The Eastern Transportation Coalition

Transportation Data Marketplace

TDM Validation Technical Advisory Committee Meeting

July 14, 2022

Welcome to the Meeting!

- VIDEO - You are welcome to turn on your camera by pressing the camera icon in the bottom left corner of your screen

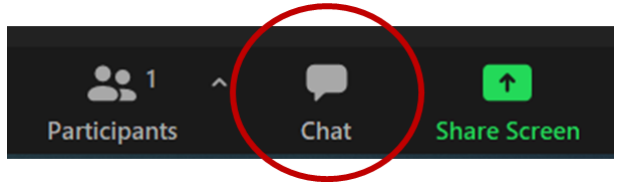
- AUDIO - Please select **ONE** of the following audio options:
    1. **Computer: Use your computer speakers and microphone by clicking the "Join Audio button at the bottom left of the screen (Preferred method of audio)**
    2. **Phone:** Call into the meeting by dialing the phone number based on your location (provided in the confirmation email) and enter the Meeting ID at the prompt

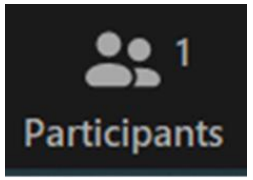
- **This web meeting is being recorded for internal use.**
- **Questions** with the audio or web? Please contact Esther via the Chat Box or email (ekleit@kmjinc.com)

Asking Questions

In the Chat Box

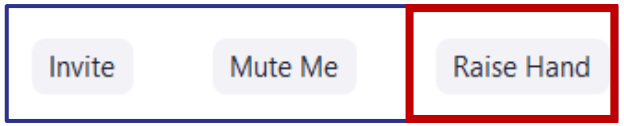
- You may pose your questions using the Chat Box. Click on the chat icon at the bottom of your screen
- The questions in the Chat Box will be monitored and answered at the end of each section.
- When responding to a message in the Chat Box, please indicate who you are referring to using the "@" symbol (ex. @John)





Verbally

- Please raise your hand *(click on the participants button at the bottom of the screen then scroll down to the bottom of the list of participants, and click on the "Raise Hand" button)*, and the host will call on you.



- Please give your name and agency before asking your question

- **Please mute yourself when you are done asking a question**

While you are not speaking….
Please confirm you are **MUTED**

Using your computer audio? Mute your computer mic

Using your phone? Mute your line

Thank
You!

Today's Speakers

Stan Young, PE, PhD
Chief Data Officer,
The Eastern Transportation Coalition

Zach Vander Laan,
Faculty Specialist
University of Maryland CATT

Mike Fontaine, PE, PhD
Associate Director
Virginia Transportation Research Council
Virginia DOT

Welcome

Participating Agencies

Connecticut DOT	Pennsylvania DOT
Delaware DOT	State of Rhode Island - Planning
Florida DOT	Tennessee DOT
Massachusetts DOT	Univ. of Kentucky/Kentucky Transportation Center
New York State DOT	Vermont AOT
North Carolina DOT	Virginia DOT

Today's Agenda

1. Results of Final VPPII Validation: PA – Work zones and tunnels
2. Volume Accuracy Literature Review
3. Product/Vendor Briefing Material
4. Results of Initial Volume Accuracy Tests
5. Plans for First State-Specific Volume Validation – North Carolina
6. Next Steps: Update on Targets and Priorities – TAC Feedback

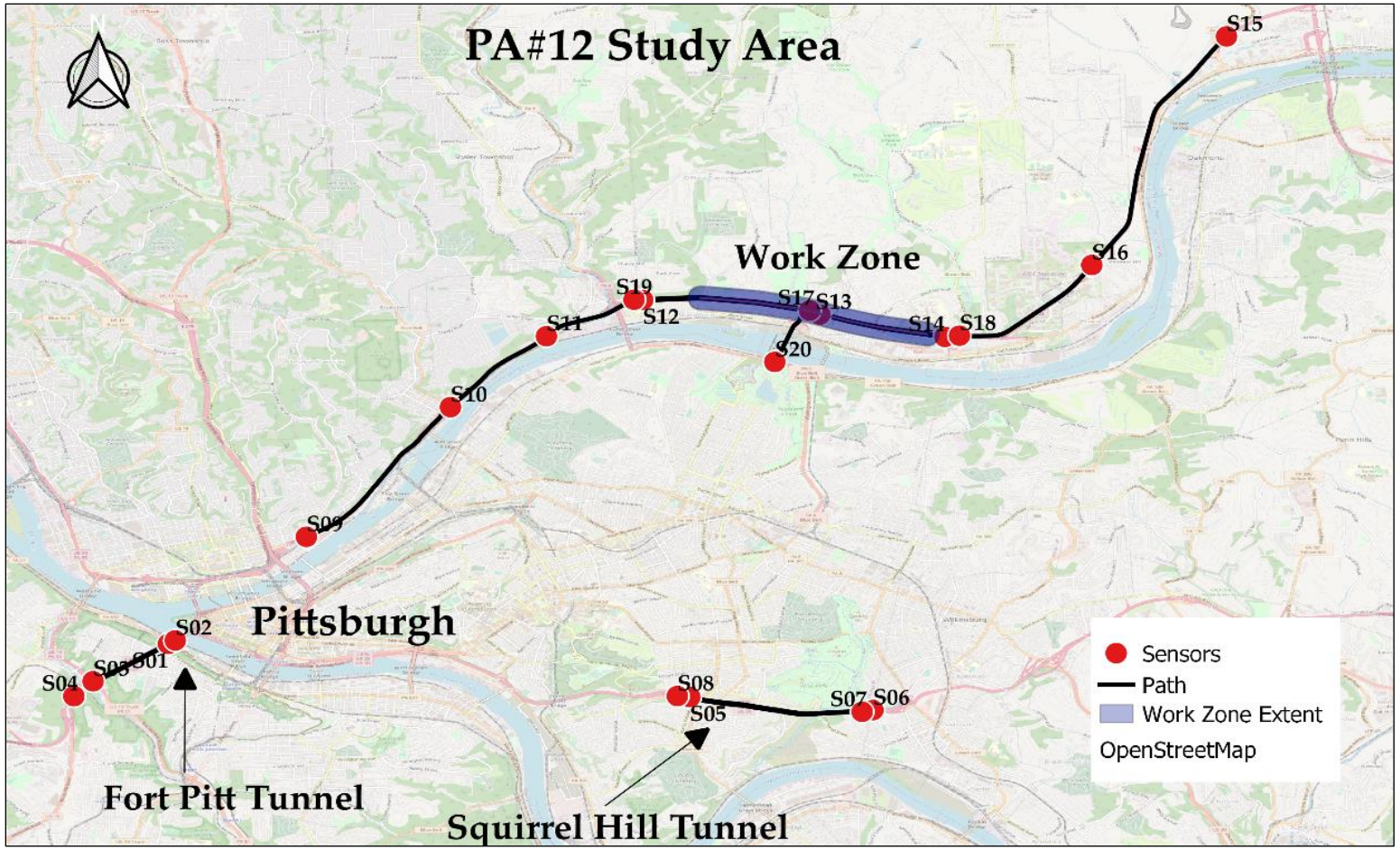
Results of Final VPPII Validation

Pennsylvania #12 – Tunnel Work Zone Scenarios

Study Area – Pittsburgh

Dates: October 26 – Nov 6, 2021

Corridor	Lanes	AADT	Speed Limit
I-376 (Tunnels)	2-4	95.8k	50-55 mph
PA-28 (Work zone)	1-4	54.0k	45-55 mph



