Bluetooth Travel Time for Signal Timing

AK ITS Convention October 20, 2015

The Timing Problem

–Adaptive Signal Control (ASC) Systems change travel time -5% to +10%

–Greatest benefits occur during unusual events.

–ASC is to Coordinated Signal Timing as Actuated is to Pretimed

-Timing Plans must be compared under similar conditions
         2 weeks data collection = 1 month turnaround

•Days are variable. We are not trying to characterize delay caused the variability of the traffic. We are trying to characterize delay after abstracting from the variability of traffic.
•Incidents – because ASC is respsonsive to incidents it is fair to include incidents in the analysis. However,

Criteria for Test

- Criteria for test
  - Two weeks max for data collection
    - Gives two of each day, in case there was an incident or some other abnormality

  - 5% difference in mean is significant, 2% desirable
    - Dispersion is the enemy of accuracy
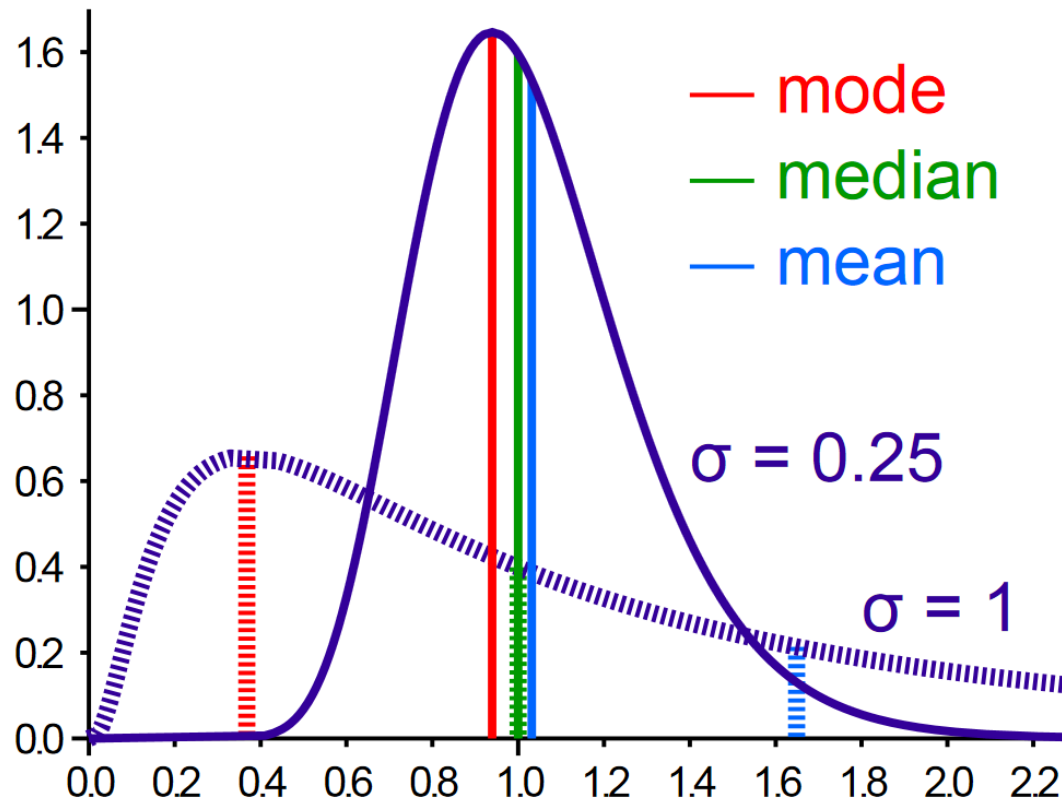
  - How often are we willing to be "wrong"?
    - 1 in 10 seems about right. 1 in 5 seems a little too much. 1 in 20 would be highly desirable.

  - One or two tails
    - Normal vs Log Normal

Travel Time Distributions Model

- Normal vs Log Normal Distributions:

Travel Time Technologies

- Point in time – not suitable for ASC
  - Floating car with various technologies
    - Expensive to get statistically valid results
  - Continuous
    - Wireless
      - Use of MAC address presents privacy issues -
      - Bluetooth
        » Shorter range– sample every second
      - Wifi
        » Longer range - sample every 10 seconds
   - License plate reader - optical

The Data Analysis Problem

• Why Validate?

