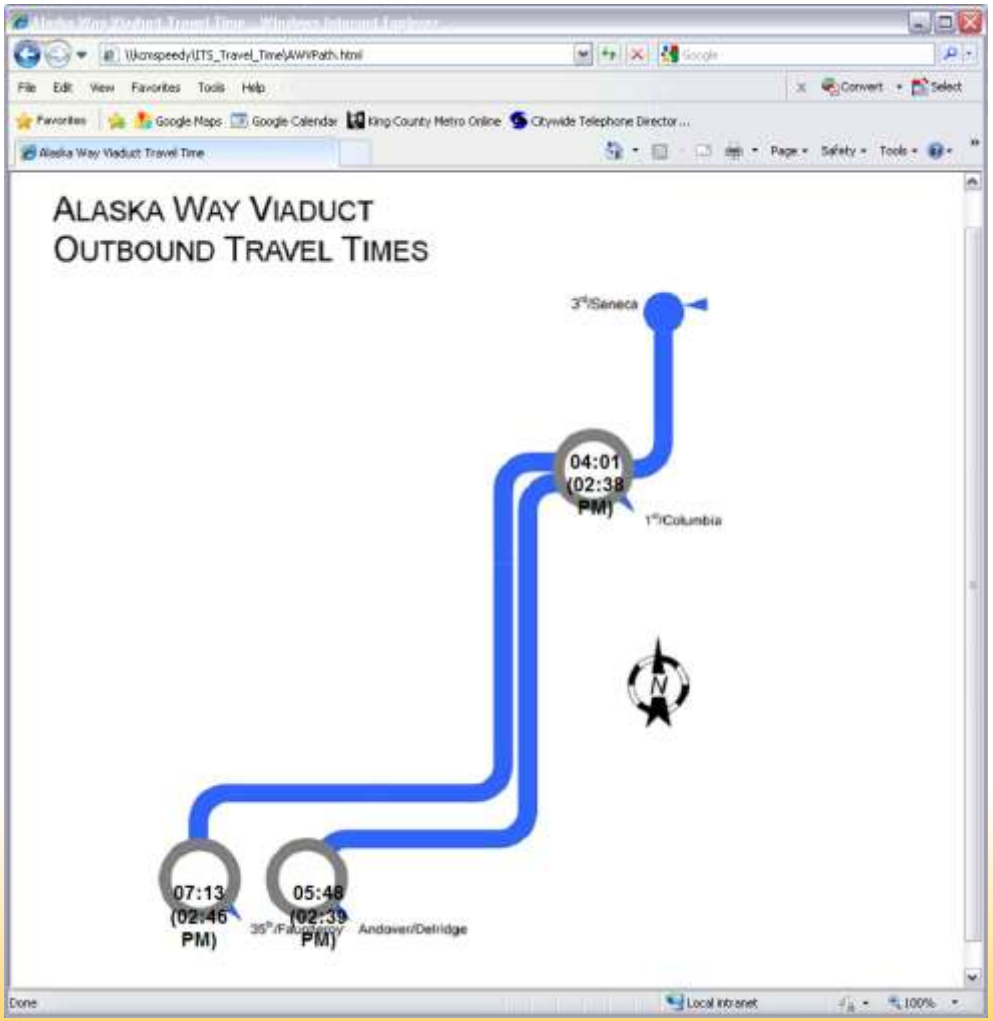
- Baseline Condition: Fall 2009
- Fall 2010: 1st & Spokane Ramp Closure
  - Lengthy & unreliable detour
- Spring 2011: Lane Reduction on SR-99
  - Routes moved to 3rd Ave
  - Traffic diversion to 1st Ave

Ad-Hoc Reporting



Alaskan Way Viaduct 8-Day Closure Results

Experiments in Real-Time



Real-Time Travel Time Tool

Seattle Bus Monitoring System

LESSONS LEARNED

AVI Equipment Challenges

- Power Connections
- RF Interference
  - Tag Reads
    - 900MHz Band Fixed Frequency
  - Wireless Communication
    - 900MHz Spread Spectrum
    - Repeaters
- Read Rate Reliability

Data Processing Challenges

- Return Trips Confound Matching
  - No Trip ID in AVI data
  - Use maximum travel time cap
- Same Endpoints, Different Pathway
  - Filter with Schedule Data
- Development Effort
  - Expanded territory added complexity
  - Ongoing refinement

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