Organic vs. Purchased Data for Travel Time Predictions

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2019 Western States Rural Transportation Technology Implementers Forum

Glossary

- ATMS – Advanced Traffic Management System.
- BTR – Bluetooth Reader.
- GUI – Graphical User Interface.
- HERE – HERE Technologies. 3rd Party TT Provider.
- IP – Internet Protocol ("IP address").
- LAN – Local Area Network.
- MAC – Media Access Control ("MAC address").
- SLT – South Lake Tahoe.
- TT – Travel Time.
- Waze – 3rd Party TT & Alerts Provider.
- WiFi – Wireless LAN.

Overview

Organic Data

- Loops – Single vs. double
- Bluetooth
- WiFi

Purchased Data

- Waze
- HERE

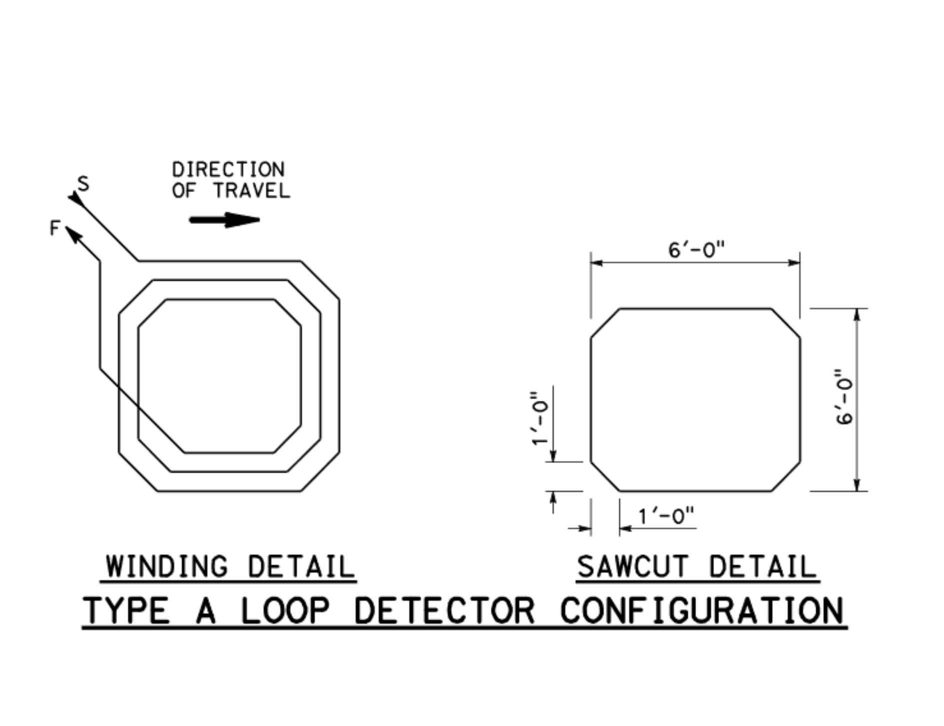
Bluetooth/Waze/HERE

- South Lake Tahoe Case Study

Single Loops

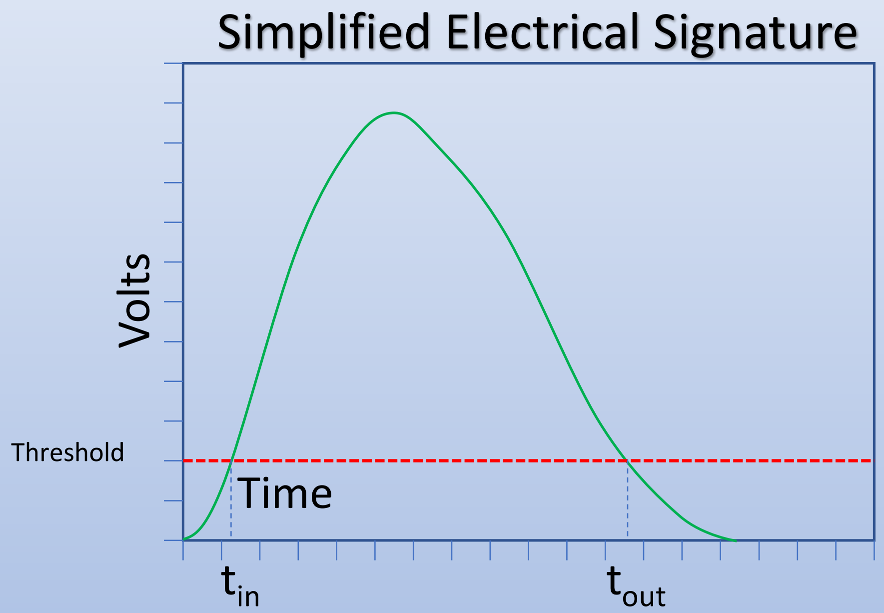
CT Standard Plans 2010 – ES 5B

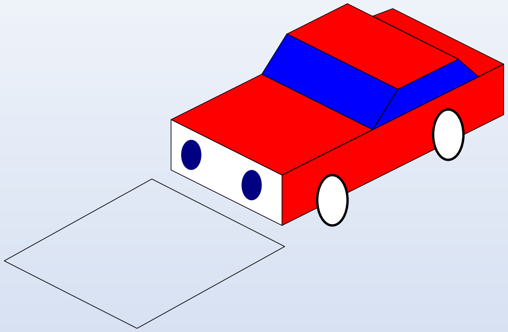
Cutout on New Pavement



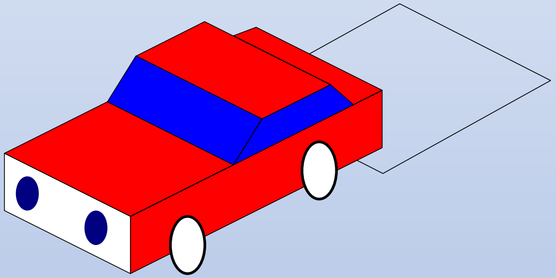
Single Loop

Time Measurement





T_{in} – Vehicle's front enters loop.



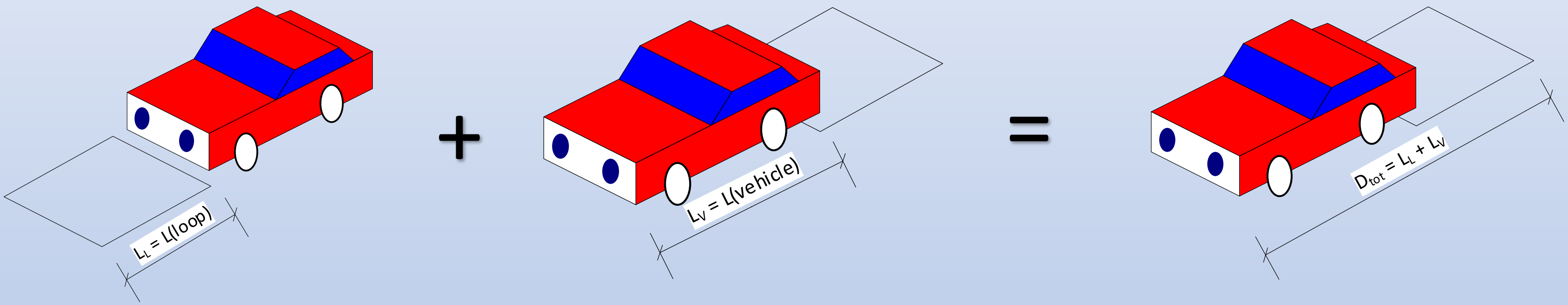
T_{out} – Vehicle's rear exits loop.

Therefore $t_{tot} = t_{out} - t_{in}$.

Notice that t_{in} and t_{out} can be affected by multiple variables.

Single Loop

Distance Measurement



L_L = Length of the loop.

L_V = Length of the vehicle.

D_{tot} = L_{tot} = Length of loop + vehicle.

Note that the total distance traveled is NOT just the length of the loop, nor is it just the length of the vehicle. It's a combination of both. In other words, t_{tot} start counting when the front of the vehicle enters loop, and Stops counting when the front of the vehicle has traveled the length of the loop plus the length of the car.

Single Loop

Speed Calculation

Speed calculation is simply: $\boldsymbol{S = \frac{D_{tot}}{t_{tot}}}$

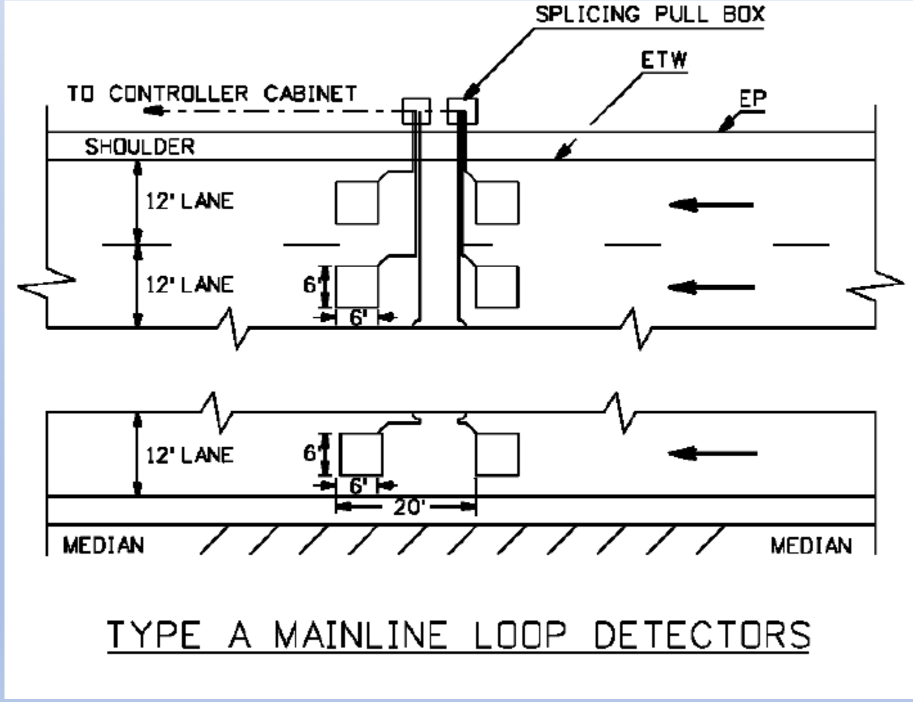
Unfortunately, there are many factors that introduce variance into t_{tot}

- Vehicle Length.*
- Vehicle Height.*
- Lane Alignment.
- Loop Installation.
- Detector Sensitivity.
- Detector Setting.

Dual Loop calculation eliminates most of these issues.

Dual Loops

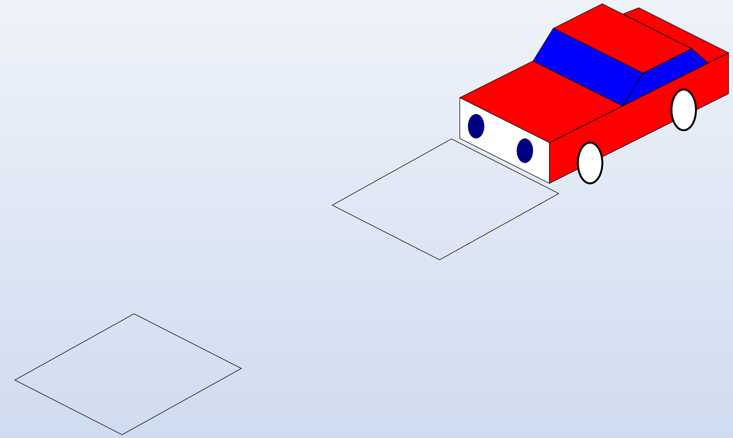
Ramp Metering Design Manual



Cutout on New Pavement

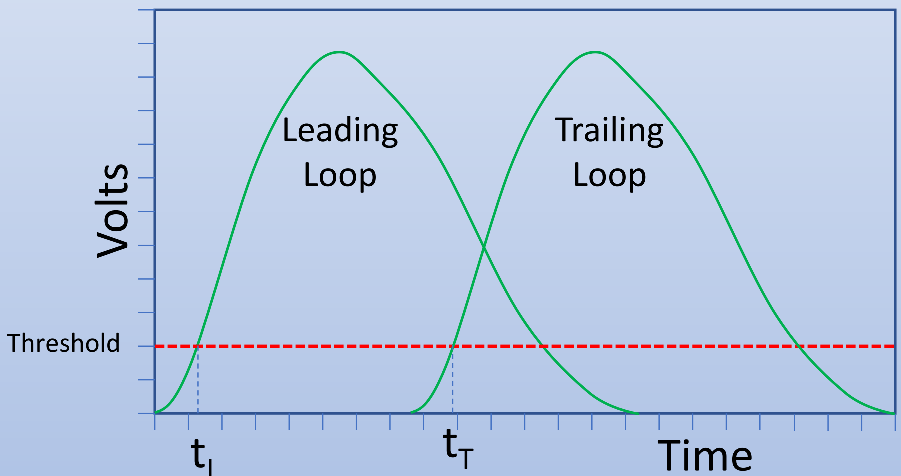
Dual Loop

Time Measurement

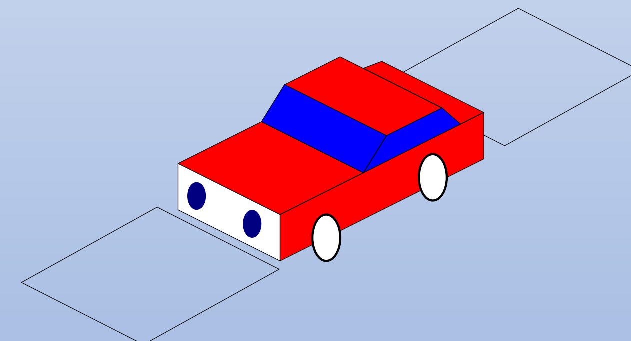


T_L – Vehicle enters Leading Loop.

Simplified Electrical Signature



Therefore $t_{tot} = t_T - t_L$.



T_T – Vehicle enters Trailing Loop.

Notice that t_T and t_L can be affected by multiple variables, but they cancel out.

Dual Loop

Speed Calculation

Distance is fixed at 20'. Hence : $\boldsymbol{S} = \dfrac{\mathbf{20}\ \boldsymbol{ft}.}{\boldsymbol{t_{tot}}}$

Hence these potential issues with Singe Loop Calculations have been eliminated.

- ✓ Vehicle Length.
- ✓ Vehicle Height.
- ✓ Detector Sensitivity.*
- ✓ Sensitivity Setting.*

While these have been mitigated and their impact minimized.

- ✓ Lane Alignment.
- ✓ Loop Installation.*

However, a new variable has been introduced.

- ➢ Loop Distance.

But, this can be corrected in the configuration. Hence it is not an issue.

*As long as same on both loops.

Loop Pros

Existing Infrastructure

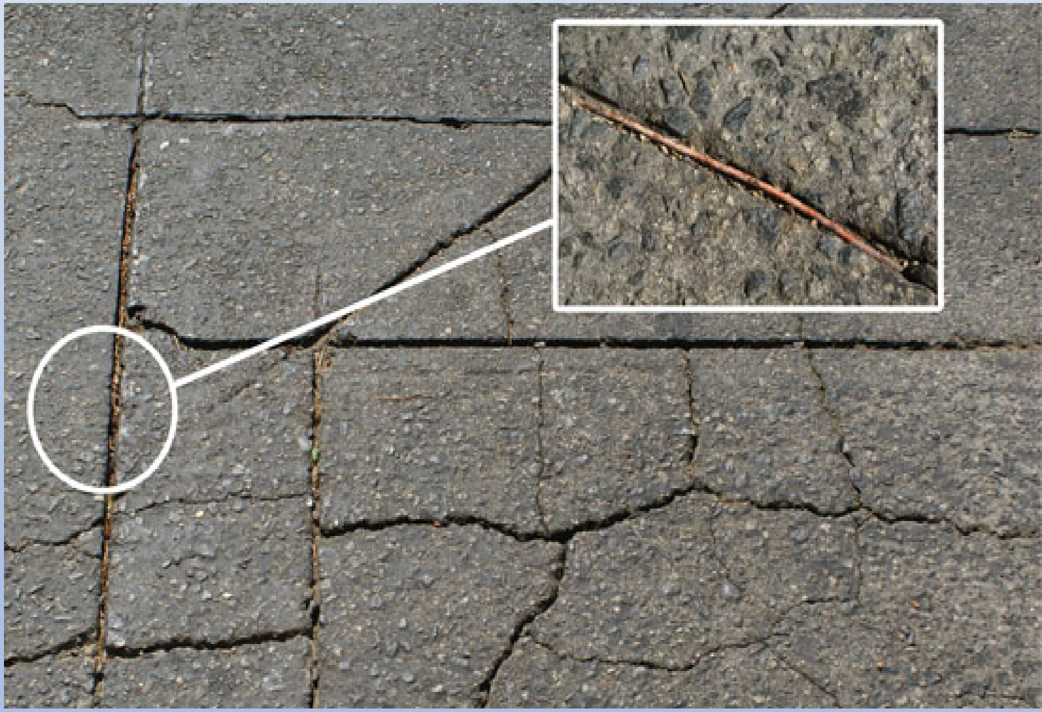
Per Lane Calculations

Census Counters

Tried & True Technology

Loop Cons

- Inaccurate Calculations
    - Single Loops
- Defaces New Concrete
- Weakens Concrete
- Requires Lane Closure
- Incorrectly Wired
- Damaged by Contractors
- Uneven Burial Depth
- Potential for Exposed Loops
- Repair Cost
- Not all Vehicles Detected
- Speed at Single Point



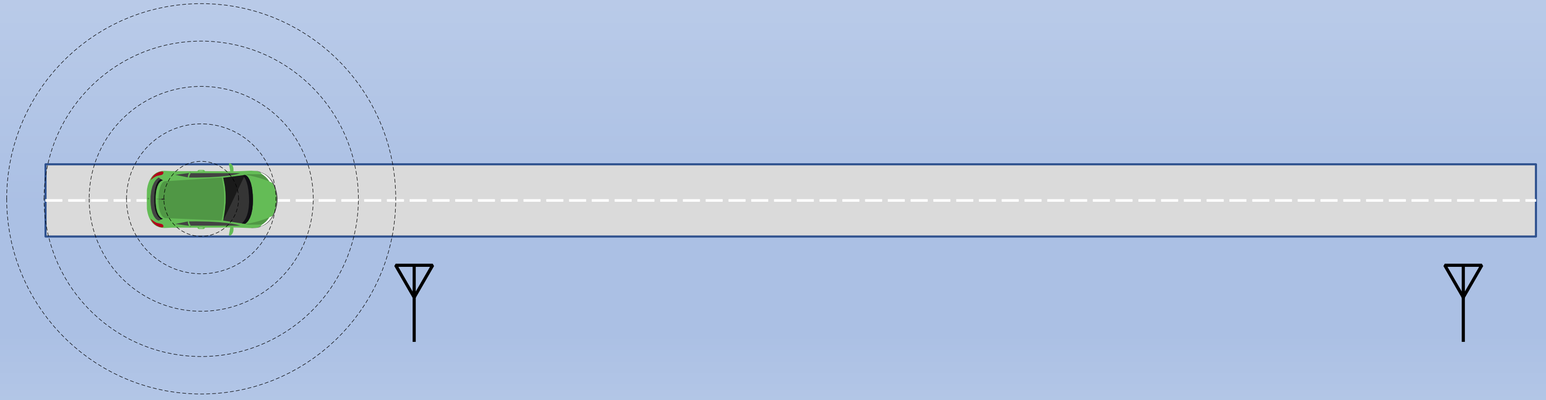
Bluetooth/WiFi Eliminates Most of These….