   • Vendors selling "black box" algorithms

• Link Status most common application

   • Effects of non-timing differences very important

   • Signal Timing: Must extract timing effects from variable traffic flows

AADT

"Low" volume roads

- Parks Hwy 20,000 ADT, about 2.5% of is sampled. 500 vpd
- Some vehicles turn off. Others stop for errands and/or turn around
- For 14 days 4000 hits, about 3000 valid or 285/215 per day or 25 per peak pm hr.
- Sterling 18,000, Kenai Spur 14,000, PW and Glenn Thru Palmer 13,000
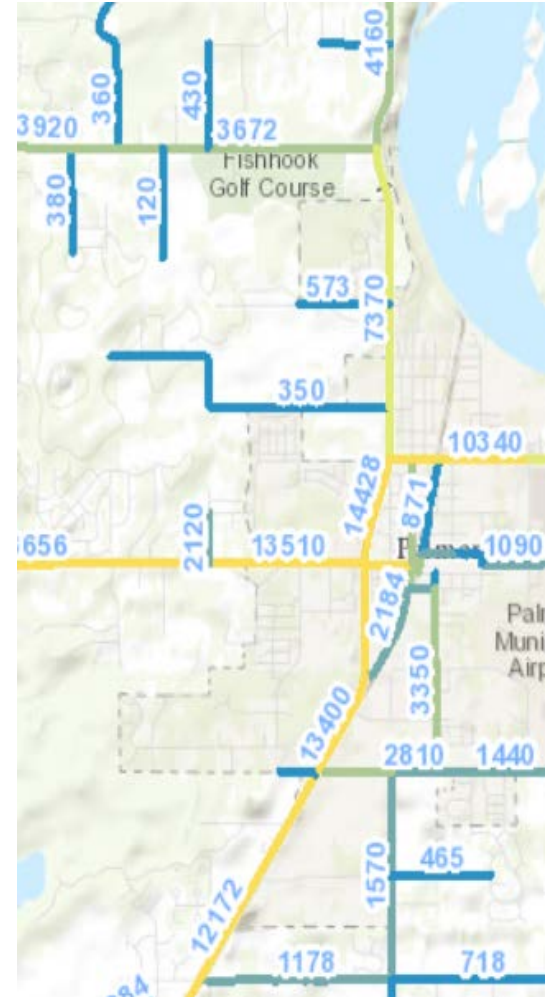
Filters to reduce meaningless dispersion