Tunnels – Ft Pitt and Squirrel Hill

- Ft Pitt and Squirrel Hill tunnels characterized by:
  - High volume (96k AADT)
  - Regular fluctuations in travel time, some congestion
- Follow-up to 2017 study (Maryland), where multiple vendors struggled with accuracy in tunnels

Squirrel Hill

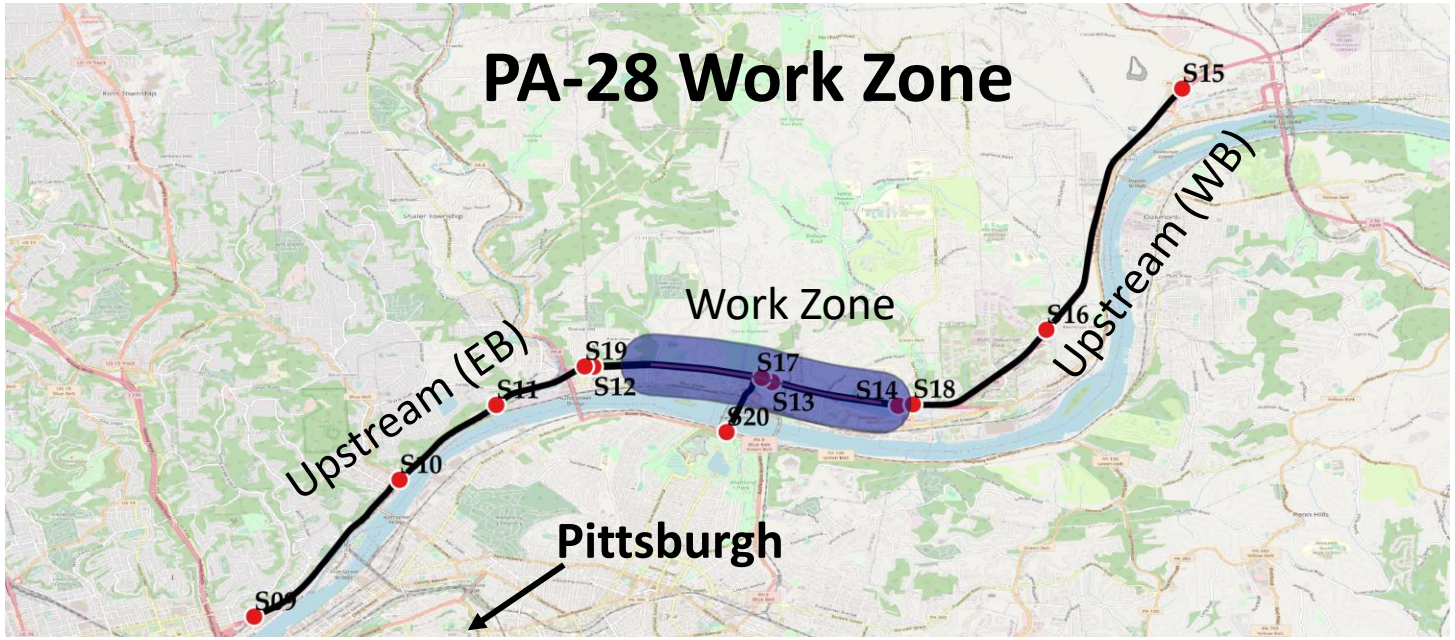
In 2017 all vendors significantly under-reported speeds in the highest speed bin

Speed Bin	AASE (Band)			SEB (Band)			# Observations		
	A	B	C	A	B	C	A	B	C
0-30	6.8	4.5	3.1	-1.8	-0.3	0.3	834	233	762
30-45	5.8	3.0	3.4	2.8	-0.9	-2.7	1915	523	1823
45-60	4.3	3.7	7.2	-0.3	-3.7	-7.2	5790	2514	5574
60+	6.8	8.3	18.4	-6.6	-8.3	-18.4	3368	3181	3278

Fort Pitt

Work Zone: PA-28

- Work zone location along PA-28 selected in consultation with PennDOT
- Long-term project (entire duration of data collection) -- Eastbound and Westbound
- Focus area is within and upstream of Work Zone (presumably where congestion will spill back)



Google Maps (Sep 2021)

General Observations

1. **Dense reference data -- able to characterize traffic conditions with high fidelity**
   - High volume roadways without many access points – minimal lost through traffic
   - ~ 5% penetration rate

2. **Both tunnel and work zone scenarios contained non-trivial traffic conditions**
   - Recurring and non-recurring congestion associated with busy urban freeways
   - Work zone traffic patterns may deviate from historical patterns

3. **Traditional error measures work well for this study area**
   - Traditional analysis was designed for freeway facilities and speeds
   - Not an edge case, but challenging mainstream

4. **Visual inspection also useful for understanding traffic patterns and evaluating performance**
   - E.g., did vendors capture progression of congestion across segments?

Findings -- Tunnels

- **All vendors demonstrated excellent average accuracy levels on tunnel segments**
- Much better avg accuracy than in 2017 – good news!