Bluetooth/WiFi Pros

- ✓ Easy install - Less than 30 minutes per site.
- ✓ Relatively inexpensive - $2400/site.
  - ✓ BTR - $2200
  - ✓ Antenna - $160
  - ✓ Bracket - $40
- ✓ Off pavement – Any cabinet with power suffices.
- ✓ Quick repair – Less than 30 minutes per site.
- ✓ No Lane Closure – Outside Clear Recovery Zone or guarded by rail.
- ✓ Non Intrusive – Does not interfere with Travelers' Phones/Cars.
- ✓ High Deployment – Anyone over 10 years has smart phone.
- ✓ Anonymous – Can encrypt MAC address.
- ✓ Single Detector may detect both directions.

Bluetooth/WiFi Basics

1. Detector Captures MAC Addresses (48 unique bits).
2. Forwards to Server.
3. Downstream Detector Captures MAC Address.
4. Forwards to Server.
5. Server Calculates Travel Time.
6. Server Exports Travel Time.



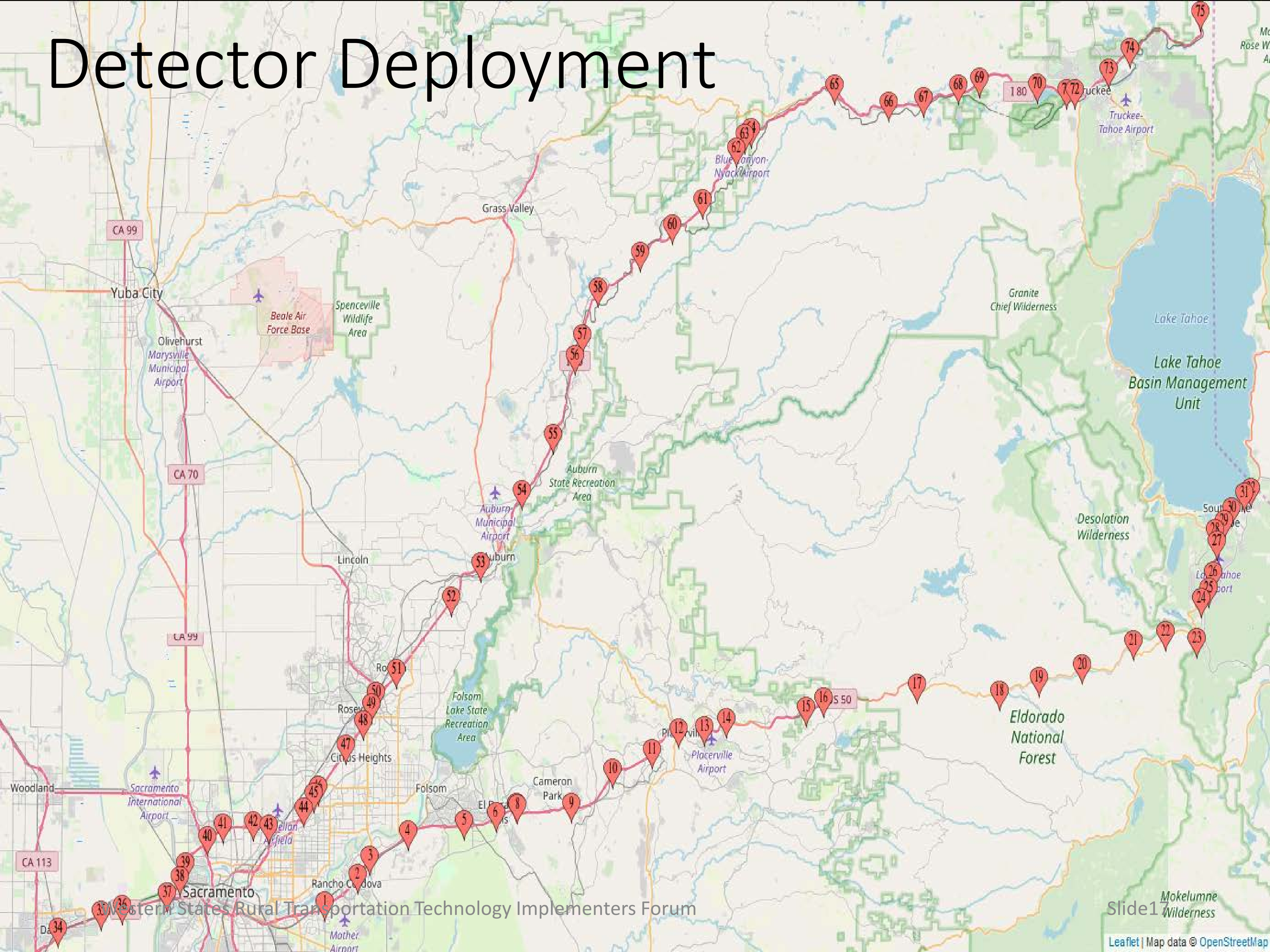
Iteris Solution

Choice of Vendors. Only Iteris' Velocity had non-cloud option.

- Caltrans owned and operated in-house VM server.
- Readers inside Caltrans metal cabinets.
- Low Bandwidth Requirement.
- Bluetooth or WiFi Detectors.
- Data is Pushed to Server.
- Linux OS.

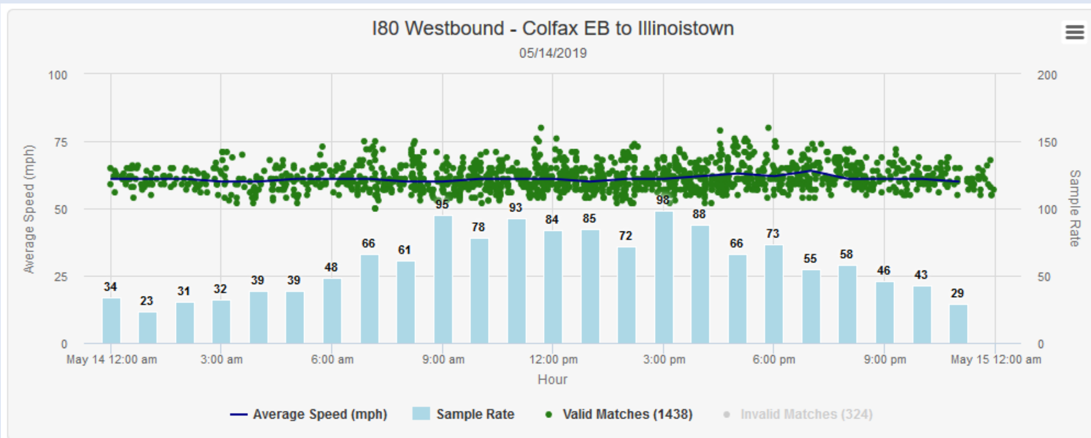
Iteris Solution

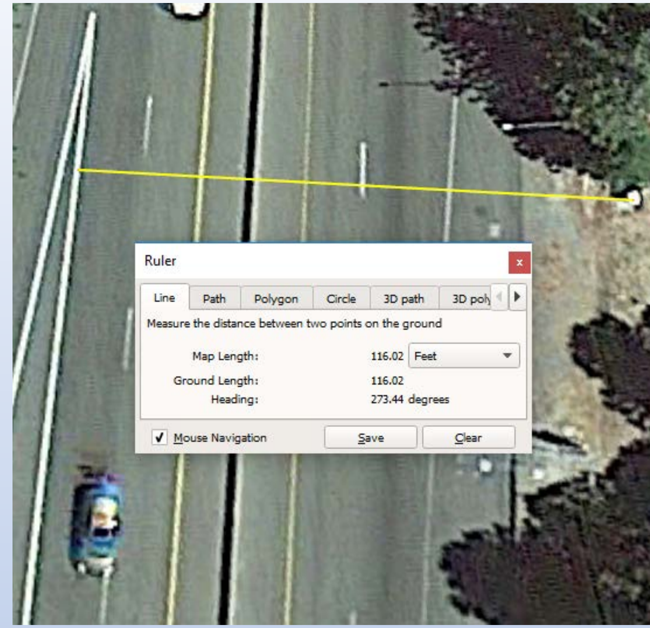
Detector Deployment

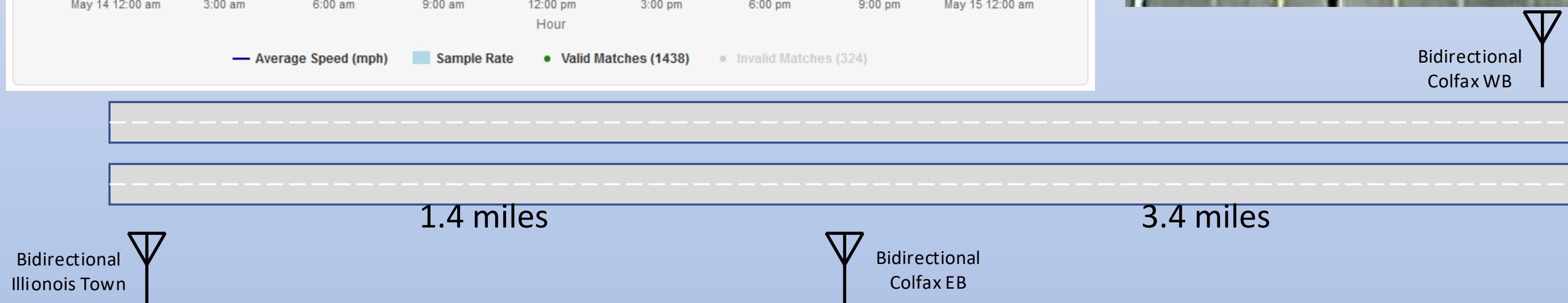


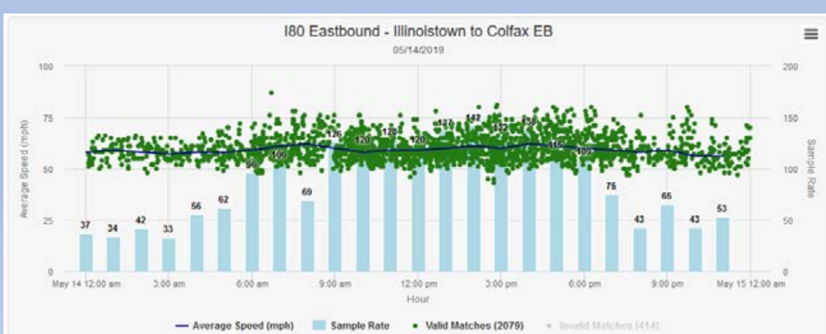
Location Selection

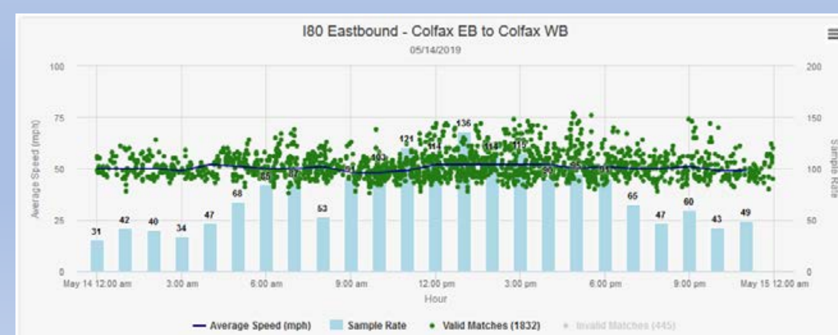
- Bidirectional Detection (Mostly).
- < 150’, Bidirectional Ok



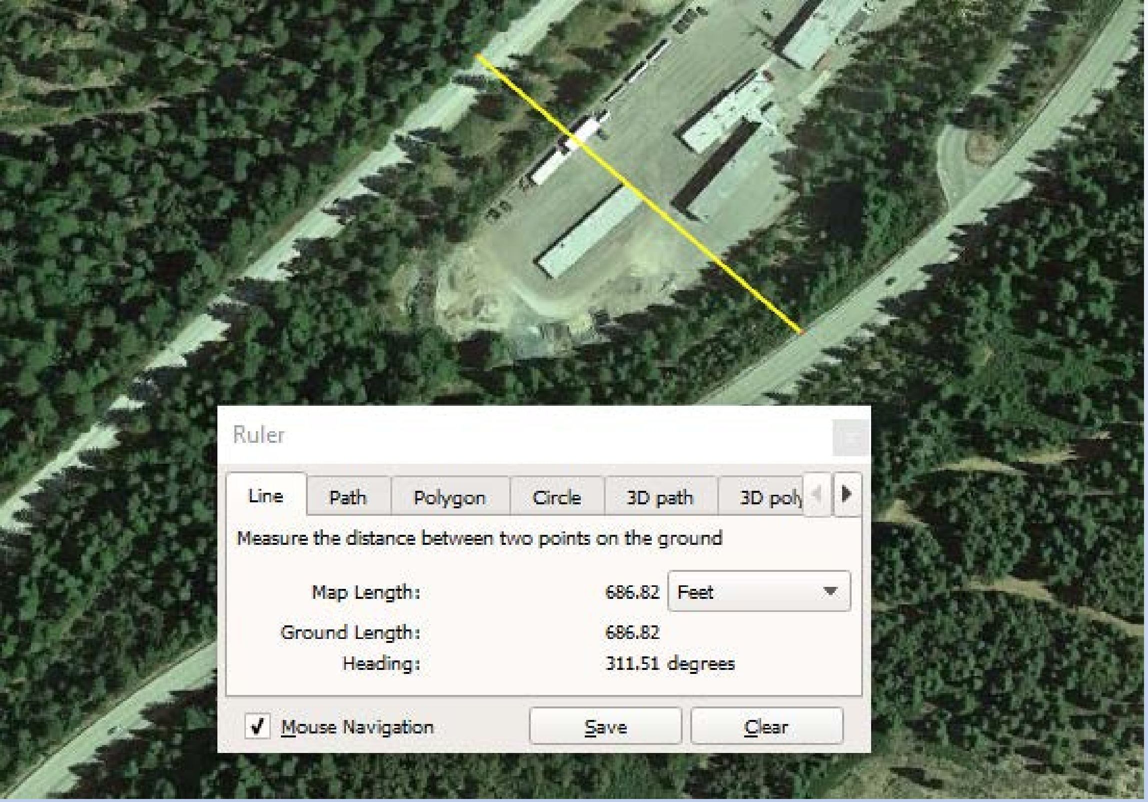








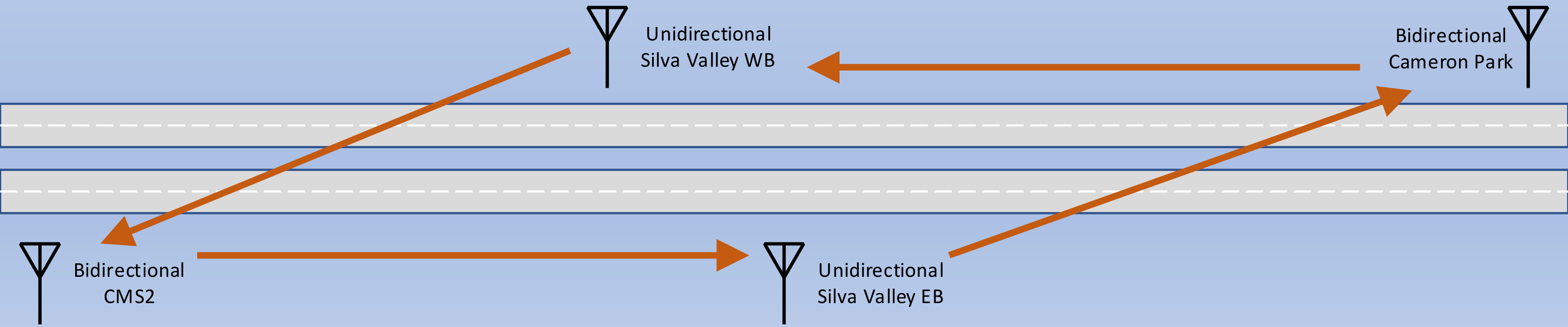
Location Selection



Kingvale Caltrans Yard

Directional Detection

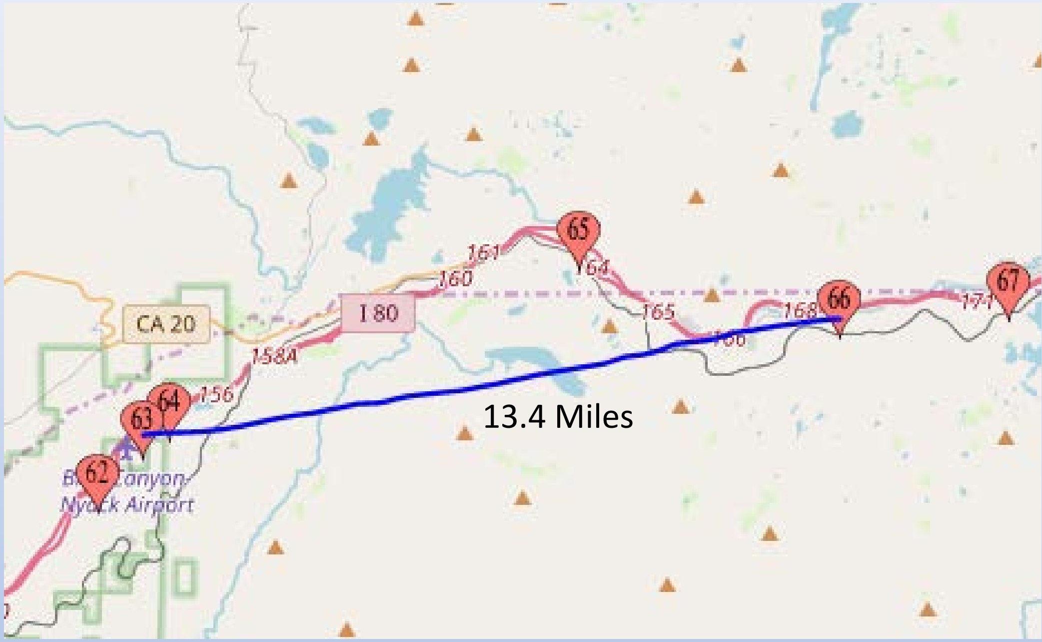
- > 150'.
- Elevation Obstruction.
- Trees.
- Buildings.