- Eliminate vehicles that were not continuous on the trip.
- Eliminate vehicles that speed – most likely an emergency vehicle – don't want to create "race"
- Distribution is really "multi-modal" with peaks at each platoons arrival.
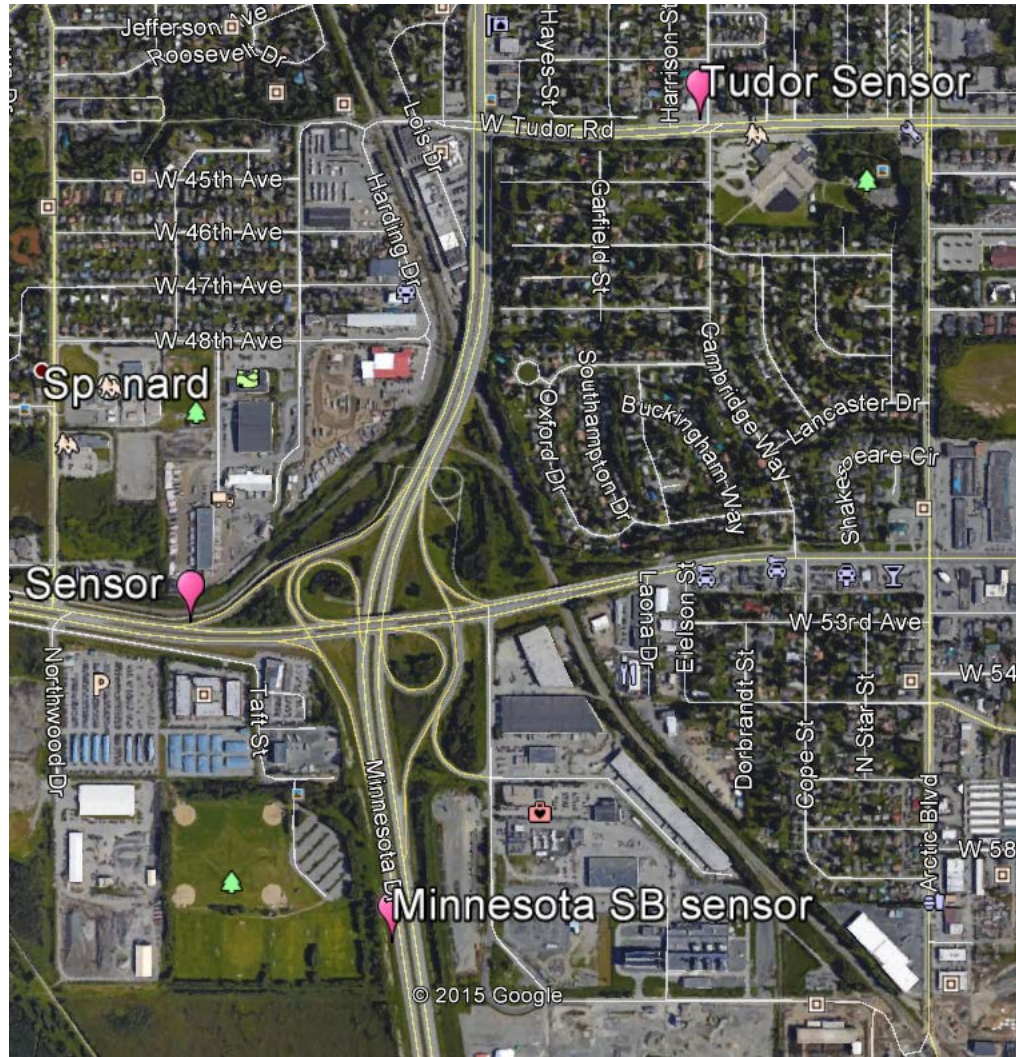- Delayed vehicles if moved outside window will appear to make the performance "better".