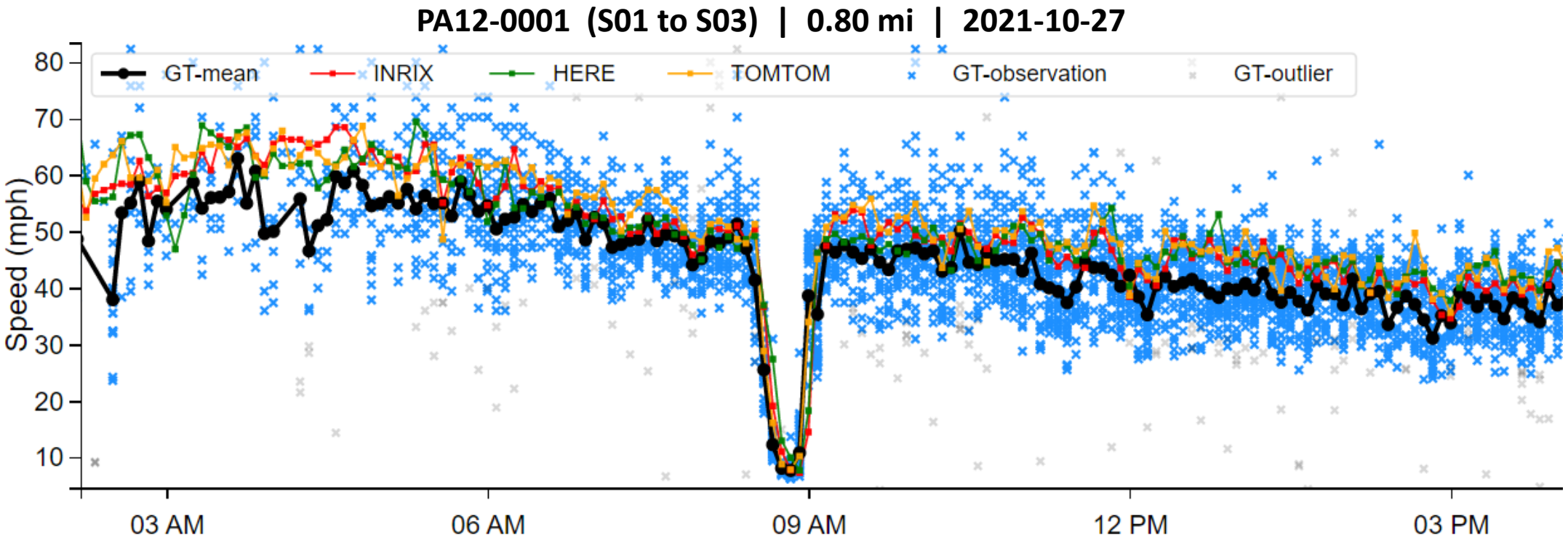
VPPII Specs (freeways)
- AASE: 10 mph
- SEB: +/- 5 mph

TDM Specs (freeways)
- AASE: 5 mph
- SEB: +/- 4 mph

TUNNELS ONLY – HERE					
Speed Bin	Average Absolute Speed Error (AASE)		Speed Error Bias (SEB)		Number of 5 Minute Samples
	1.96 SEM Band	Mean	1.96 SEM Band	Mean	
0-30	0.92	1.87	0.55	0.72	1293
30-45	2.15	4.22	1.56	2.84	2811
45-60	1.46	4.64	1.26	3.52	5702
60+	1	4.77	-0.73	-2.56	720
All Speeds	1.55	4.2	1.12	2.58	10526

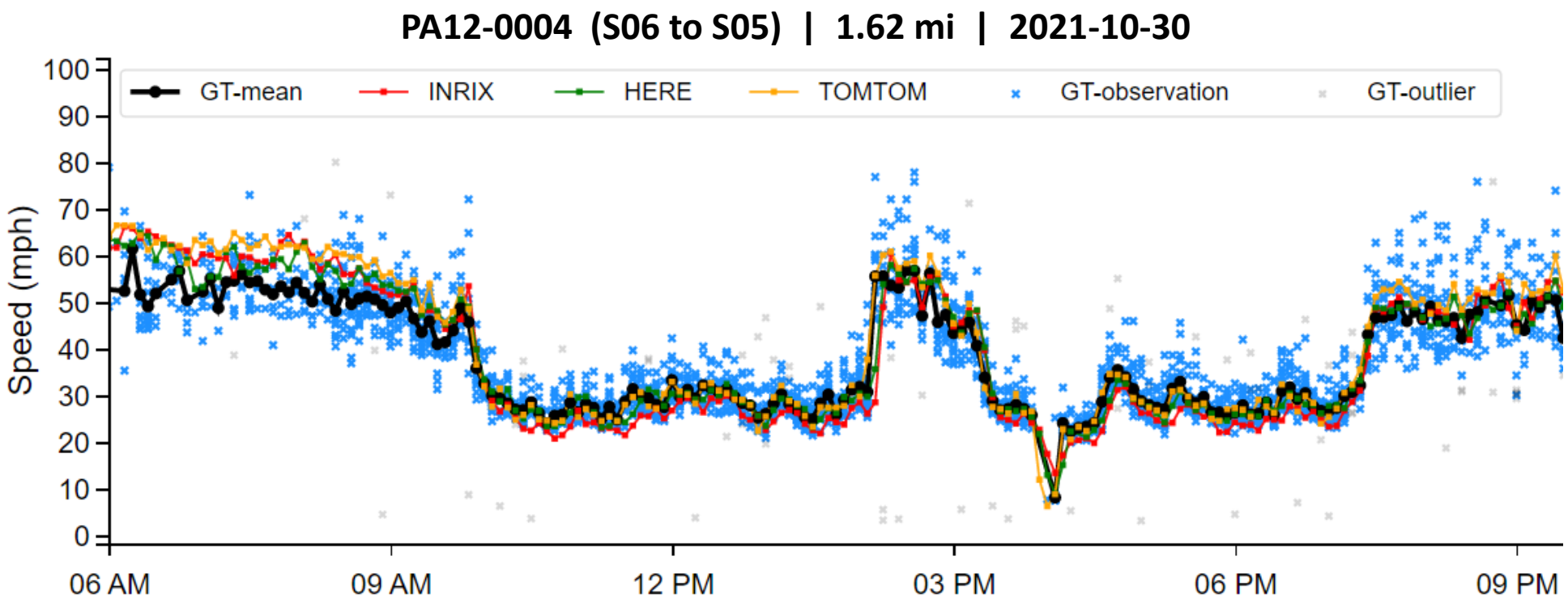
Tunnels – Ft Pitt Example

- Dense reference data
- All vendors capture congestion event with minimal latency/bias
- All vendors within spec during non-congested period (slightly higher speeds)



Tunnels – Squirrel Hill Example

- All three vendors track reference data very closely – very encouraging!