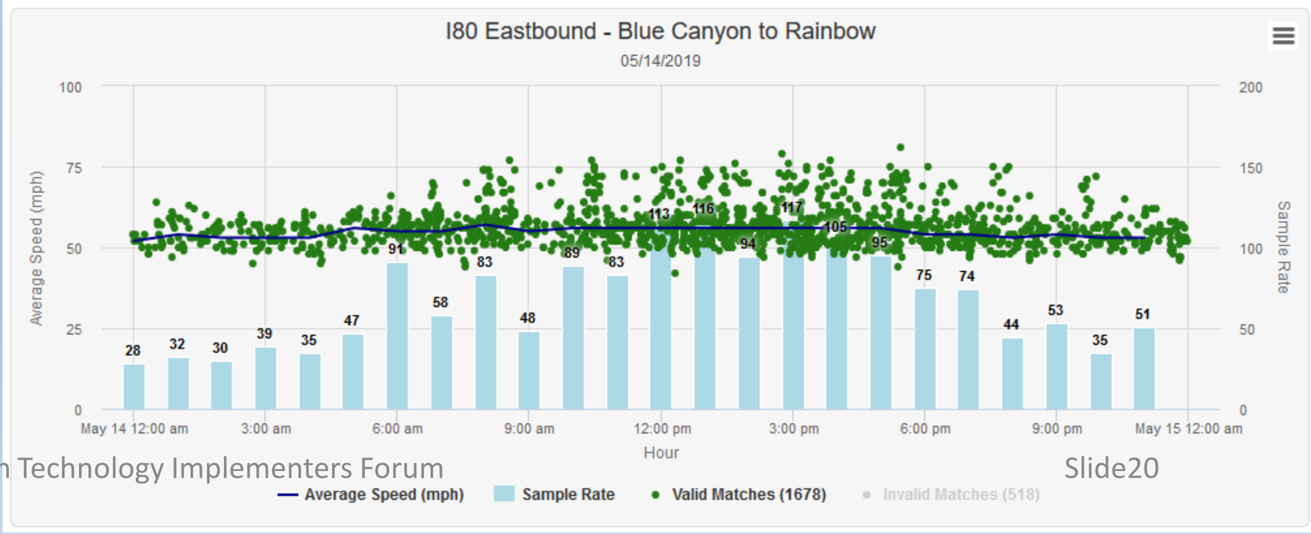


Location Selection

BTR Location Considerations:

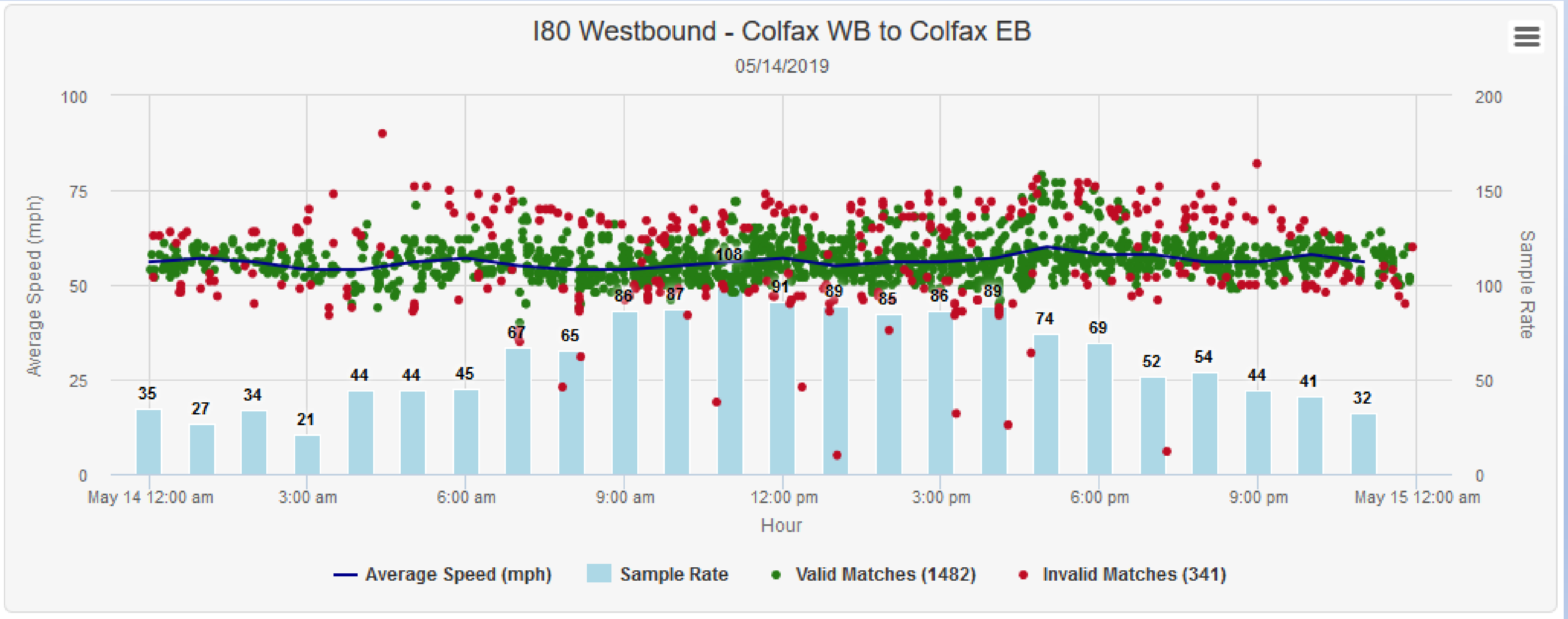
- On/off points
- Frontage Road
- Traffic Lights
- 2.4Ghz Noise
- Power (Wired vs Solar).
  - If Solar, Snow Implications.
- Communication
  - Low Bandwidth
  - 93 Byte Frame/Hit





BTR Detector Filters

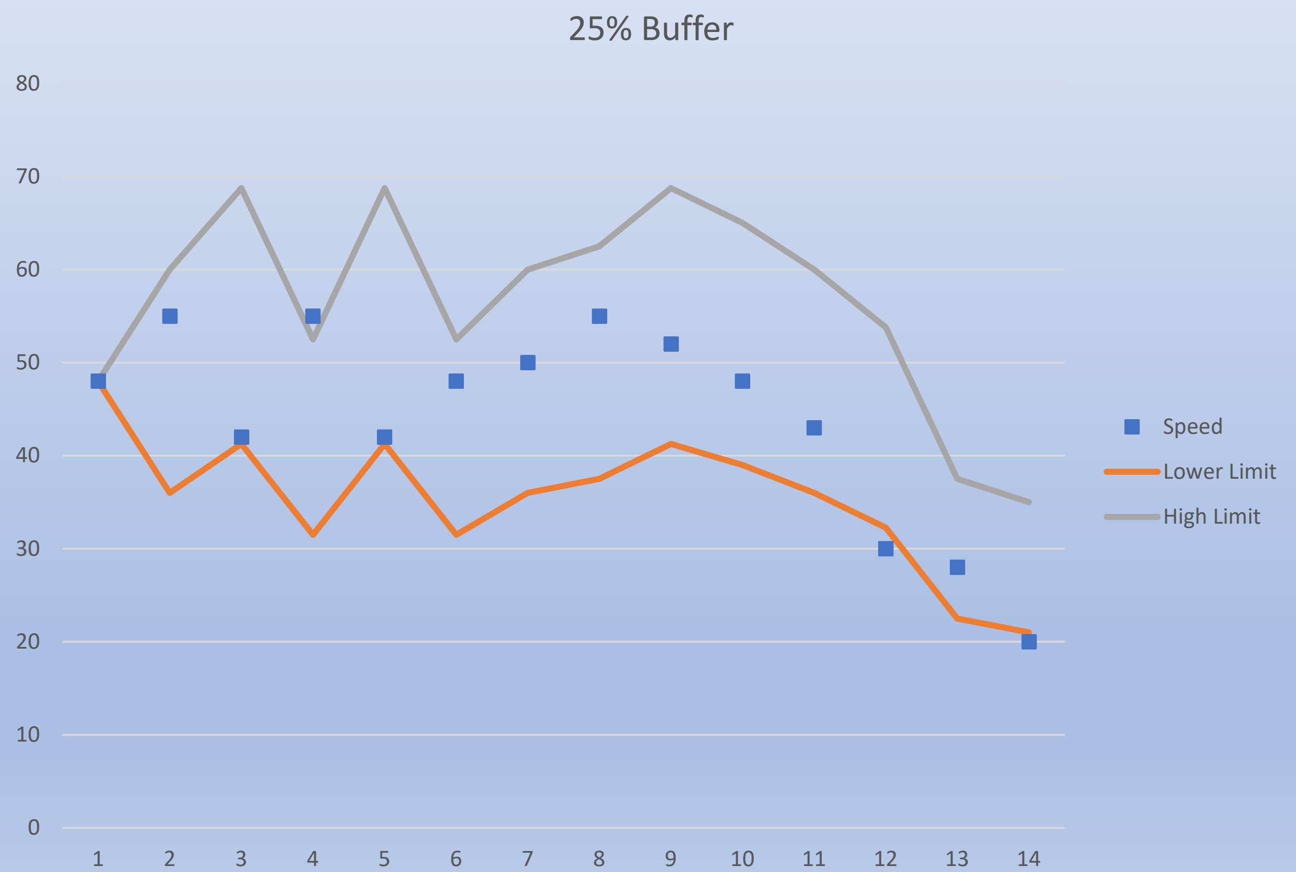
Data Filters
- ❑25% Buffer
- ❑45% Buffer
- ❑Interquartile Range
- ❑None



Percent Filter Example

Speed	Lower Limit	High Limit
48	n/a	n/a
55	36	60
42	41.25	68.75
55	31.5	52.5
42	41.25	68.75
48	31.5	52.5
50	36	60
55	37.5	62.5
52	41.25	68.75
48	39	65
43	36	60
30	32.25	53.75
28	22.5	37.5
20	21	35

Is data point within 25% of previous sample? i.e.. Less than 125% or greater than 75%? If outside range, it is an outlier.

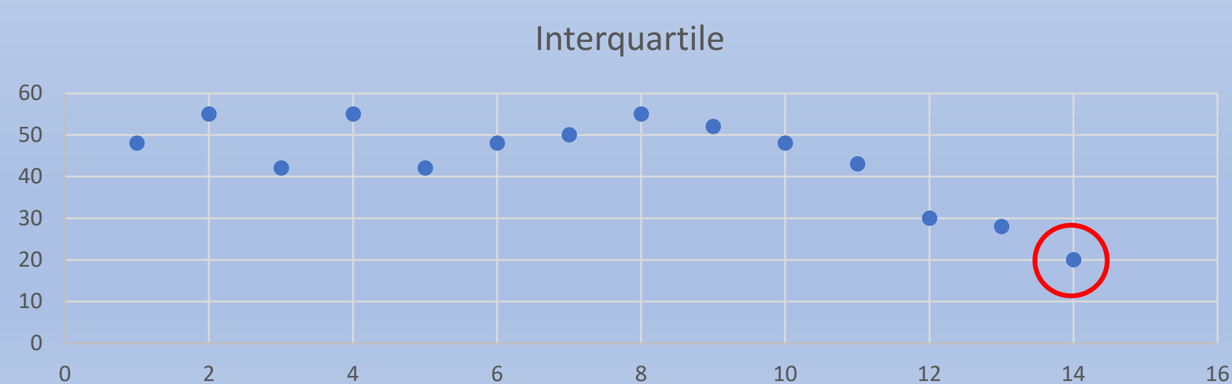


Sample	Speed
1	48
2	55
3	42
4	55
5	42
6	48
7	50
8	55
9	52
10	48
11	43
12	30
13	28
14	20

Interquartile Filter Sample

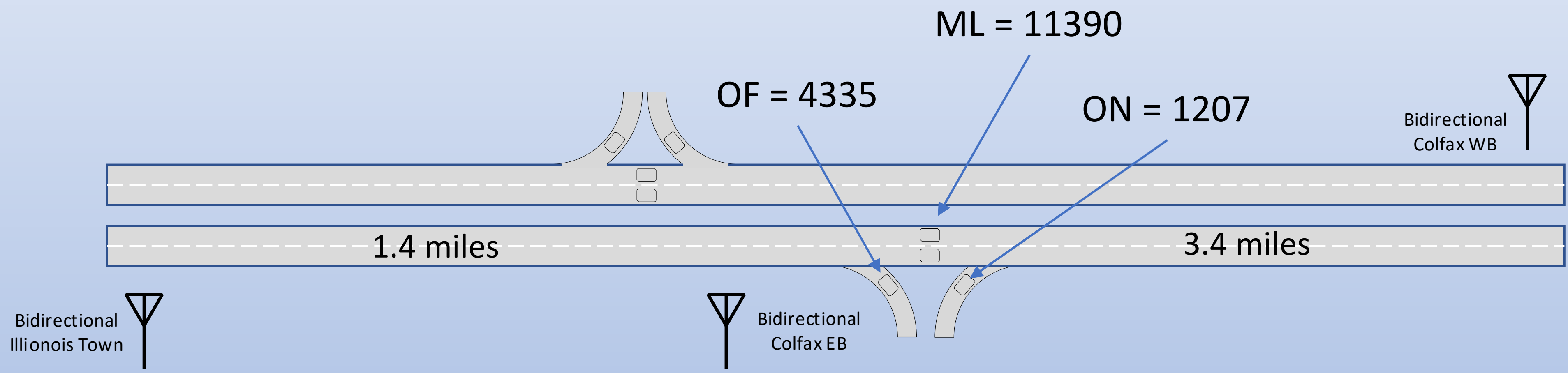
Is data point more than 1.5 interquartile ranges (IQR) below the first quartile or above the third quartile? If so, it's an outlier.

Variable	Value
1^{st} Quartile (Median of lower half of samples)	42
3^{rd} Quartile (Median of higher half of samples)	51.5
IQR (3^{rd} – 1^{st})	9.5
Low Threshold (Q1 - 1.5*IQR)	27.75
High Threshold (Q3 + 1.5*IQR)	65.75



BTR Detector Penetration

(Same Side and Both Sides)



Loop Counted Vehicles = 11,390 (ML) + 4,335 (OF) = 15,725
BTR Matches = 2079 Valid (+ 414 Outliers) = 2,493
Percent Penetration = 13.2% (+ 2.63%) = **15.9%**

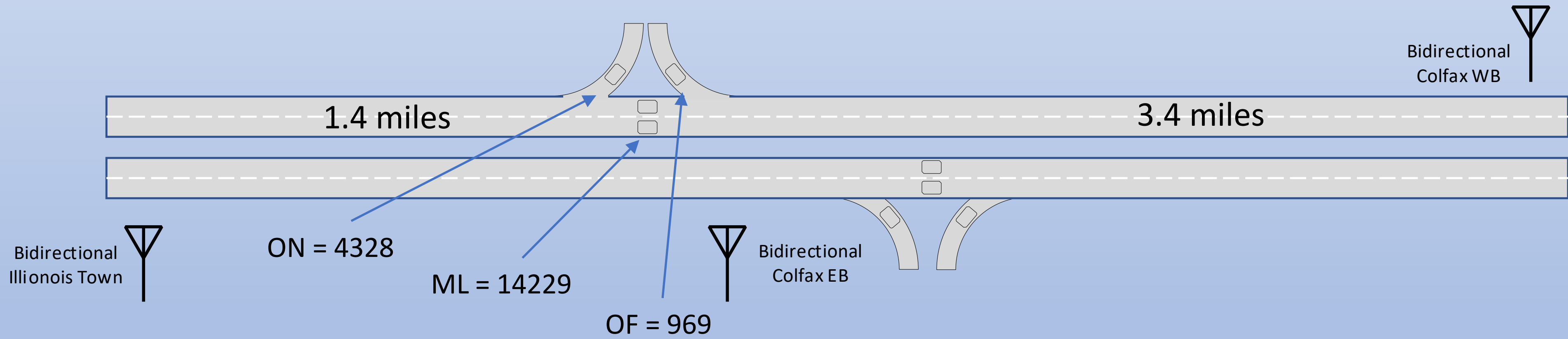
Loop Counted Vehicles = 11,390 (ML) +1,207 (ON) = 12,597
BTR Matches = 1832 Valid (+ 445 Outliers) =2,277
Percent Penetration = 14.5% (+ 3.53%) = **18.5%**

BTR Detector Penetration

(Opposite Side and Both Sides)

Loop Counted Vehicles = 14,229 + 4,328 = 18,557
BTR Matches = 1,438 (+ 324) = 1,762
Percent Penetration = 7.75% (+ 1.75%) = **9.50%**

Loop Counted Vehicles = 14,229 + 969 = 15,198
BTR Matches = 1482 (+ 341) = 1,823
Percent Penetration = 9.75% (+ 2.24%) = **12.0%**