Dispersion due to Signal Capture

• Earliest detection

• Strongest detection

• Last detection

Locating RFI Bluetooth Readers
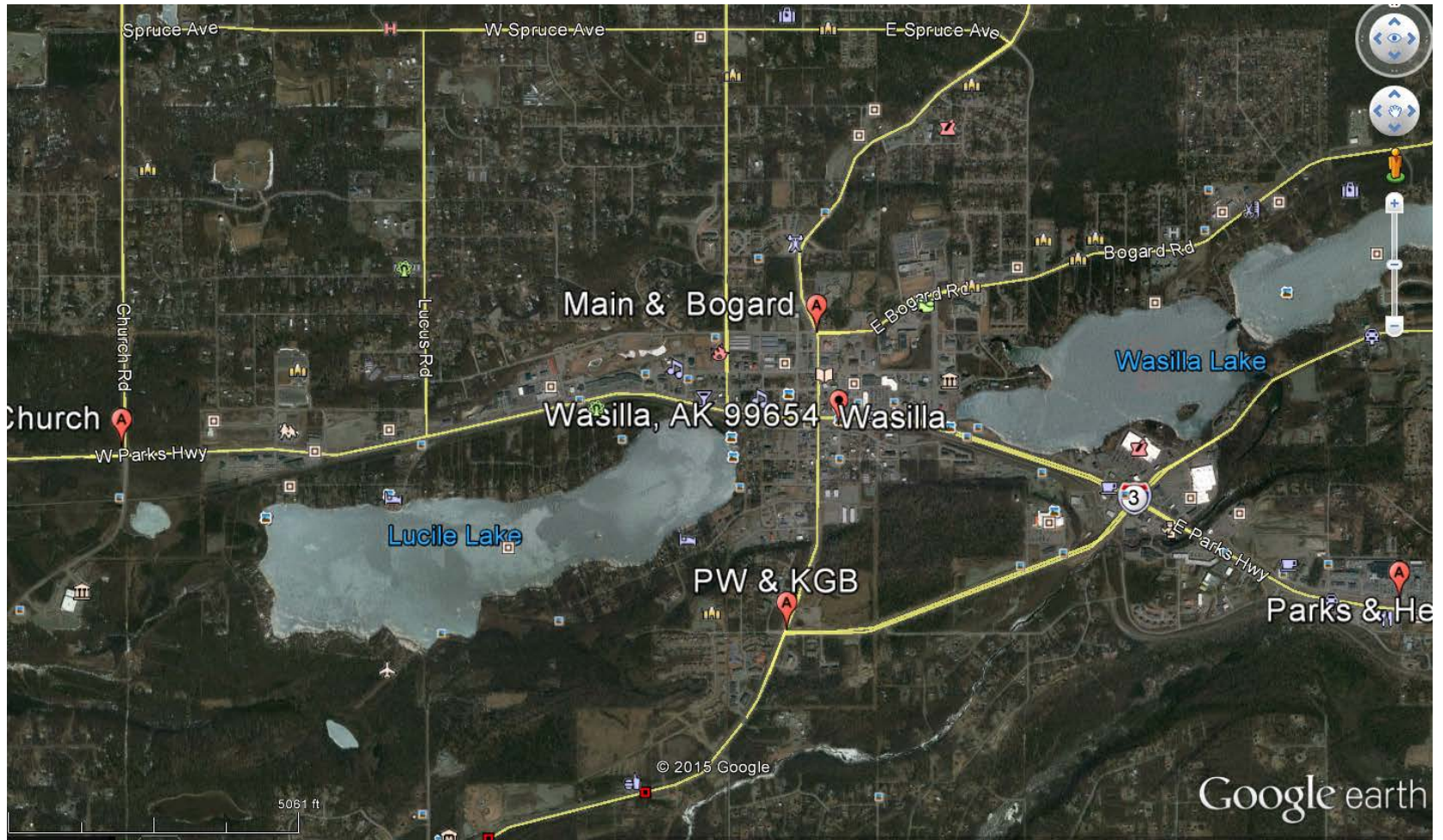
Targeting Specific Movements

Filter to reduce dispersion

Filters:	
Day of week	
Daily Start Time	13.00
Daily End Time	16.00
Max desired speed?	46
Desired Min Time=	210
Cycle length?	180
Percent Delay per cycle?	70%
Number of stops to allow?	3
Max Time (s)	588
Speed	16
Mean difference for TTest %	-2%

Date/Time	Seconds	MPH	Status
10/10/2014 5:38:41 PM	1744	6	invalid
10/10/2014 5:42:24 PM	408	24	valid
10/10/2014 5:42:29 PM	413	24	valid
10/10/2014 5:46:14 PM	490	20	valid
10/10/2014 5:46:39 PM	501	19	valid
10/10/2014 5:56:08 PM	314	31	invalid
10/10/2014 6:01:58 PM	518	19	valid
10/10/2014 6:09:21 PM	267	36	invalid
10/10/2014 6:14:20 PM	2253	4	invalid
10/10/2014 6:14:24 PM	449	22	valid
10/10/2014 6:17:26 PM	353	28	valid
10/10/2014 6:21:18 PM	668	15	invalid
10/10/2014 6:23:16 PM	460	21	valid
10/10/2014 6:24:59 PM	416	23	valid
10/10/2014 6:27:57 PM	345	28	valid
10/10/2014 6:30:33 PM	289	34	valid

Mounts

•Signal poles –
  As shown previously

•Signal Cabinet
  •Maintenance Electricians have very strong preference for cabinet mounted hardware.

  •Palmer Maintenance Station has the same number of maintenance personnel as it did in 1977.
    •As one electrician is fond of saying, "Even an engineer could fix it."

Selection Criteria

- Hardware Capabilities very similar

- Analysis tools a priority for engineers

- Cabinet mount a priority for electricians

Project Status

- On hold pending FYA

- Questions???

- Thank you.