Findings – Work Zone (1/3)

- All vendors demonstrated excellent average accuracy levels on WZ segments

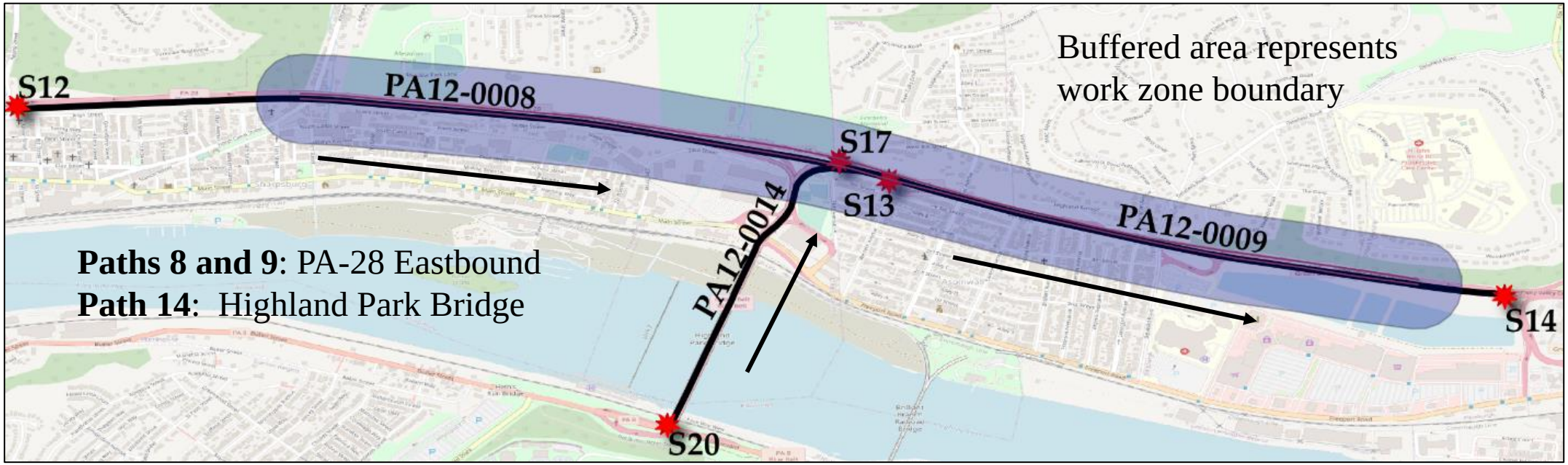
VPPII Specs (freeways)
- AASE: 10 mph
- SEB: +/- 5 mph

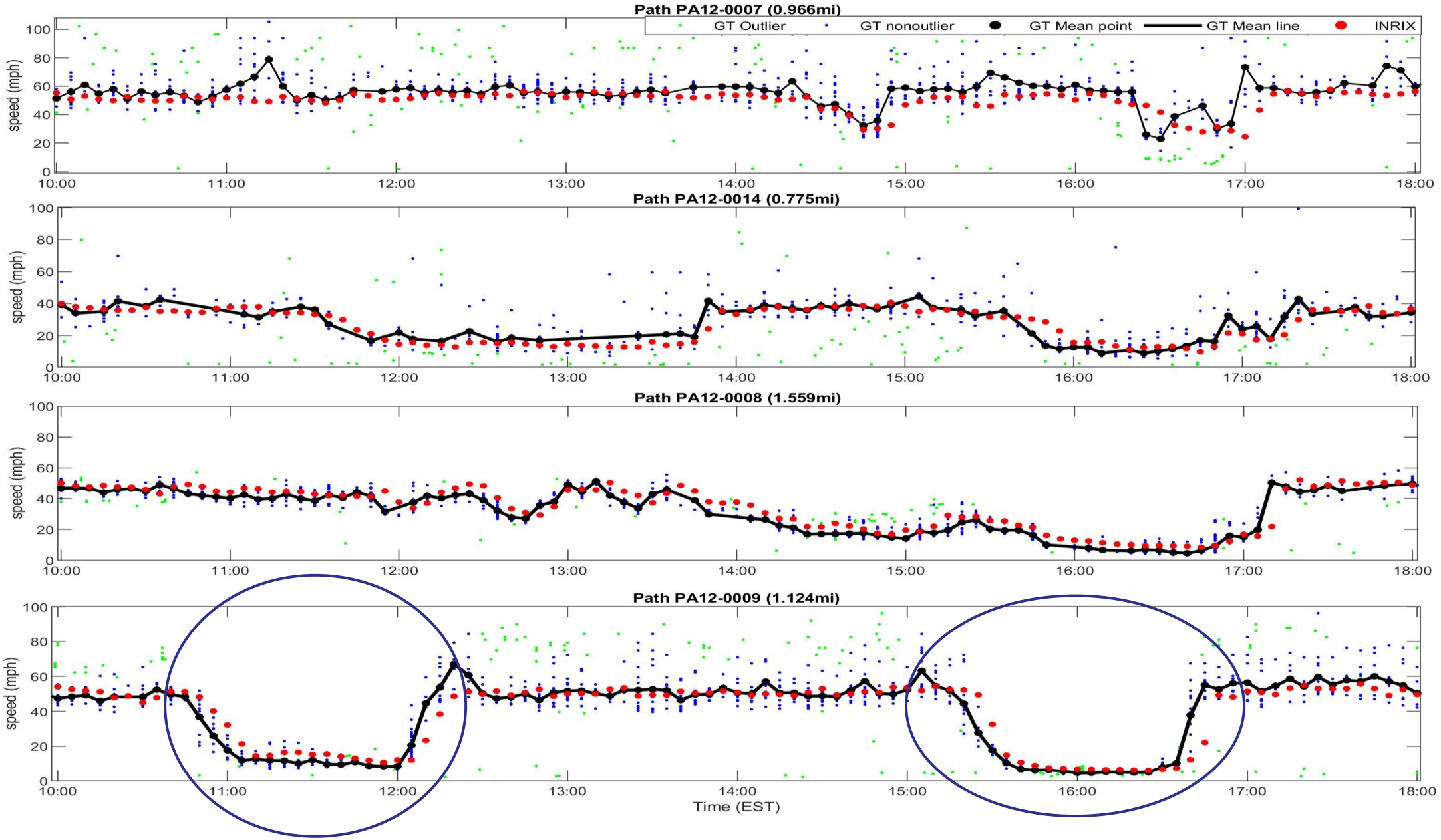
TDM Specs (freeways)
- AASE: 5 mph
- SEB: +/- 4 mph

TUNNELS ONLY – TOMTOM					
Speed Bin	Average Absolute Speed Error (AASE)		Speed Error Bias (SEB)		Number of 5 Minute Samples
	1.96 SEM Band	Mean	1.96 SEM Band	Mean	
0-30	0.44	1.3	-0.07	-0.24	1303
30-45	2.27	4.32	2.05	3.52	2864
45-60	2.79	6.51	2.73	6.13	5714
60+	0.68	4.09	0.01	0.59	720
All Speeds	2.22	5.12	2.02	4.26	10601