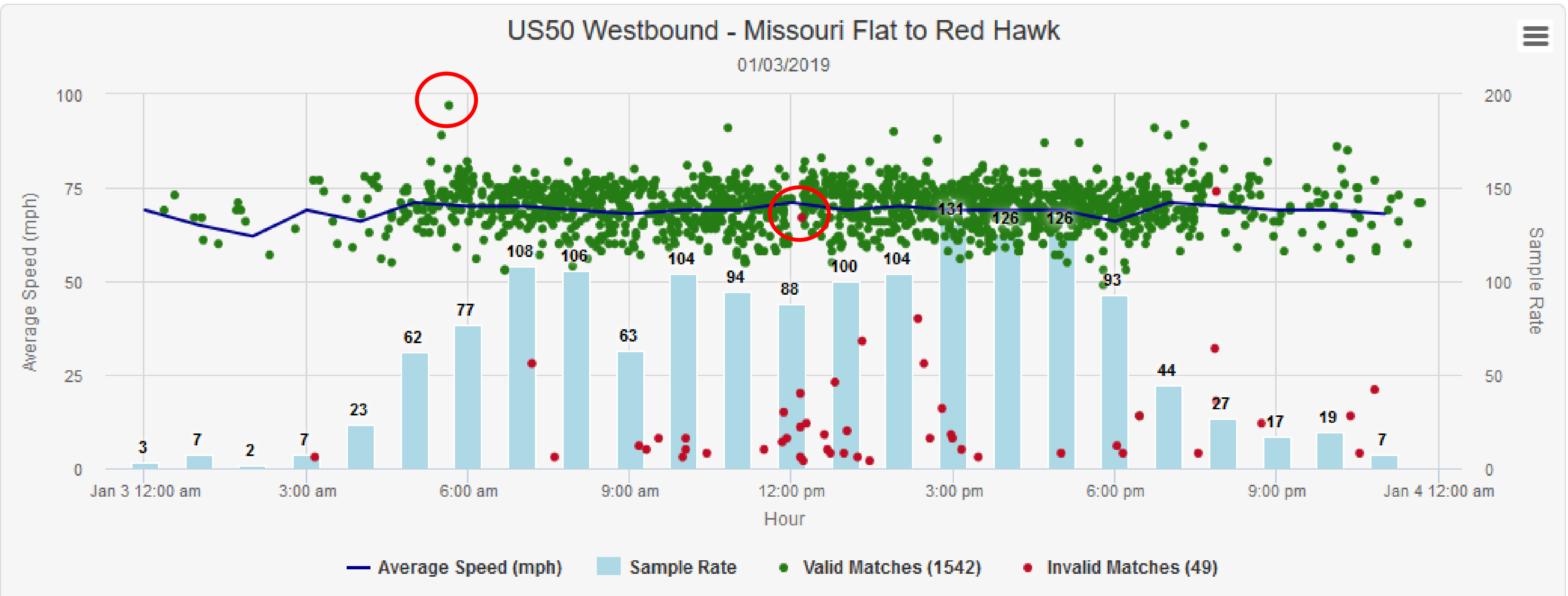


BTR Detector Penetration at Colfax

Bluetooth Issues

Filtering Algorithm Issues

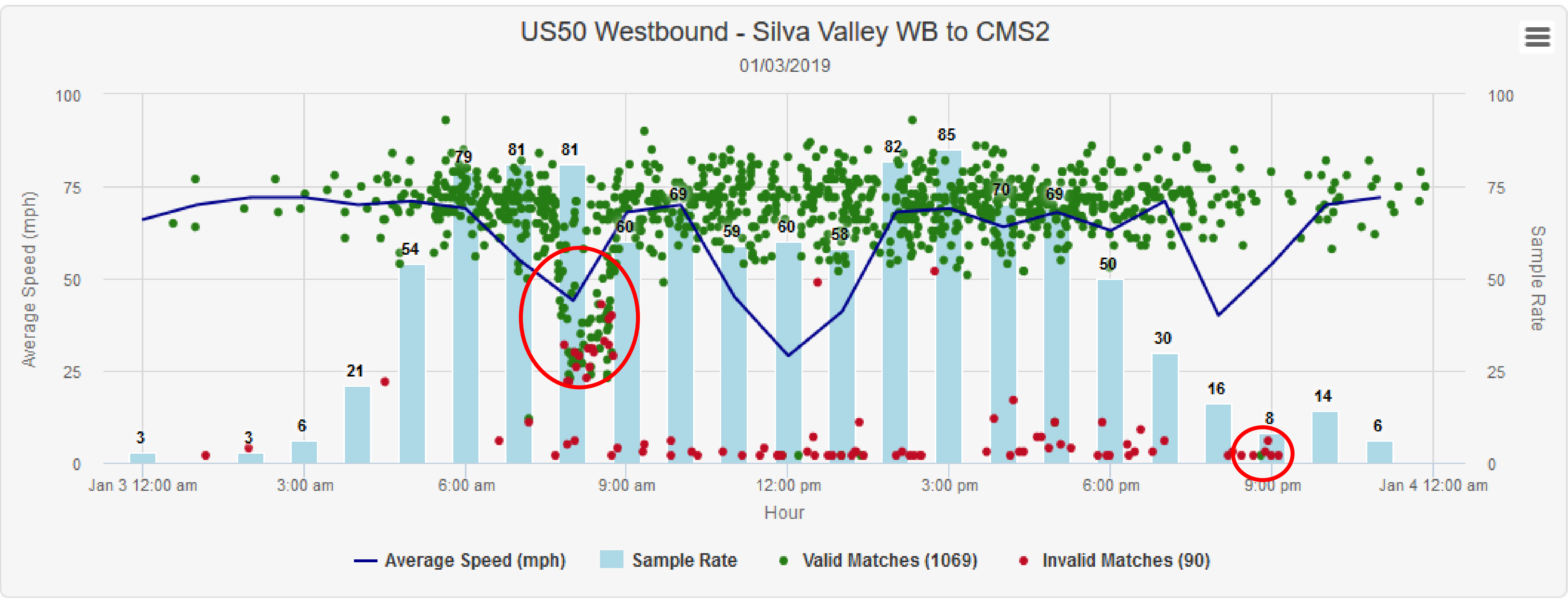
- Excessive Speeds Reported (Outliers?).

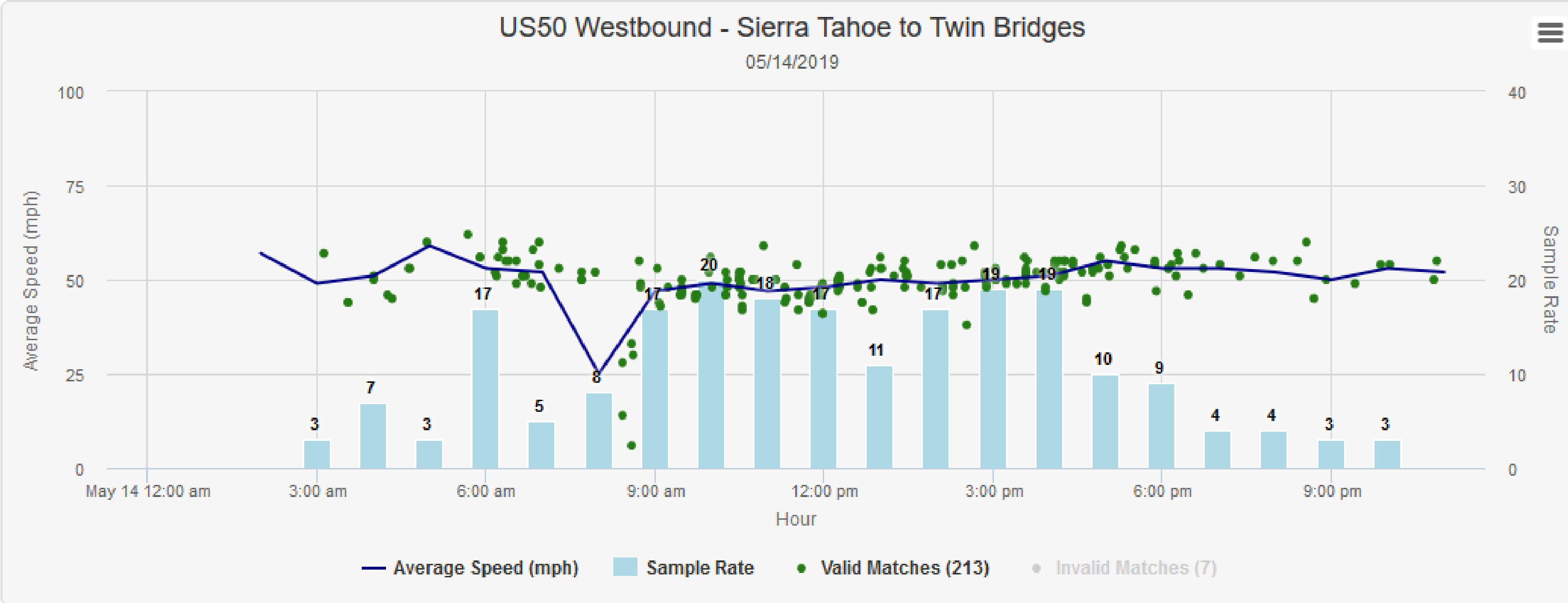


Bluetooth Issues

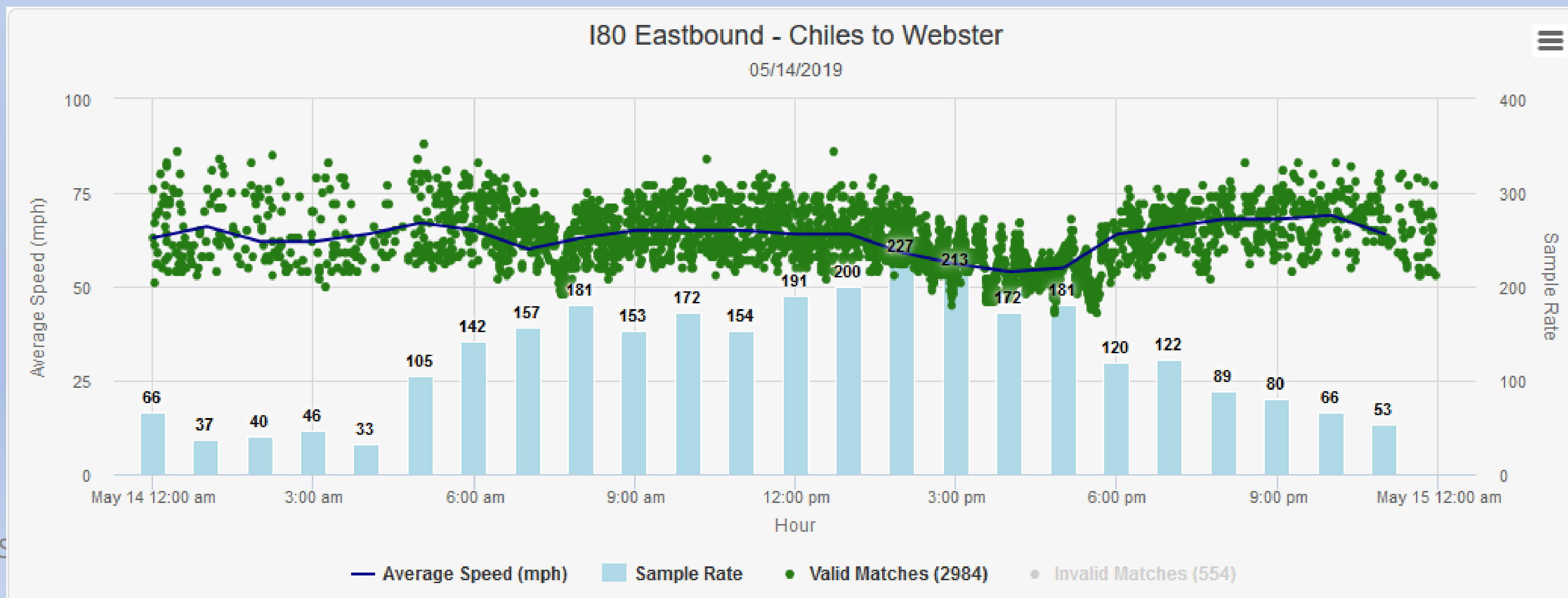
Speeds graphs were not smooth

- Average affected by single outlier.
- Average changed significantly minute over minute.
- Frontage Road Interference.





Rural vs. Urban – May 14th, 2019



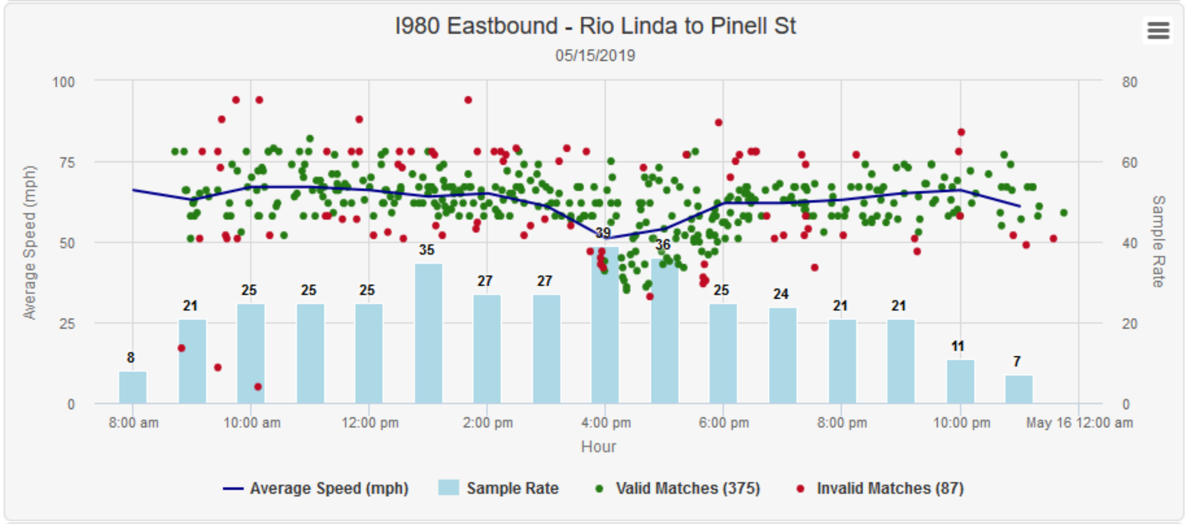
WiFi Detour

- Deep Penetration.
- Clients regularly broadcast WiFi Probe Requests.
- Already Associated to an AP?
- Iteris Detects Some Associated Clients.
- Designed for Greater Range than Bluetooth.
  - 10’s of feet vs 100’s of feet.
- Same Frequencies, but Less Channels Than Bluetooth.

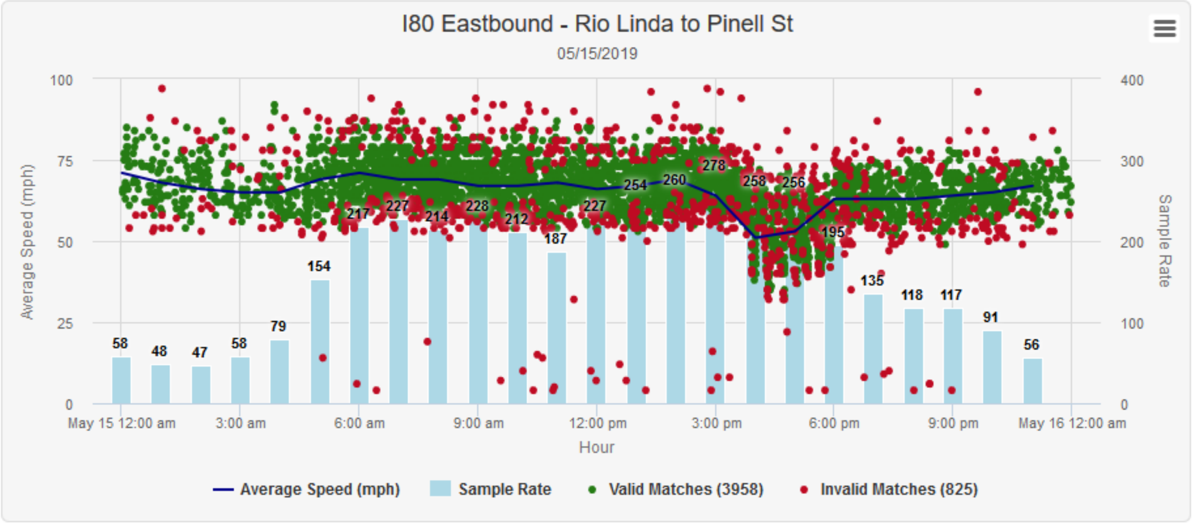
Initially Deployed on I80. However…

WiFi Detour

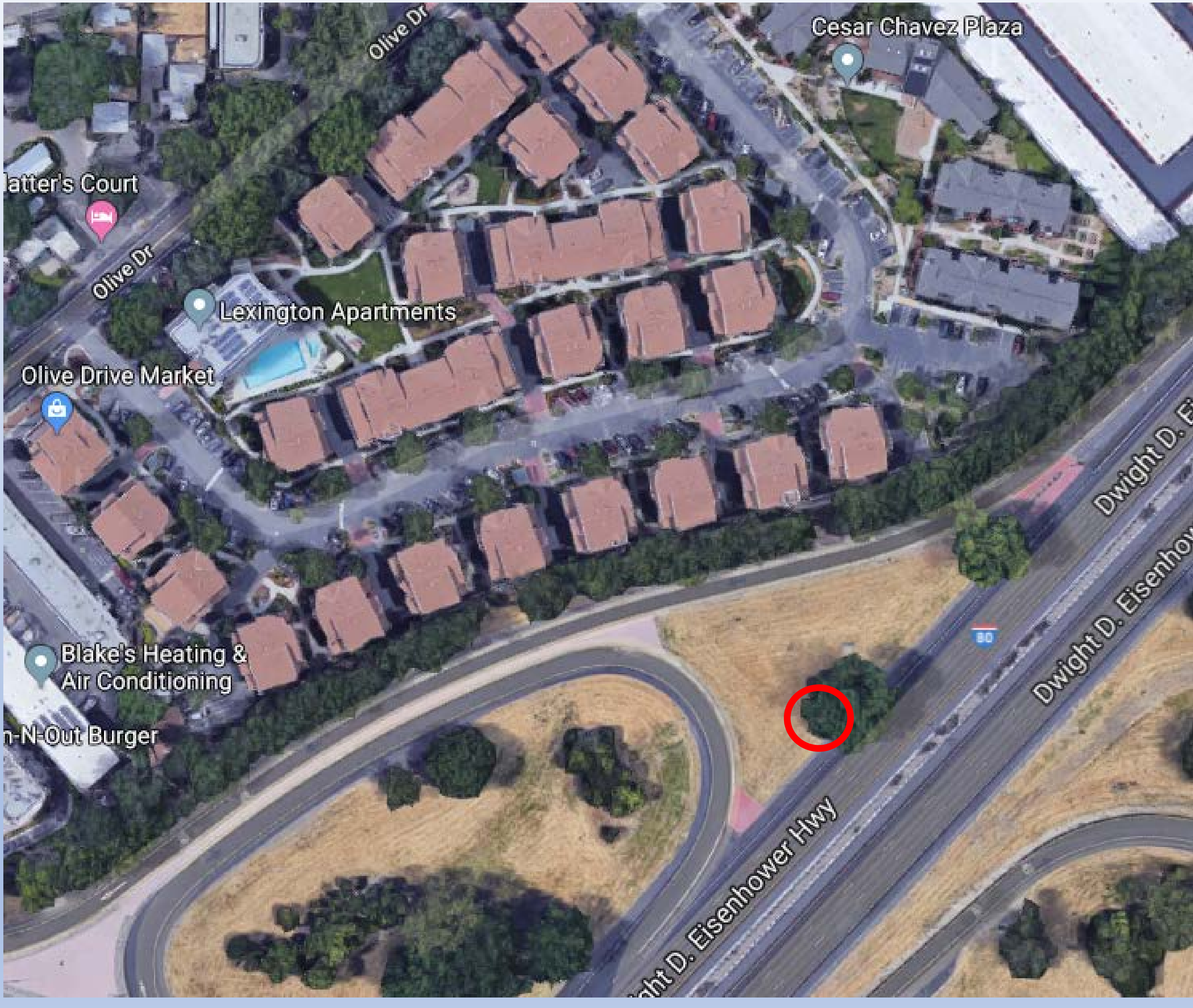
WiFi



BT



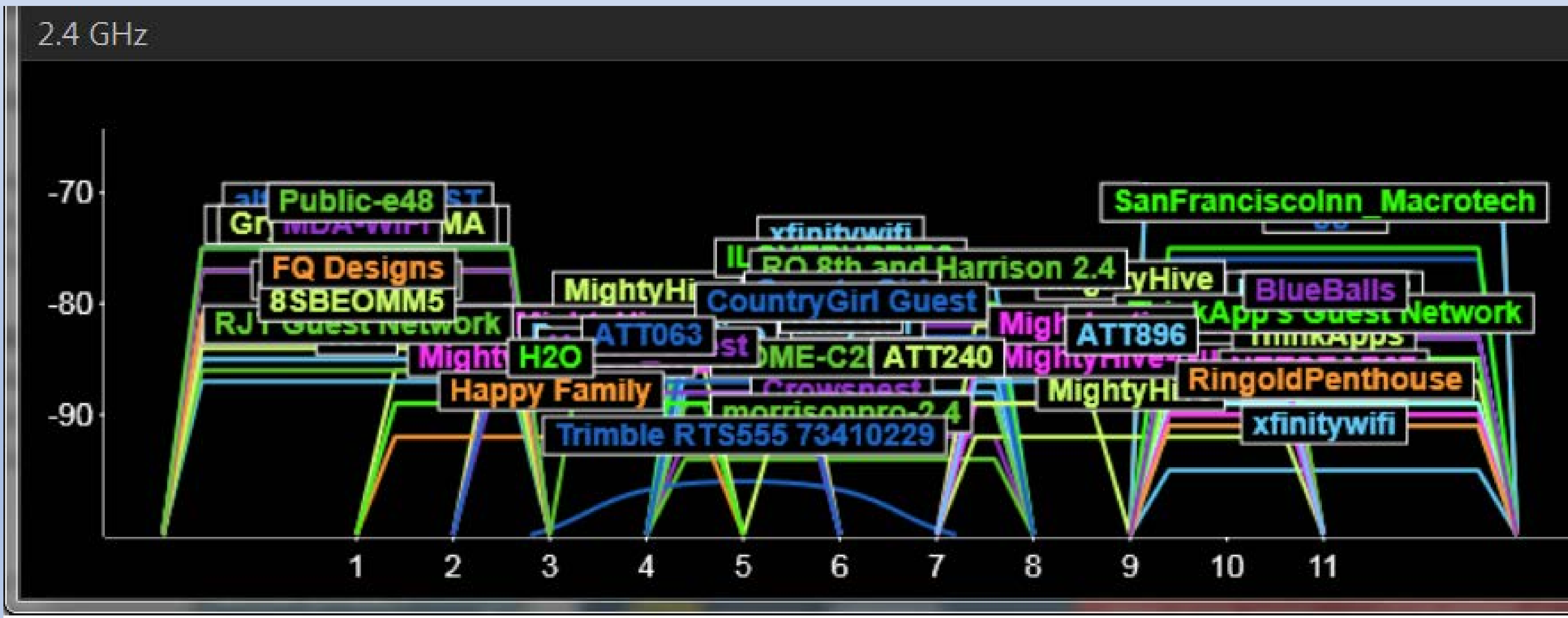
WiFi Issues



UC Davis

WiFi Issues

UC Davis Off Ramp

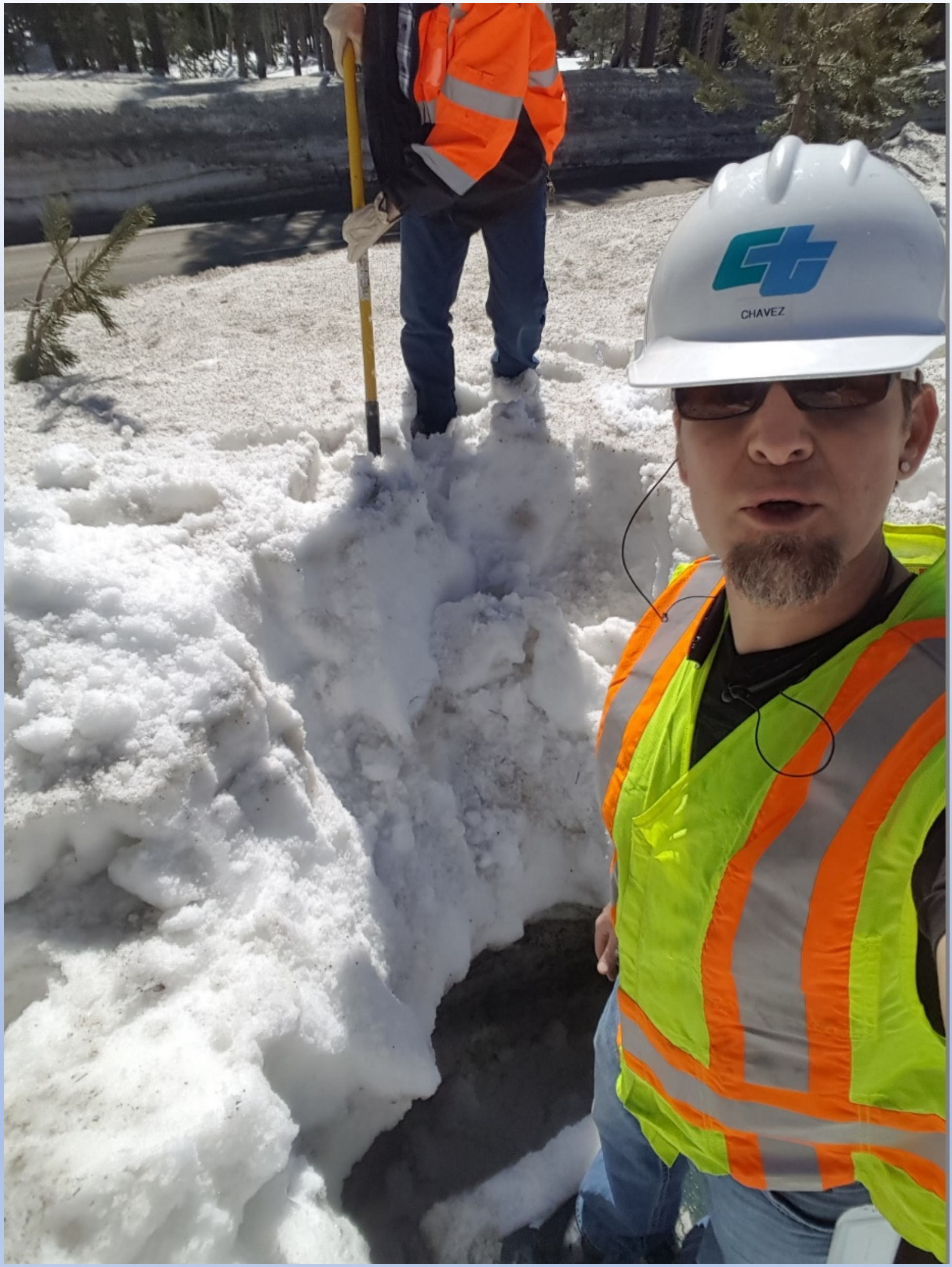


BTR HW Issues

- HW Failures.
  - Motherboard (Close to 20%/Year)
  - Power Supply (Wall Wart)
  - WiFi/USB Dong (Consumer Grade)
- No Reset Button
  - Serial Interface Discouraged

Environmental Issues

- Snow
- Knock Downs
- 2.4 GHz Noise?



Bradshaw Rd:

BTR would fail every 2 to 3 weeks. Swapped out all supporting hardware. Root cause was never isolated. At least 8 units bricked.

SW Issues

- IP Address Maintained in Two Files.
- Lack of Reset Button.
- Cleartext Password.
- 2x Reboots (by Design).
- Can Bypass Login via Links.
- OS Randomly Corrupted.
- Duplicate MAC Addresses on Road.
- GUI Displays Last Captured MAC (Stale Data).

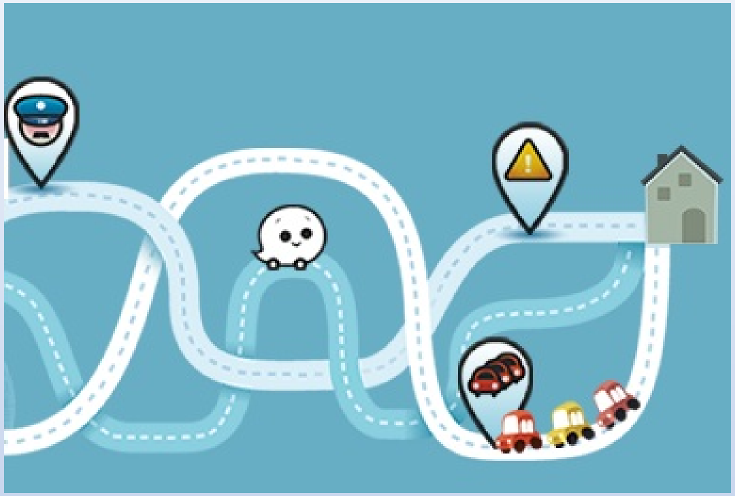
Bluetooth Cons Summary

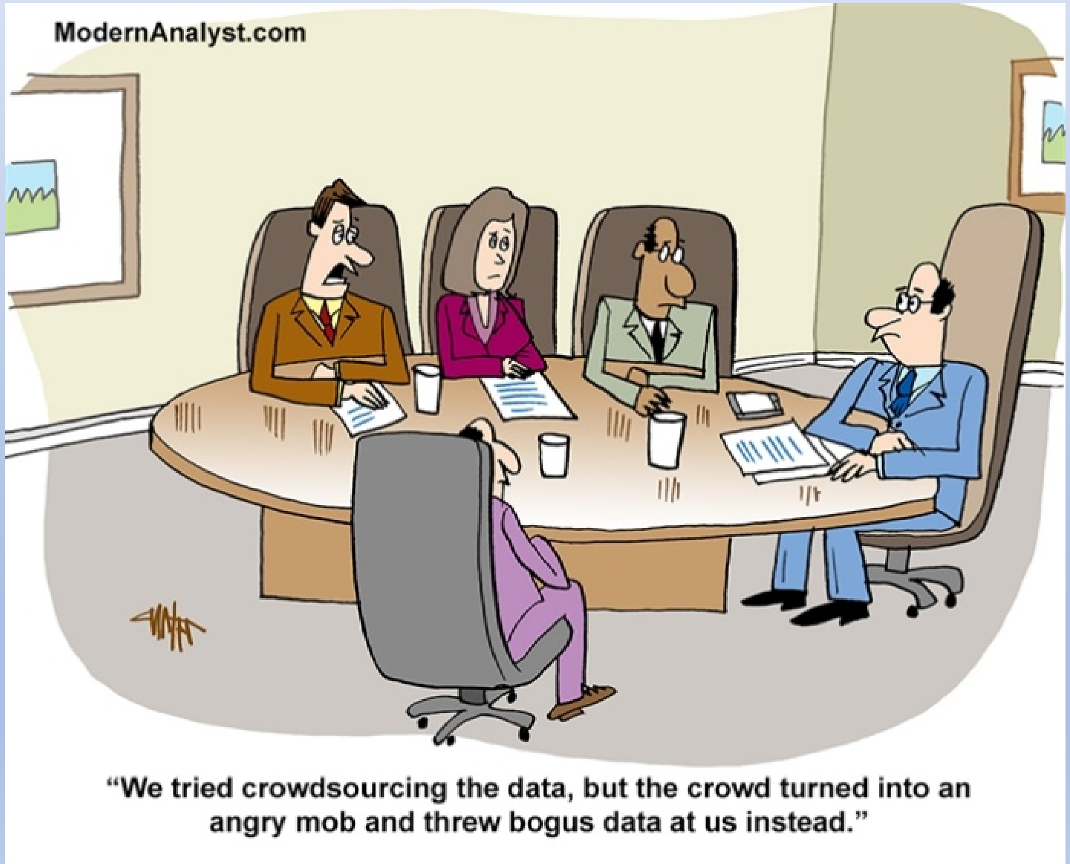
- Erratic Travel Times.
- Low Rural Penetration.
- 2.4GHz Interference.
- HW Failure.
- Snow Pack .
- Rural Power.
- Few Cabinets in Rural Areas.
- Duplicate MAC Addresses.

Let's try something to eliminate these cons, enter FREE crowd source data in the form of Waze.

What is Waze?

✓Crowd Source
✓Alerts
✓Traffic Conditions





Pros Over Bluetooth

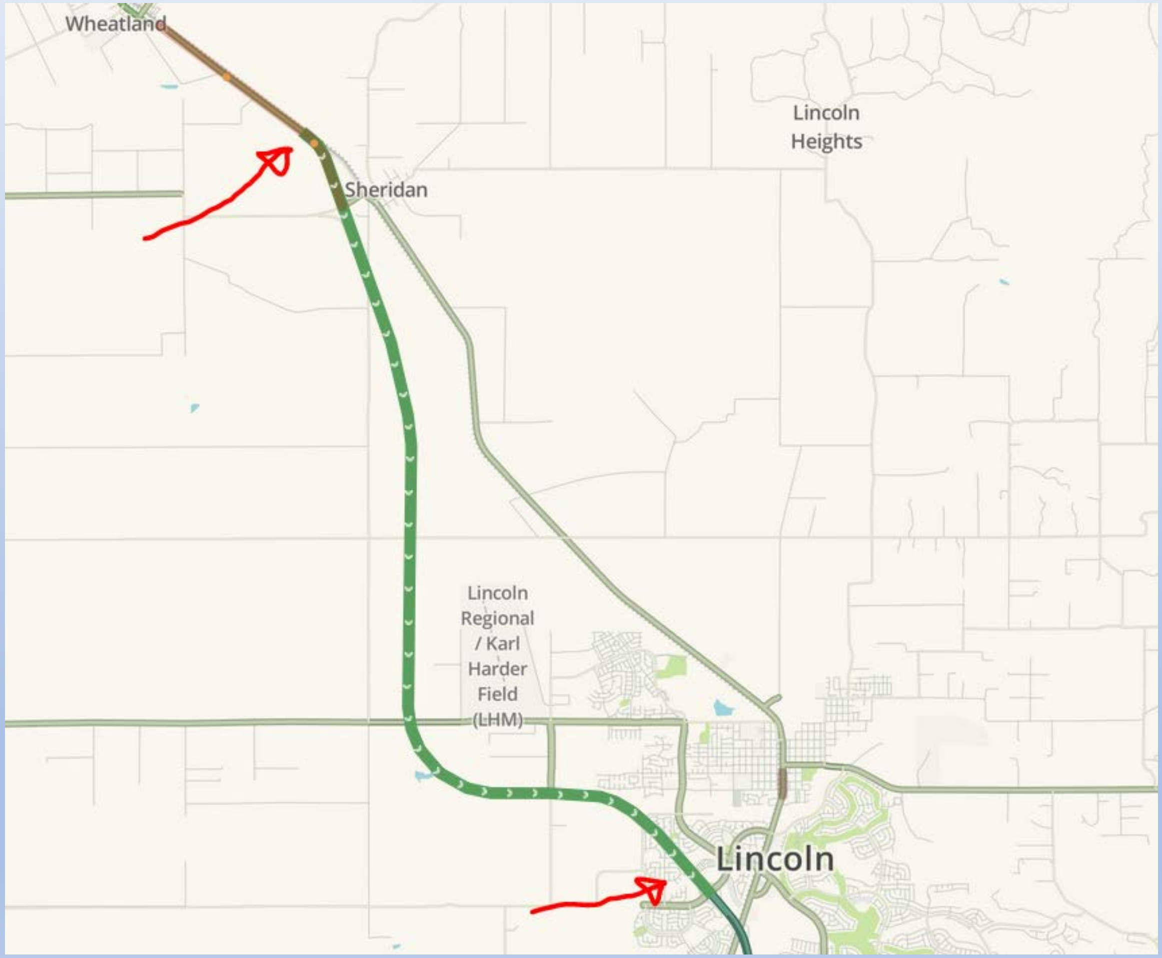
- Rurally Available
- No HW
- No Comm
- No Power
- No interference
- Immune to weather
- Non Fixed Endpoints

Waze Segment Definition

Segment Definition

- Name
- Start Lat
- Start Long
- End Lat
- End Long
- Start Dir
- End Dir
- Start Cross Street
- End Cross Street

Long Turnaround Time.