Findings – Work Zone (2/3)

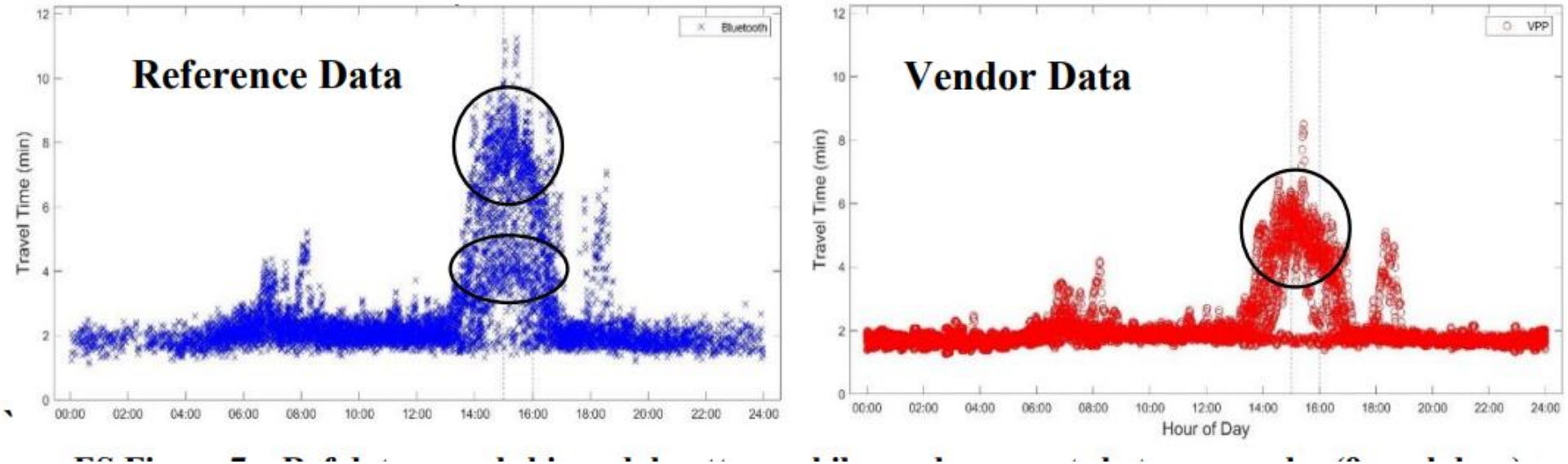
- **Visual inspection shows all vendors capture congestion patterns at work zone**
- Example: Eastbound on PA-28 (plots on next 2 slides)




Path PA12-0007 (0.966mi)
GT Outlier
GT nonoutlier
GT Mean point
GT Mean line
INRIX
speed (mph)
Path PA12-0014 (0.775mi)
Path PA12-0008 (1.559mi)
Path PA12-0009 (1.124mi)
Time (EST)

Findings – Work Zone (3/3)

- **Bi-modal travel times are occasionally observed along some segments**
  - Can be difficult to properly filter reference data
  - Reference mean can be in between legitimate modes – or closer to one
  - Vendors sometimes in between modes

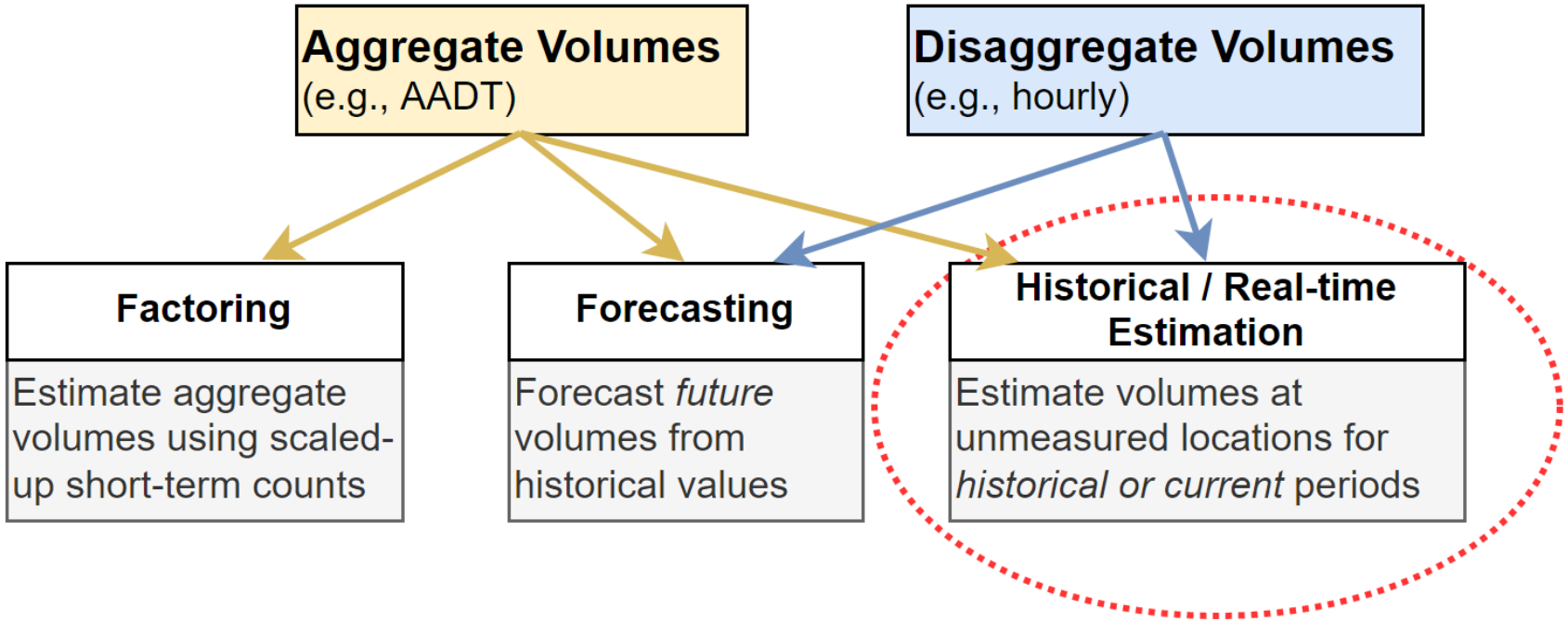


Volume Accuracy Literature Review

Overview

- Prepared tech memo for TAC – will be distributed shortly
  - Part 1: Review of Volume data items from RFP
    - AADT, ADT, AHDT, hourly volumes are *Mandatory (M)*, sub-hourly volumes are *Highly Desirable (HD)*
  - Part 2: Literature Review of volume validation / accuracy
  - Part 3: Recommendations