ATMS = Velocity(Waze)

65 Lincoln to Roseville 65-Ferrari-Ranch-Rd to 65-Blue-Oak-Blvd 5.29 miles	**Free flow** as usual **5 min**| 57 mph **5 min**| 56 mph
70 Olivehurst to 99 Riego 70-CMS503 to 99-Riego-Rd 23.67 miles	**Free flow** as usual **19 min**| 75 mph **18 min**| 75 mph
99 Riego to 99 Elkhorn 99-Riego-Rd to 99-Elkhorn-Blvd 4.45 miles	**Free flow** as usual **3 min**| 73 mph **3 min**| 73 mph
80 Richards to Dixon 80-Richards-Blvd to 80-Currey-Rd 6.59 miles	**Free flow** as usual **5 min**| 72 mph **5 min**| 73 mph

While 1

- Scrape Data
- XML.Convert
- Wait (for Velocity)
- Append
- Continue


```
- <match_summary_data distance_measurement_unit="Miles">
  - <match_summary>
      <system_id>Iteris</system_id>
      <origin_id>80_Dixon</origin_id>
      <dest_id>80_Richards</dest_id>
      <origin_roadway>I80</origin_roadway>
      <origin_cross_street>Dixon</origin_cross_street>
      <origin_direction>Eastbound</origin_direction>
      <dest_roadway>I80</dest_roadway>
      <dest_cross_street>Richards Blvd</dest_cross_street>
      <dest_direction>Eastbound</dest_direction>
      <segment_length_miles>7.6</segment_length_miles>
      <timestamp>5/17/2019 4:32:33 PM</timestamp>
      <travel_time>1025</travel_time>
      <speed_mph std_dev="2.87">27</speed_mph>
      <summary_mins>15</summary_mins>
      <summary_samples>26</summary_samples>
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      <substitute_speed>-1</substitute_speed>
    </match_summary>
```
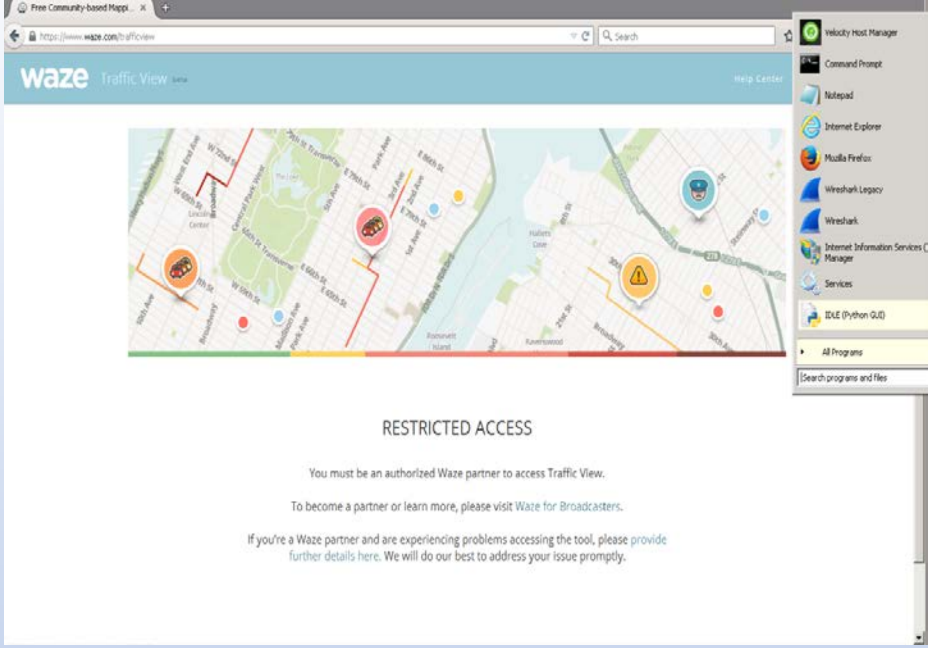
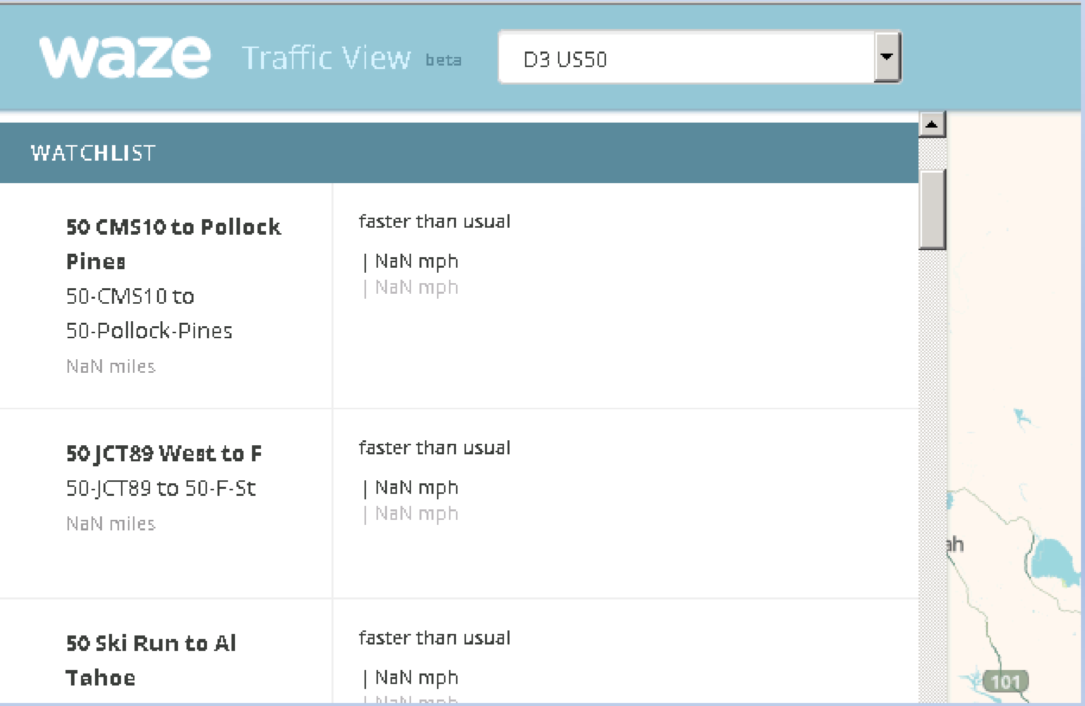


ATMS Never Knew What Hit It!

Waze Hurdles

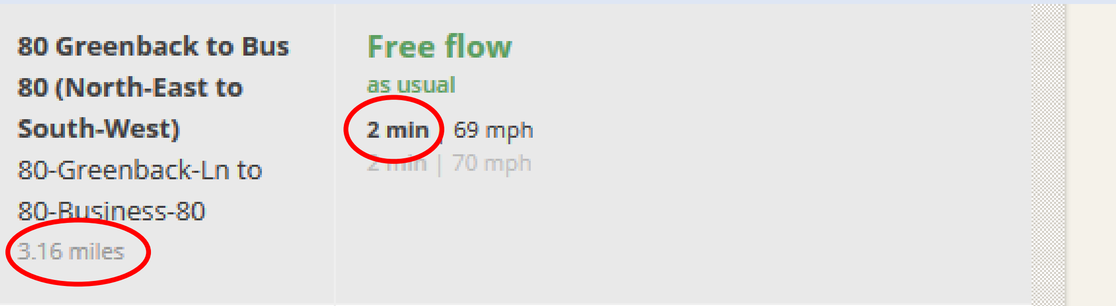


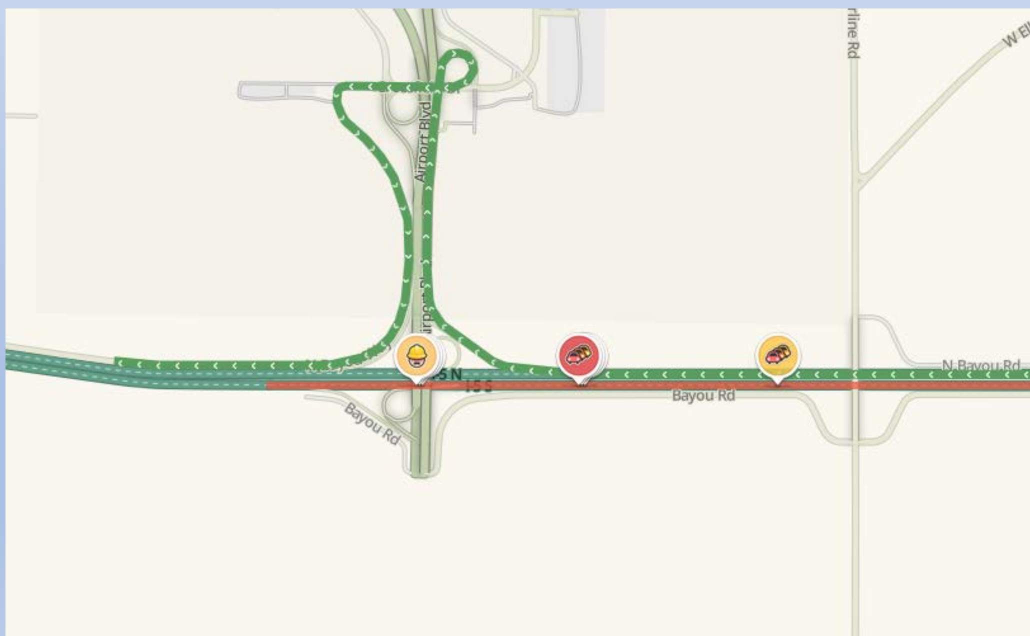


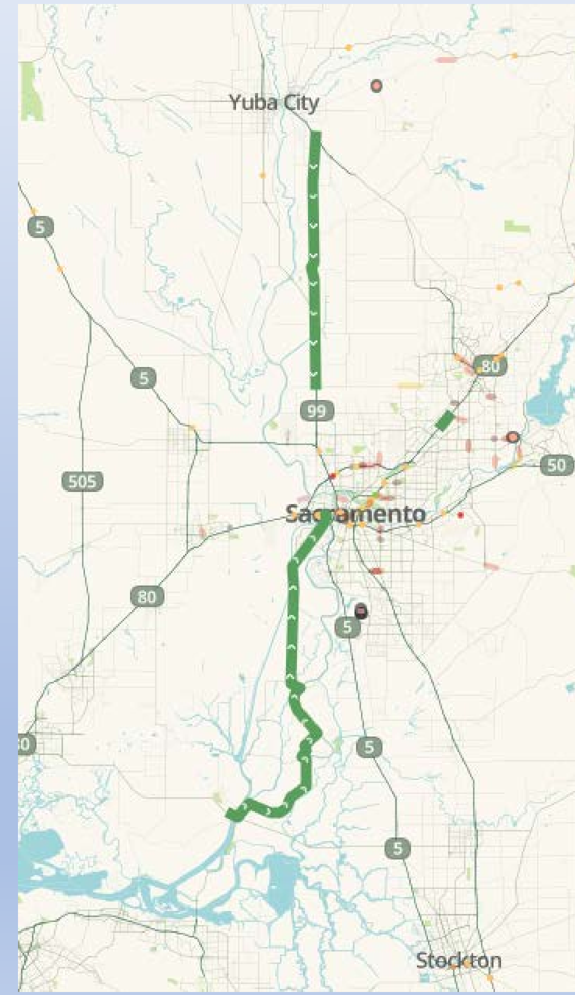
- ➢ No JSON or XML Feed
- ➢ Python and Selenium Incompatibility
- ➢ HTTP Scraping
  - ➢ Unauthorized Users
  - ➢ 404 Error
  - ➢ TT not present
  - ➢ NaN

Waze Hurdles

- Turnaround Time
- Segment Inaccuracy (Up to 30%)
- Rounding Error
- Sub Optimal Route







Waze Cons

You Get What You Pay For

- Selenium Incompatibility Issues
- HTTP Scraping
- Unreliable HTTP Feed
- Slow Turnaround Time
- Inaccurate Segments
- ATMS Hack

Let's eliminate these cons. Presenting HERE.

What is HERE?

HERE captures location content such as road networks, buildings, parks and traffic patterns. It then **sells** or licenses that mapping content, along with navigation services and location solutions.

Pros Shared With Waze

- Rurally Available
- No HW
- No Comm
- No Power
- No interference
- Unaffected by weather conditions

Pros Over Waze

- Paid Support – ($30k/yr. for District 3)
- XML Feed!
- Supported in ATMS 5.3
- Supported in ActiveITS
- Confidence Factor included
- Historical Data available

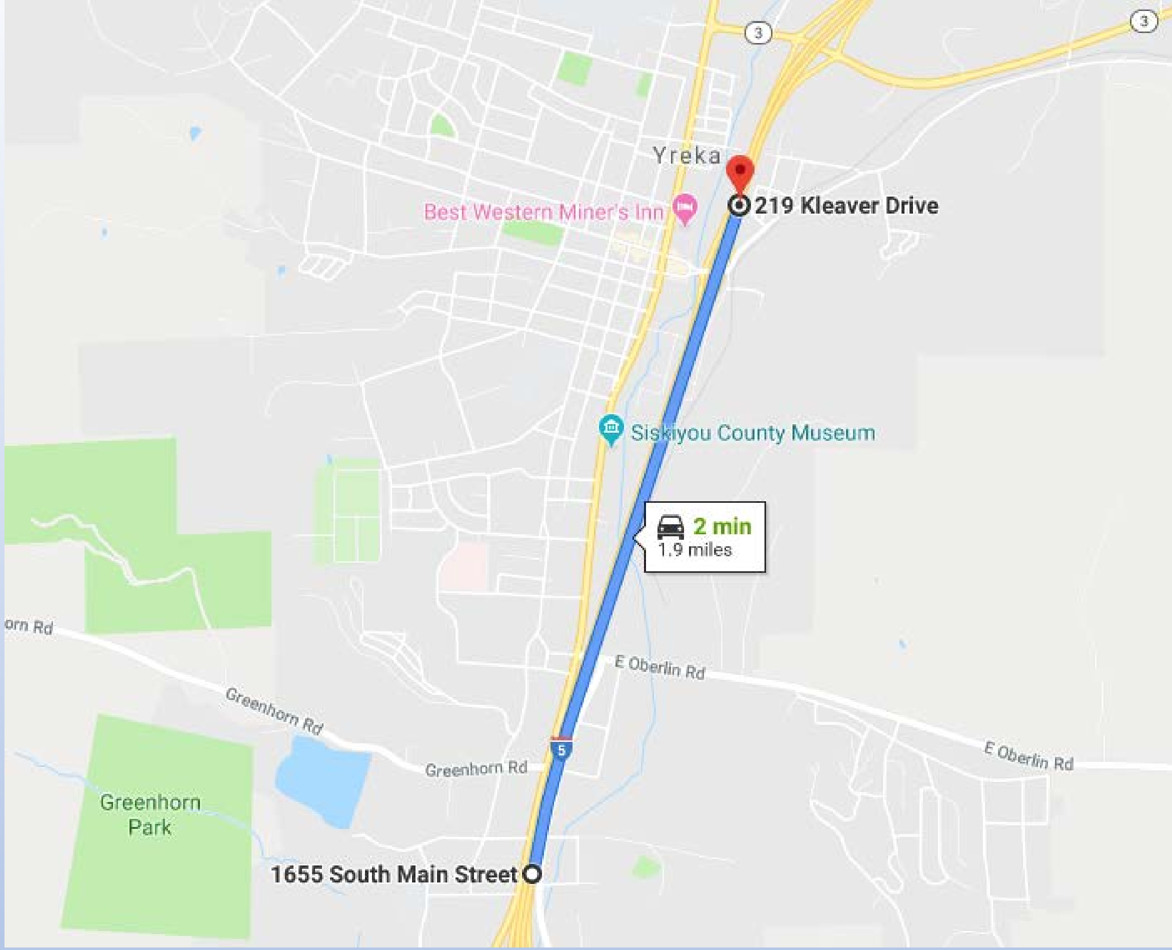
HERE TMC's

TMC: Traffic Message Channel.

- ✓ TMC codes are a reference system designed to give a unique alpha-numeric code to road segment for the purposes of assigning traffic information to that segment.
- ✓ Assigned and certified by TISA (Traveler Information Services Association).

Country Code	Table ID	Direction	Location
1 (Numeric or Alpha)	05 (Numeric)	N(-) or P(+)	012345
Country Code. The United States uses Country Code 1.	Table ID within the country.	Direction of travel. P(+) = North or East N(-) = South or West	Specific location.

TMC Example



105P05430

1 = US
05 = Northern California
P = Northbound
05430 = Unique identifier within US, CA, NB.

HERE TMC's Defined

1	ADMIN1	ADMIN2	ADMIN3	ADMIN4	ADMIN5	TMC	TMC_LENGTH
489475	United States	California	Siskiyou	Uninc Siskiyou County		105P05435	2.621803
489476	United States	California	Siskiyou	Yreka		105P05430	1.852229
489477	United States	California	Siskiyou	Yreka		105P05431	0.743655

LINEAR	PARENT_LIN	TMC_ORDER	ROAD_NAME	ROAD_NUM	ROAD_DIR	POINT_DESC
105P00139	105P03009	182		I-5	Northbound	Bailey Hill Rd/Exit 793
105P00139	105P03009	177		I-5	Northbound	Foothill Dr/Exit 775
105P00139	105P03009	178		I-5	Northbound	CA-3/Montague Rd/Exit 776

TMC_TYPE	POS_OFF	NEG_OFF	START_LAT	START_LON	END_LAT	END_LON
1	105P05436	105P05434	41.92239	-122.57598	41.95772	-122.59409
1	105P05431	105P05429	41.70787	-122.64236	41.73348	-122.63174
1	105P05432	105P05430	41.73348	-122.63174	41.74239	-122.62407

TMC Definitions Released Twice Per Year

TMC's Travel Time

Travel Time File: RealtimeFlowA0105.xml


```xml
<RW LI="105+03009" DE="I-5" PBT="2019-05-21T02:22:17Z" mid="0bd861ff-1567-421a-942d-6419ffe0bbb4">
    <FIS>
        <FI>
            <TMC PC="5430" DE="Foothill Dr/Exit 775" QD="-" LE="1.85222"/>
            <CF TY="TR" SP="64.54" SU="64.54" FF="65.12" JF="0.12952" CN="0.74" TS="0"/>
        </FI>
        <FI>
            <TMC PC="5431" DE="CA-3/Montague Rd/Exit 776" QD="-" LE="0.74365"/>
            <CF TY="TR" SP="62.26" SU="62.26" FF="64.81" JF="0.57629" CN="0.73" TS="0"/>
        </FI>
        <FI>
            <TMC PC="5432" DE="CA-96/Klamath River Hwy/Exit 786" QD="-" LE="10.17161"/>
            <CF TY="TR" SP="60.31" SU="60.31" FF="62.45" JF="0.50320" CN="0.77" TS="0"/>
        </FI>
```


RW: Roadway

- **LI**: Unique String Identifier. **Note Embedded +/- Sign**.
- **DE**: Text Description of the Road.
- PBT: Base Timestamp.
- mid: NAVTEQ identifier. DO NOT USE.

TMC's Travel Time

Travel Time File: RealtimeFlowA0105.xml


```
<RW LI="105+03009" DE="I-5" PBT="2019-05-21T02:22:17Z" mid="0bd861ff-1567-421a-942d-6419ffe0bbb4">
    <FIS>
        <FI>
            <TMC PC="5430" DE="Foothill Dr/Exit 775" QD="-" LE="1.85222"/>
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        </FI>
        <FI>
            <TMC PC="5431" DE="CA-3/Montague Rd/Exit 776" QD="-" LE="0.74365"/>
            <CF TY="TR" SP="62.26" SU="62.26" FF="64.81" JF="0.57629" CN="0.73" TS="0"/>
        </FI>
        <FI>
            <TMC PC="5432" DE="CA-96/Klamath River Hwy/Exit 786" QD="-" LE="10.17161"/>
            <CF TY="TR" SP="60.31" SU="60.31" FF="62.45" JF="0.50320" CN="0.77" TS="0"/>
        </FI>
```


FIS: List of Flow Items.

- FI: Flow Item.
    - **TMC: Traffic Message Center.**
    - **CF: Current Flow.**

TMC’s Travel Time

Travel Time File: RealtimeFlowA0105.xml


```xml
<RW LI="105+03009" DE="I-5" PBT="2019-05-21T02:22:17Z" mid="0bd861ff-1567-421a-942d-6419ffe0bbb4">
    <FIS>
        <FI>
            <TMC PC="5430" DE="Foothill Dr/Exit 775" QD="-" LE="1.85222"/>
            <CF TY="TR" SP="64.54" SU="64.54" FF="65.12" JF="0.12952" CN="0.74" TS="0"/>
        </FI>
        <FI>
            <TMC PC="5431" DE="CA-3/Montague Rd/Exit 776" QD="-" LE="0.74365"/>
            <CF TY="TR" SP="62.26" SU="62.26" FF="64.81" JF="0.57629" CN="0.73" TS="0"/>
        </FI>
        <FI>
            <TMC PC="5432" DE="CA-96/Klamath River Hwy/Exit 786" QD="-" LE="10.17161"/>
            <CF TY="TR" SP="60.31" SU="60.31" FF="62.45" JF="0.50320" CN="0.77" TS="0"/>
        </FI>
```


TMC: Traffic Message Channel.

- **PC:** Point Location Code = TMC ID (stripped).
- DE: Description.
- QD: Queuing direction. (Opposite of traffic flow).
- LE: Length. Units defined above.

TMC’s Travel Time

Travel Time File: RealtimeFlowA0105.xml

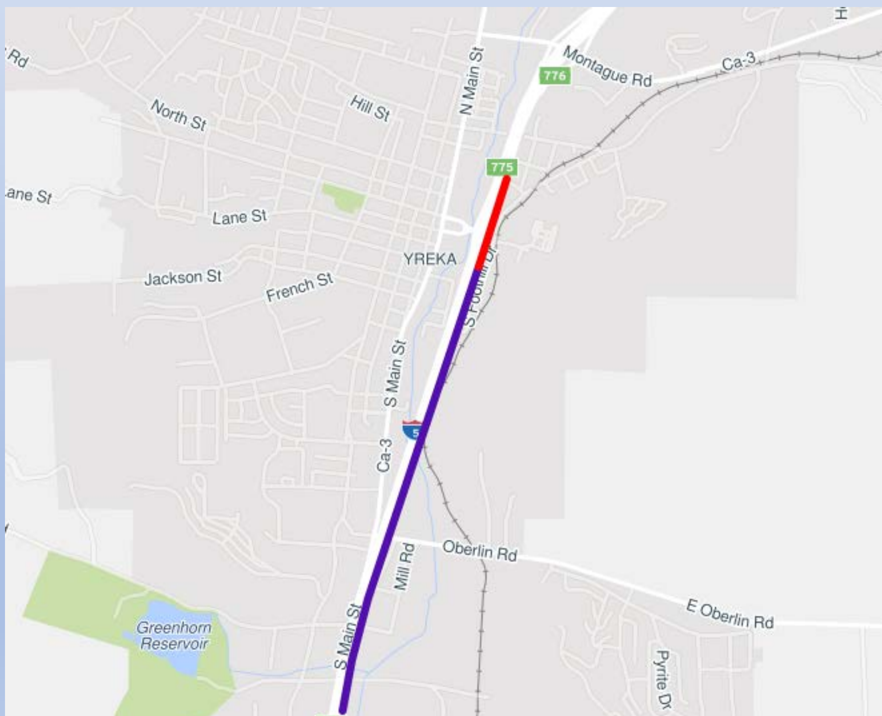

```
<RW LI="105+03009" DE="I-5" PBT="2019-05-21T02:22:17Z" mid="0bd861ff-1567-421a-942d-6419ffe0bbb4">
    <FIS>
        <FI>
            <TMC PC="5430" DE="Foothill Dr/Exit 775" QD="-" LE="1.85222"/>
            <CF TY="TR" SP="64.54" SU="64.54" FF="65.12" JF="0.12952" CN="0.74" TS="0"/>
        </FI>
        <FI>
            <TMC PC="5431" DE="CA-3/Montague Rd/Exit 776" QD="-" LE="0.74365"/>
            <CF TY="TR" SP="62.26" SU="62.26" FF="64.81" JF="0.57629" CN="0.73" TS="0"/>
        </FI>
        <FI>
            <TMC PC="5432" DE="CA-96/Klamath River Hwy/Exit 786" QD="-" LE="10.17161"/>
            <CF TY="TR" SP="60.31" SU="60.31" FF="62.45" JF="0.50320" CN="0.77" TS="0"/>
        </FI>
```


CF: Current Flow

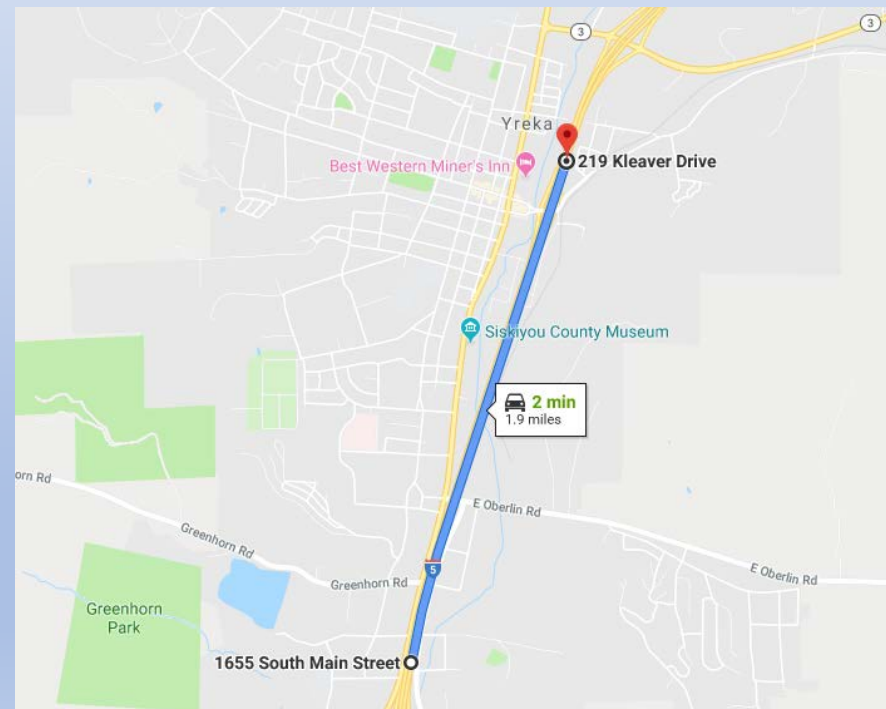
- TY: Always “TR” for normal lanes. (RM, EX, Etc.)
- **SP:** Capped Average Speed.
- **SU:** Uncapped Average Speed.
- FF: Free Flow Speed.
- JF: Jam Factor. -1 to 10.
- **CN:** Confidence Factor. 0.1 to 1.0 (DO NOT IGNORE)
- TS: Travers ability Status. “O”pen or “C”losed.

WARNING!
Not All TMC's Are Created Equal

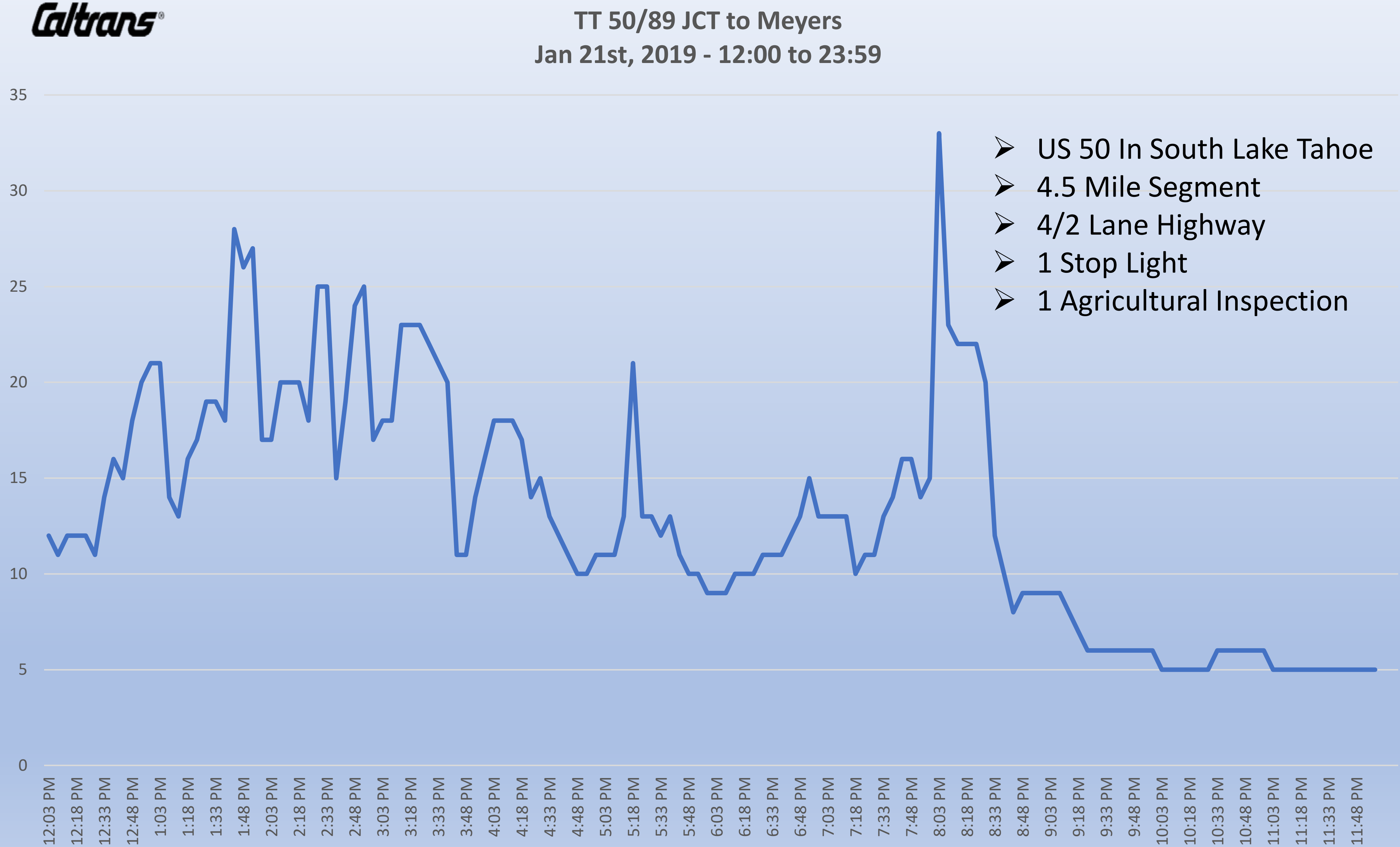
NPMRDS INRIX
105+05430 and 105P05430



HERE
105P05430



HERE in the Office – Actual CMS TT



- US 50 In South Lake Tahoe
- 4.5 Mile Segment
- 4/2 Lane Highway
- 1 Stop Light
- 1 Agricultural Inspection

From: Paula Peterson <tahoepaula@[redacted]>
Sent: Monday, January 21, 2019 8:15 PM
To: Nelson, Steve@DOT <steve.nelson@[redacted]>
Subject: Message boards in South Lake Tahoe

Hello...hope you had a nice holiday!

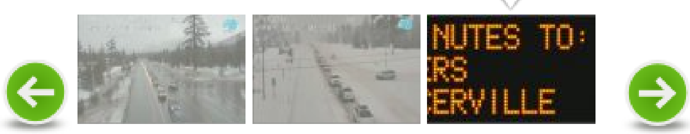
There is something off with the message board times posted in SLT. It took people between 2.5 hours and 3 hours to get from the Y to Meyers for most of the day but the sign said 11 minutes, or sometimes 14 minutes. its great if the signs are accurate so people know...many are turning back tonight as they've been on US50 for hours and not getting far. Of course that is a bigger issue, I'm just curious about the timing.

SouthTahoeNOW.com
Your One Stop for Lake Tahoe News & Information

Standstill on South Lake Tahoe area highway and streets; Groups looking into solution

Submitted by paula on Tue, 01/22/2019 - 8:44pm

A sign alerting motorists of the drive time was not accurate and well short of the actual.



Paula Peterson

SOUTH LAKE TAHOE, Calif. - It's almost a perfect storm for traffic in Lake Tahoe: extra visitors in town for the holiday weekend and epic ski conditions with snow and chain requirements over US50 and Echo Summit.

On Monday, locals and visitors alike were part of that storm, leaving motorists stranded along US 50, Lake Tahoe Blvd., and all surface streets in Meyers that have a link to the highway over Echo Summit.

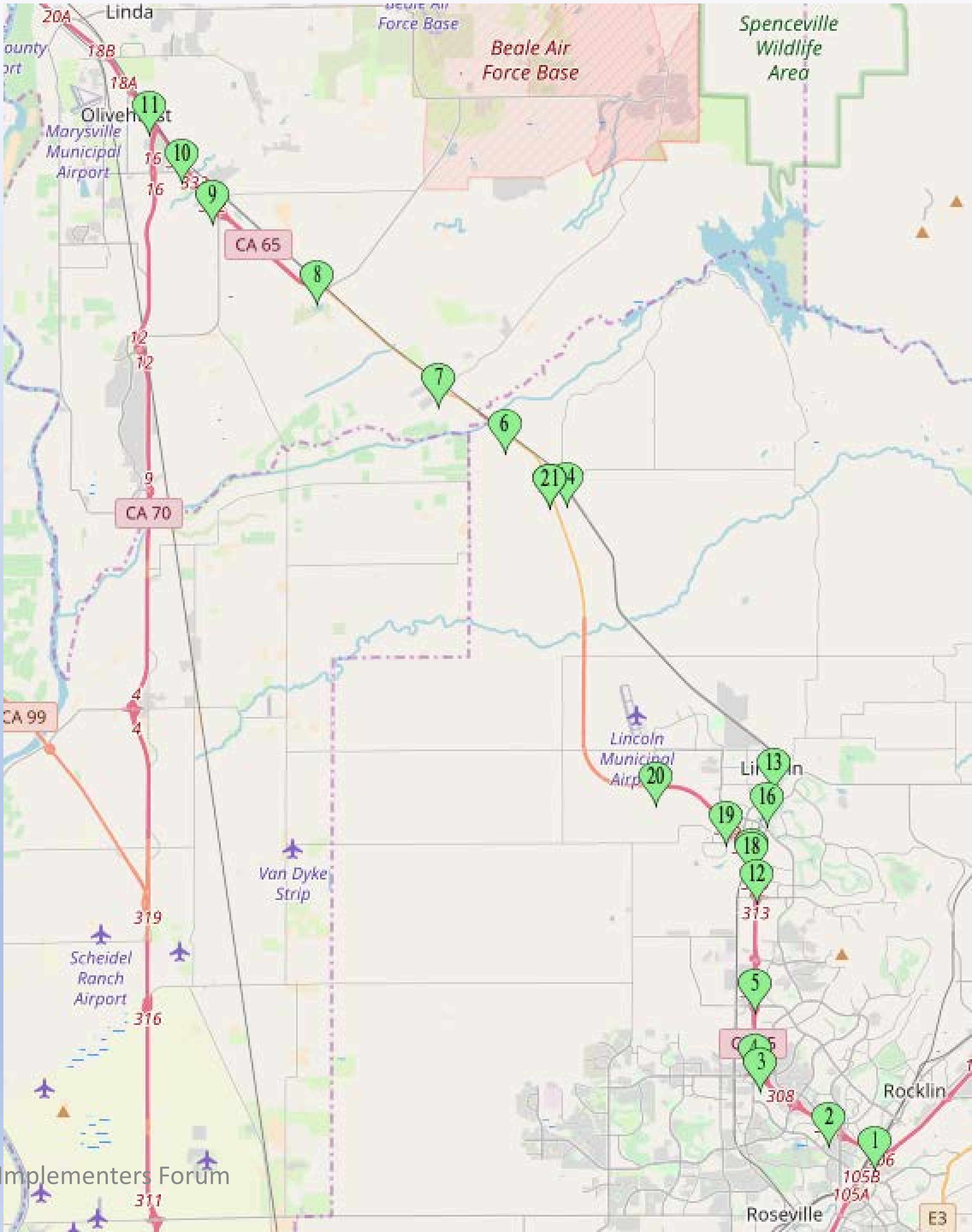
This isn't a new problem, but one that rears its ugly head on many Sundays and holidays throughout the year. And it's not just a South Lake Tahoe problem but one seen in Truckee and other towns across the west as populations grow.