Lit Review – Volume Estimation



*In each case we focus on **how accuracy is quantified***

Lit Review – Validation considerations

Important validation characteristics to consider:

- **Reference data source**
  - CCS is “gold standard” but usually publicly available
  - Other permanent counters
  - Short-term counts – useful, but depends on use case
- **Temporal granularity**
  - Hourly – analysis straightforward
  - Aggregate – lots of reference data needed (or error-prone factoring)
- **Evaluation methods**
  - Error metrics / statistical tests, reporting scenarios, visuals

Lit Review – most relevant studies

- **FHWA Pooled Fund Study (2018-2021)**
  - Streetlight (vendor) estimated AADTs nationwide & produced multiple reports
  - TTI / NREL conducted independent evaluations of data quality

- **TETC Volume and Turning Movement Project (2016-2020)**
  - Surveyed state DOTs to understand hourly volumes accuracy that would be considered “useful”
  - NREL / UMD research teams developed probe-based volume estimates and developed cross-validation framework for self-reporting accuracy

- **Evaluations of commercial probe-based AADT estimates (2017-2021)**
  - TTI evaluation of Streetlight AADT – Minnesota DOT
  - TTI / Virginia Tech evaluation of Streetlight AADTs
  - TTI evaluation of Streetlight AADT at Border crossings
  - Oregon DOT evaluation of Streetlight AADTs
  - Louisiana DOT evaluation of Streetlytics AADTs

- **TETC Hurricane Demo Project (2020)**

Initial Recommendations

- **Focus initially on hourly, rather than aggregate estimates**
  - Easier to conduct truly blind evaluation using a variety of count sources
  - Hourly volume accuracy not well-characterized in the literature
  - Represents “novel” data item well-suited for operations – need to benchmark!

- **Consider cross-validation “audit” to supplement blind analysis – especially for aggregate estimates**
  - Audit vendors’ reported accuracy at “held-out” locations – make sure data supports claims
  - If paired with blind study, how closely does self-reported accuracy agree?

- **Seek to benchmark accuracy /characteristics of non-CCS count sources before using for validation purposes**
  - E.g., test measurement error in short-term counts conducted by Coalition
  - Acknowledge error associated with scaling-up short-term counts (for aggregate volumes)

Initial Recommendations (continued)

- **Compute a variety of error metrics and visualize their distributions**
  - There is no "optimal" metric – pros/cons to each (e.g., some volume-sensitive)
  - Key metrics include:
    - Signed Error & Absolute Error
    - Percent Error& Absolute Percent Error
    - Error to Capacity Ratio (identified by DOTs in VTM project)
    - Correlation and/or R^2
  - Report mean/median/key percentiles to capture **accuracy** and **precision**
  - Report metrics by scenario. E.g.,
    - Volume level
    - Urban/Rural
    - Road Class

Soliciting Feedback from TAC

- Please read tech memo and provide written feedback to Validation team
  - Stan Young: seyoung@tetcoalition.org
  - Zach Vander Laan: zvanderl@umd.edu

Deadline: **7/29/22** (2 weeks from tomorrow)

Product/Vendor Briefing Material

Volume Vendor Comparisons ---

- Comparative Vendor Volume Data Specification Responses
- Available at the following
  - https://app.box.com/s/ugcy651099eldlrros4gv91xxx82hc2p
- Provides a matrix (Microsoft Excel Spreadsheet) comparison of vendor responses
- Examples follow…

Responses for Hourly, and Real-time Data, Spec 2.1.4 & 2.1.8

Volume Data Requirements		
Objective:		
2.1.4	Vendor shall provide historic estimated volume data reported as estimated Hourly Volumes Flows specific •to the day of year and •to the hour of the day. Example – estimated volume for June 5, 2019 from 2-3 PM is 3468 vehicles	**M**
2.1.8	Vendors may provide real time Sub-Hourly volume flows	**HD**

VENDORS			
INRIX	**HERE**	**STREETLIGHT DATA**	**ITERIS**
NRIX Core Volume Data Service will include an hourly volume archive for Freeways and Major Arterials (AADT of 20,000+), with each month's archive generated after the end of the month.	Bentley is able to provide hourly vehicle volume by day of year and hour of day as a custom, on demand product.	Yes, historical hourly volume estimates can be reported for day of the year and hour of the day.	Yes
We are reviewing approaches to introduce real-time volume data, but believe it will be later in the TDM contract period before this is possible with reasonable accuracy/confidence.	Bentley is able to provide real time sub-hourly vehicle volume by day of year and hour of day as a custom, on demand product.	Sub-Hourly Volume Flows are not currently available in real-time. We do not have explicit timing for providing sub-hourly flows in real-time.	Yes, Iteris plans to provide real time Sub-Hourly volume flows at 15 minutes granularity.

Results of Initial Volume Accuracy Run

Overview

BACKGROUND

- Planning to use short-duration counts as part of volume validation strategy alongside permanent counters
- Objective: Understand accuracy/fidelity of portable and permanent counting equipment

PLAN

- Deployed 2 portable radar counters next to Automatic Traffic Recorders (ATR) in Maryland for 1 month to see how closely they would match
  - I-70 E of Frederick: 3 lanes each direction, ~60k AADT
  - MD-4 in PG county: 2 lanes each direction, ~37k AADT

Preliminary Findings

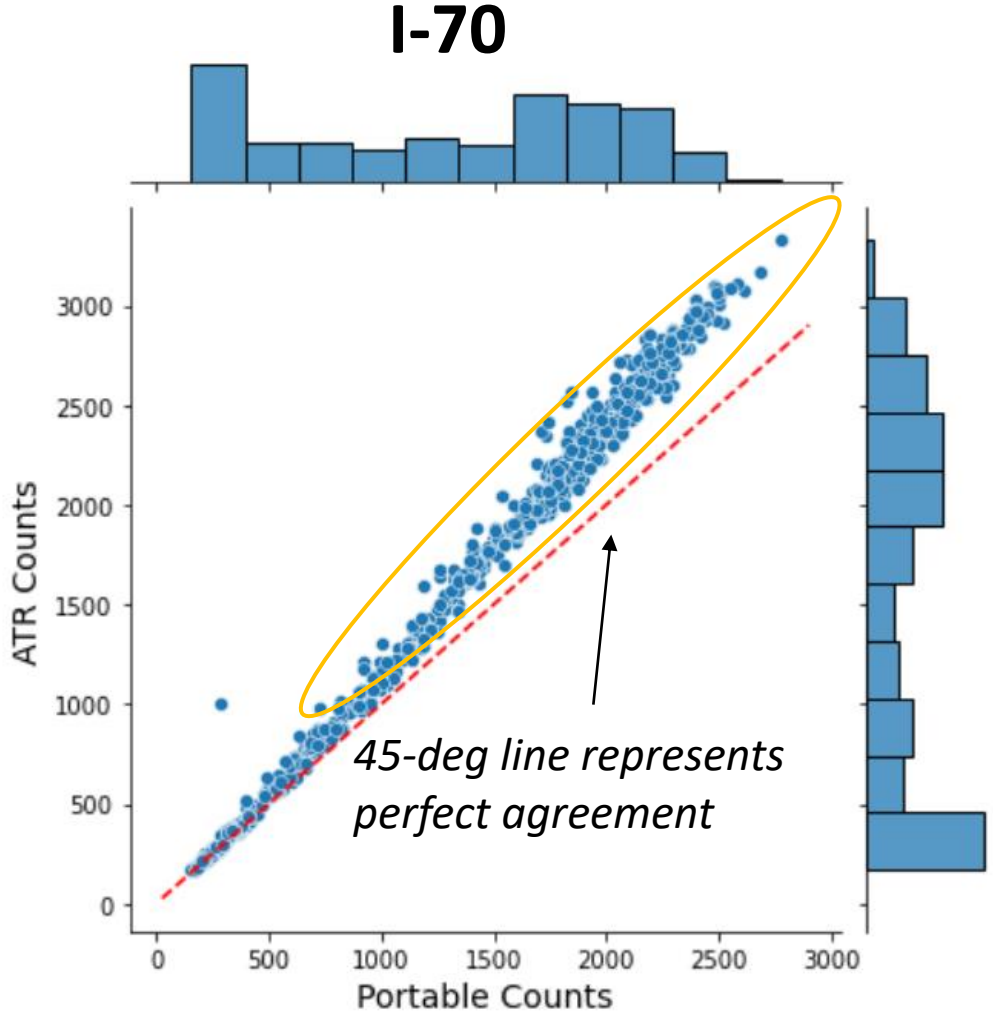
Location	# 1-hr Periods	Signed Error (veh)		Percent Error (%)		Absolute Percent Error (%)	
		Mean	Median	Mean	Median	Mean	Median
I-70 EB	772	-247	-260	**-13.1**	-14.6	13.2	14.6
MD-4 WB	834	-127	-123	**-15.0**	-14.7	15.0	14.7

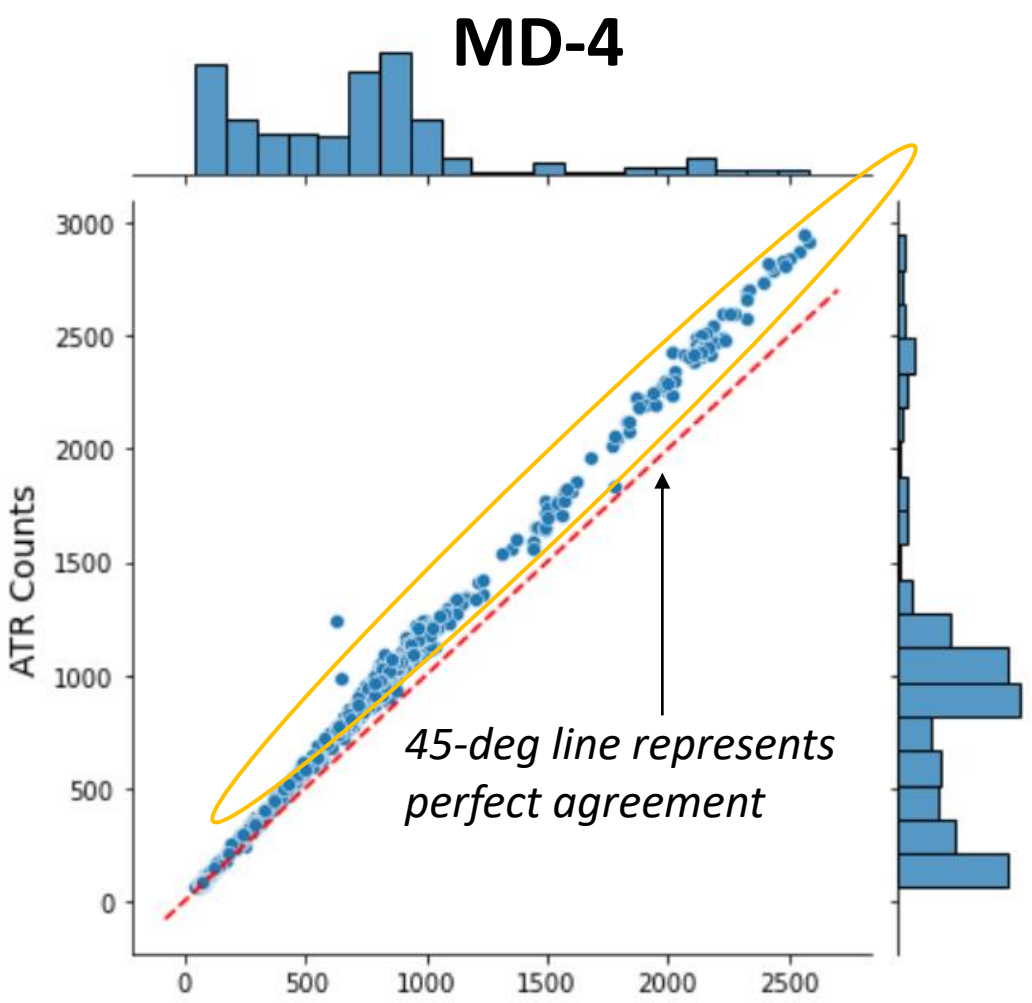
SUMMARY

- Consistent under-counting of 13-15% across volume ranges – though pronounced at higher volumes on I-70
- Planning to consult with equipment vendor