TMC Gotchas

- Non Sequentially Numbered.
- Parallel Paths. -→
- Hardcoded Endpoints.
- 6 Month TMC Updates.

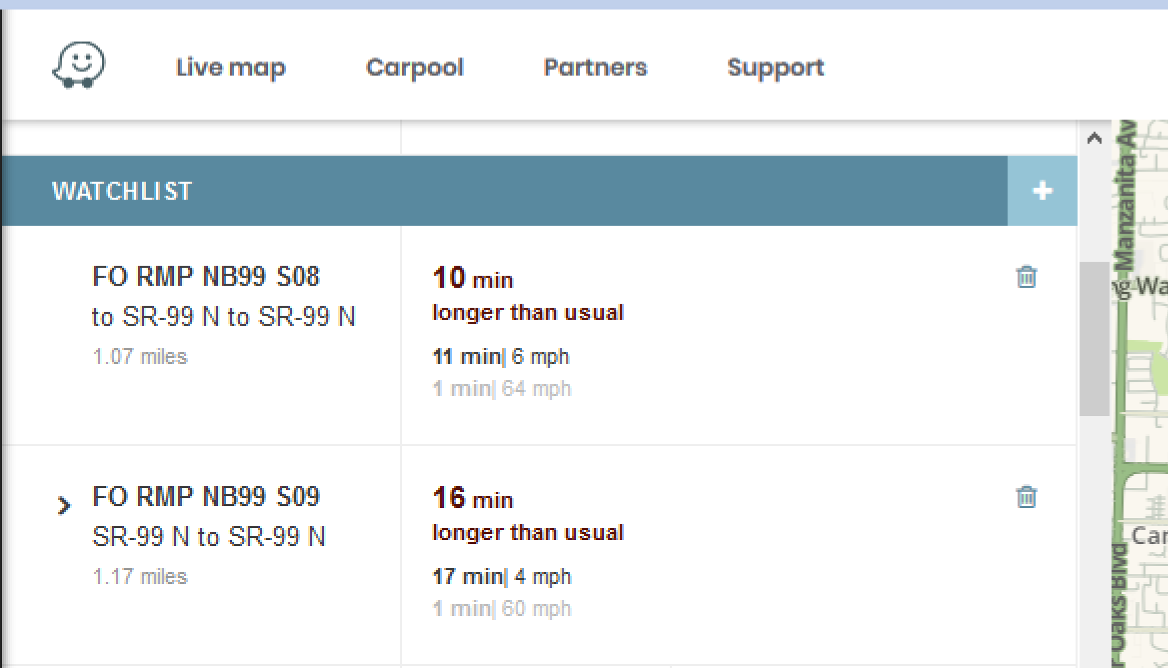
Create problems for ATMS.
ActiveITS is more resilient.

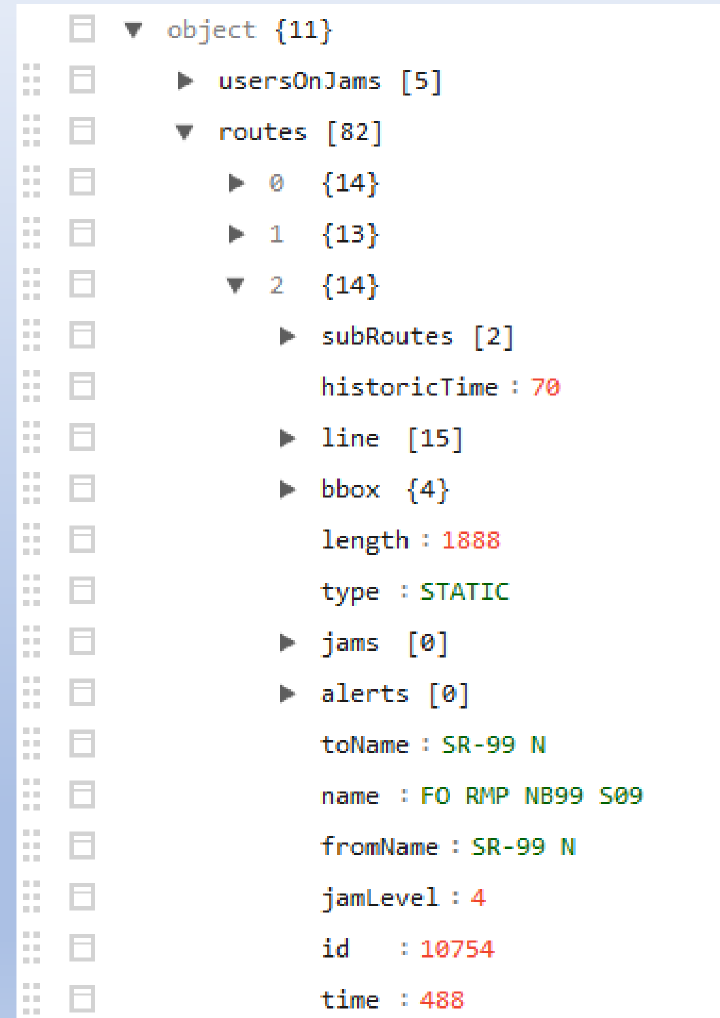
Do NOT ignore Confidence Factor



Waze 2nd Pass Pros

- JSON Feed
- Segment Definition
- Segment Accuracy (Immediate)
- TT Accuracy (In Seconds)
- Not Limited by TMC End Points
  - ¿Interpolated by Waze?





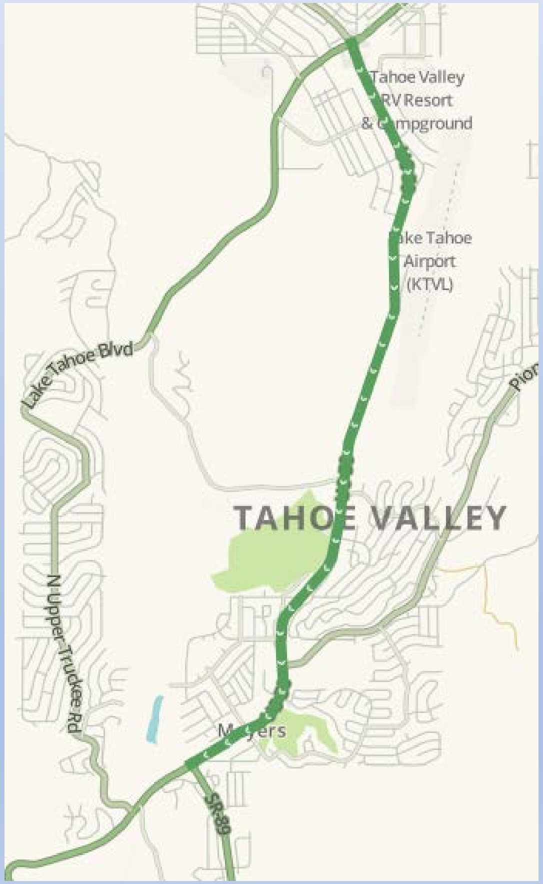
Waze 2^{nd} Pass Cons

Not Resolved in 2^{nd} Pass

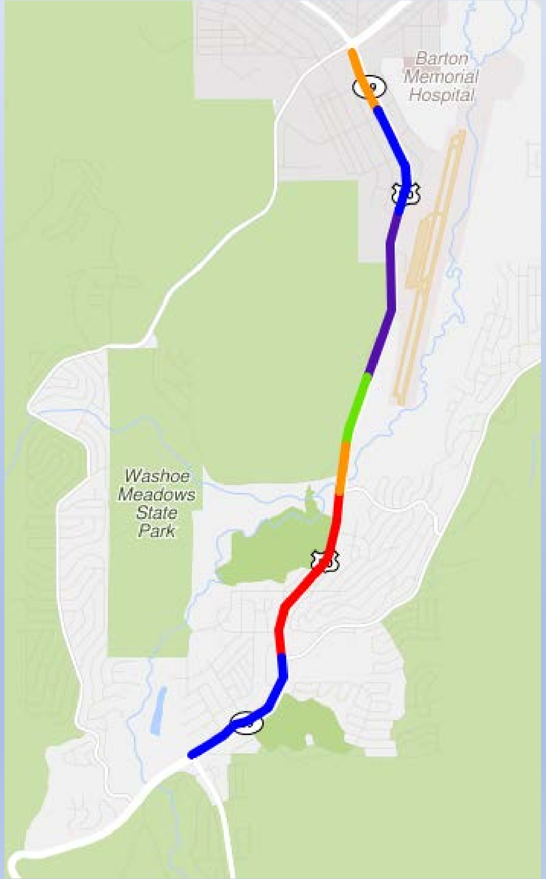
- Lack of Confidence Factor
- ATMS Integration (Velocity Spoofing)
- No Support for ActiveITS

SLT Revisited

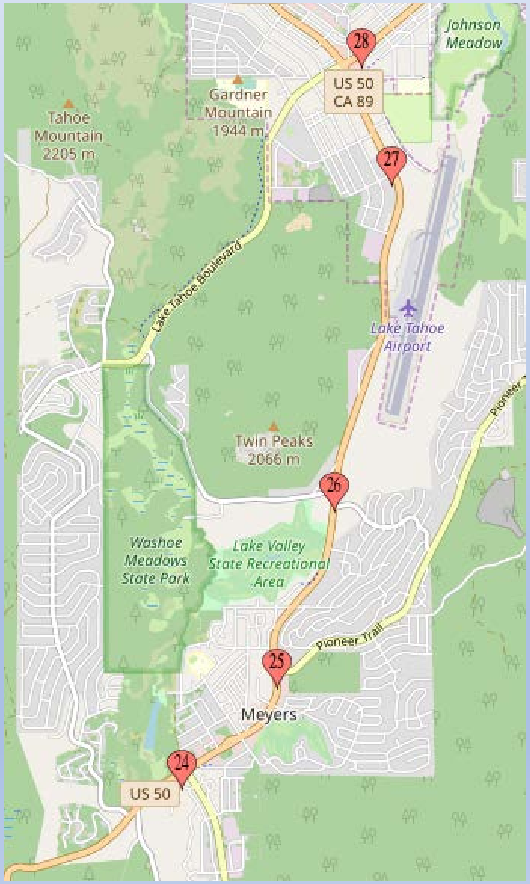
Waze
1 Easy Segment
4.83 Miles



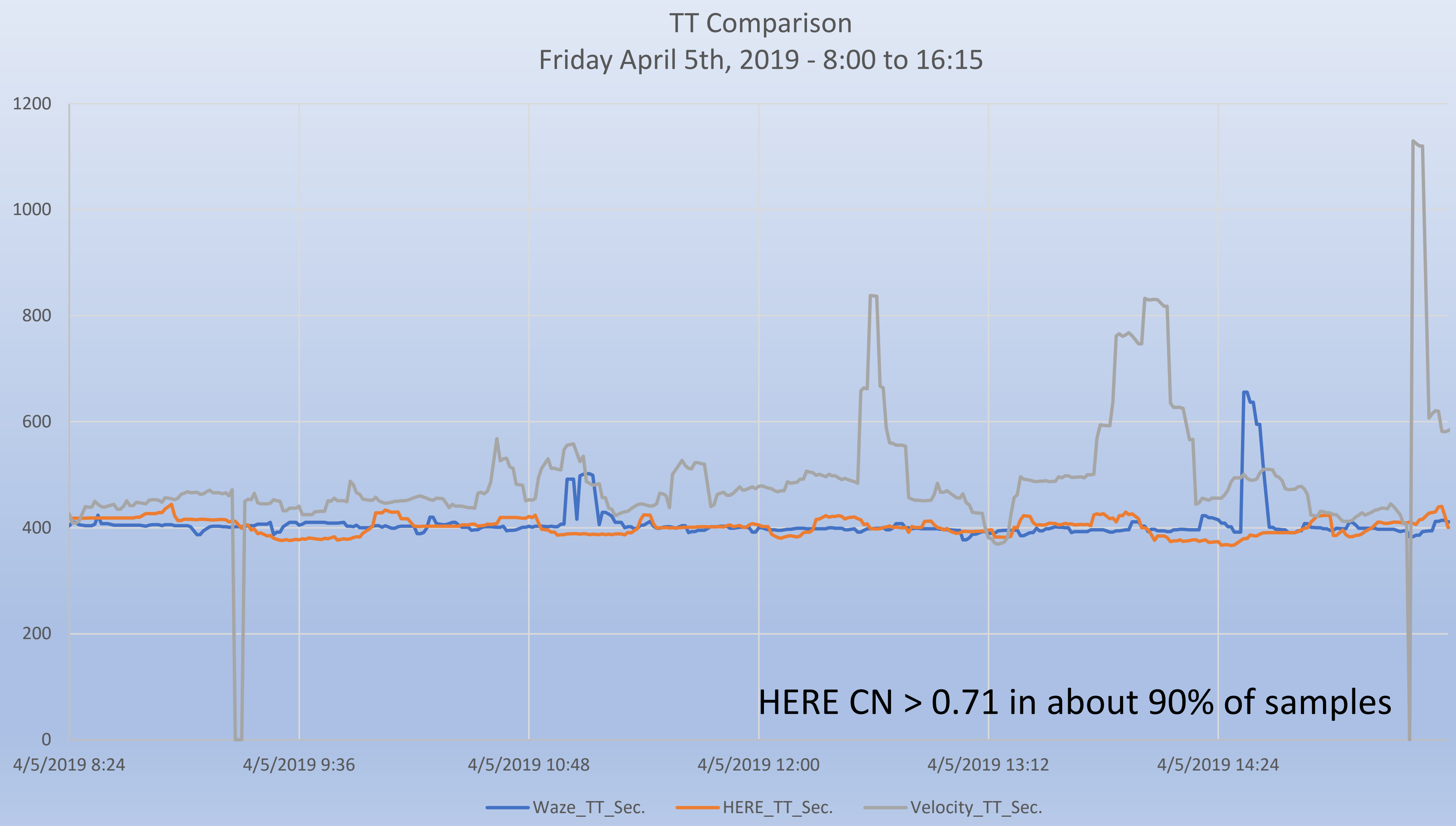
HERE
7 Fixed Segments
4.81



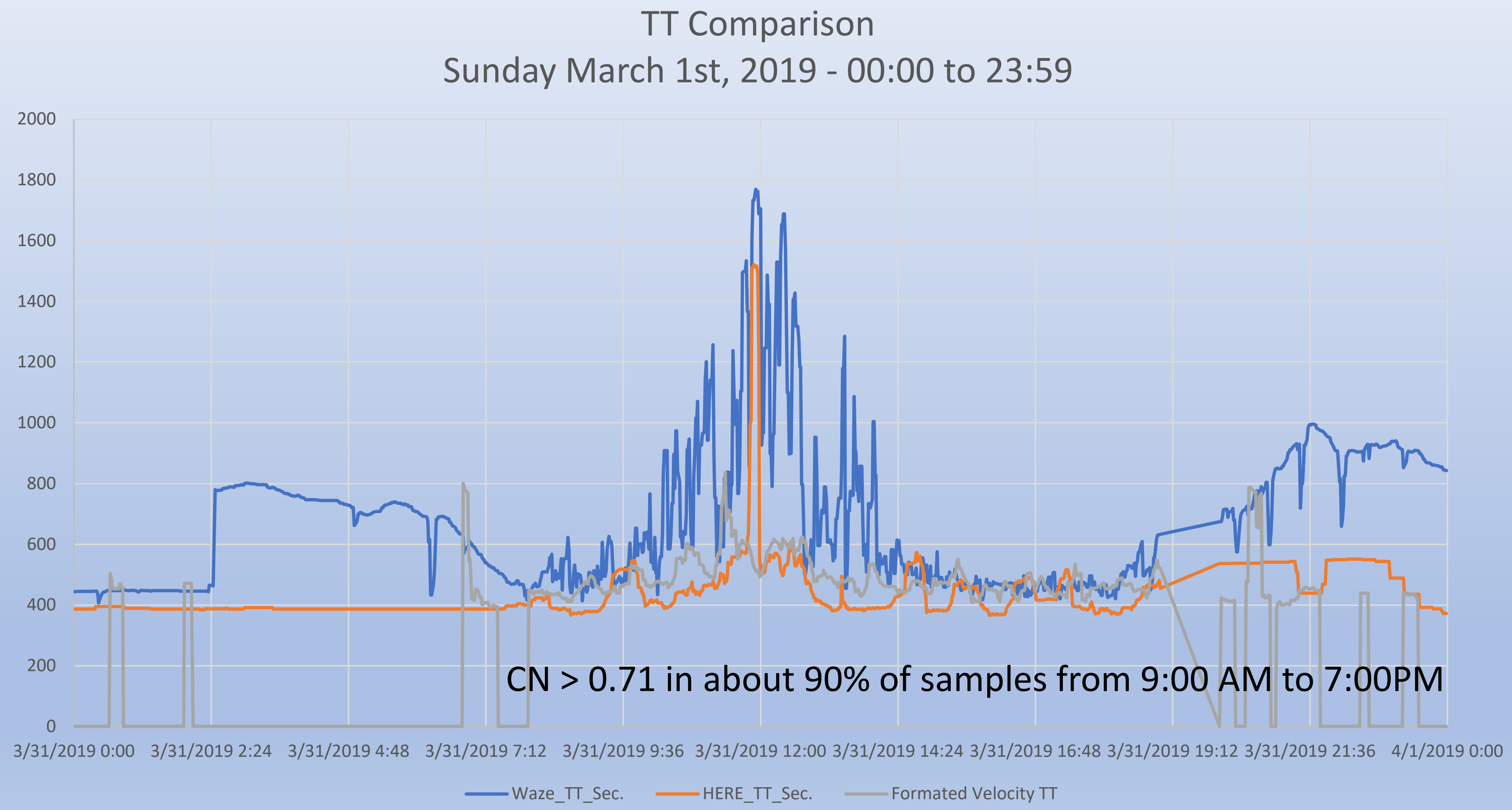
Bluetooth - Velocity
5 Readers, 4 Segments
5.01 Miles



SLT Revisited – Free Flow



SLT Revisited – Heavy Flow



Conclusion & Next Steps

- BTR's are out.
- Phasing out Loops. (ActiveITS)
- Jury is out on Waze vs. HERE.
- Tach Runs
  - Free flow with Traffic.
  - Free flow without Traffic.
  - Bad Weather.
  - Holiday Weekend (July 4th).

Q & A