** These values should not be interpreted as being representative of portable counter (or radar) accuracy*

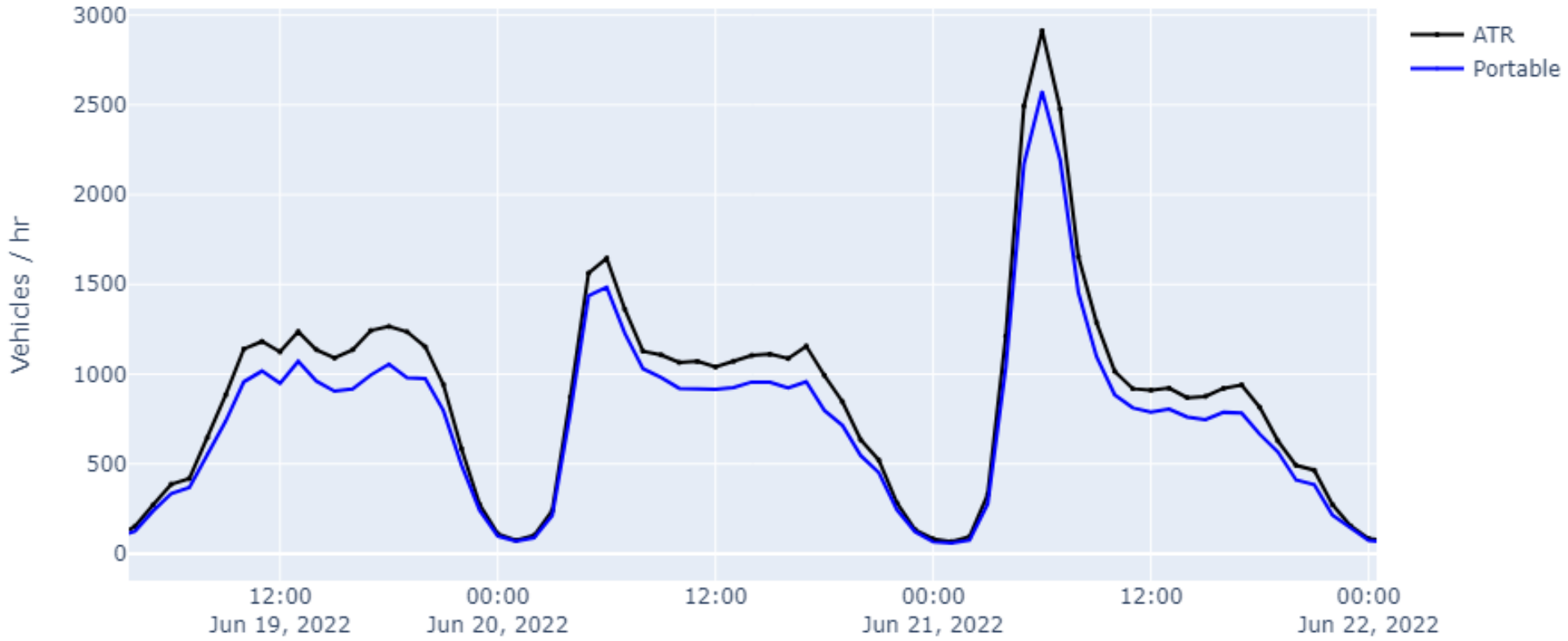
ATR vs portable counts





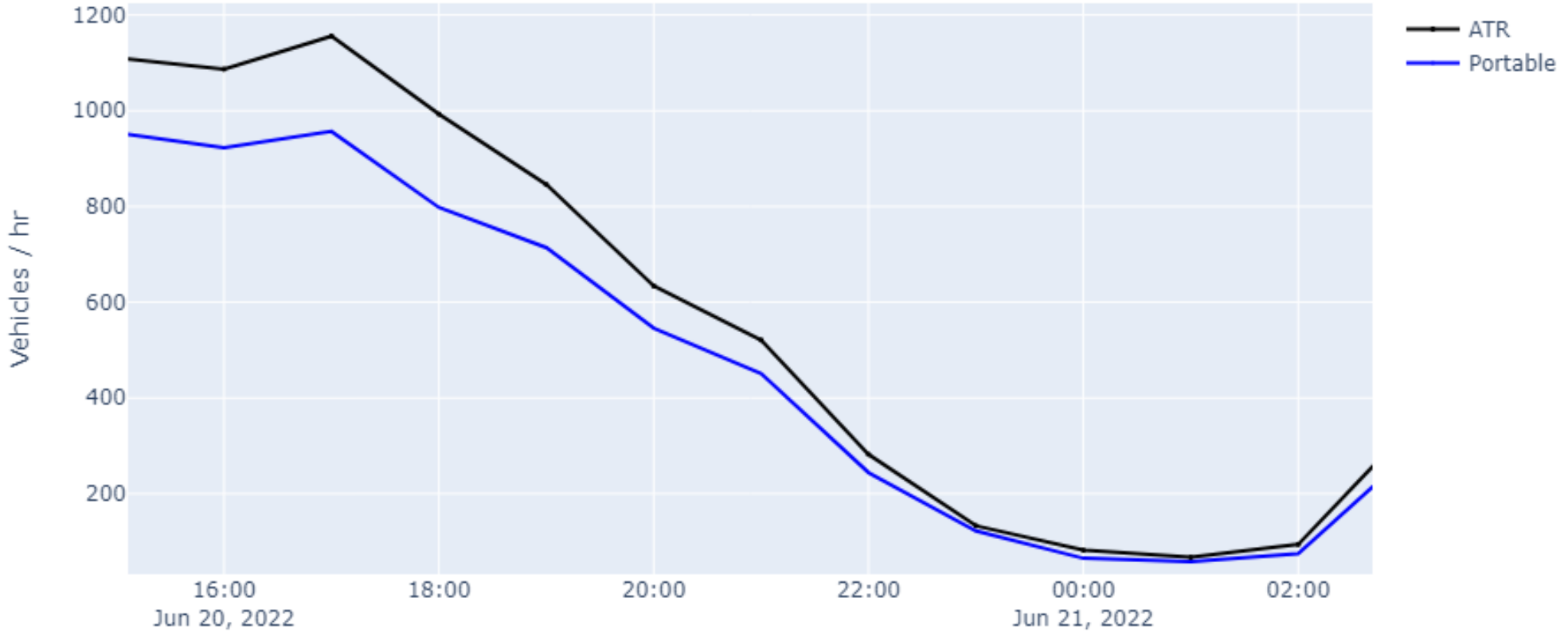
Example time series (MD-4)

Under-counting is particularly evident during peaks



Example time series (MD-4)

... but also occurs at lower volumes



Next Steps

- Investigate sources of discrepancy
  - mounting/calibration
  - placement in field relative to ATR
  - ATR accuracy (check with MDOT-SHA)
- Continue testing and incorporate additional technologies (videos & tubes) for comparison with permanent counters
- Determine level of error that is viable for validation purposes

Plans for First State-Specific Volume Validation - Discussion

Volume Validation Exercise in Q3

- Target first volume data collection / validation / exercise
  - May also include Travel Time
- Objective is to test data structures, methods, and metrics
- Focus – North Carolina
  - Volume products and Travel time & Speed products

Challenges

- Ingesting and processing data from multiple vendors
  - Varying data formats
  - Varying segmentation (map) schemes
  - Un-certain data latency (Travel Time)
  - Solution – implementation of Geo-Referencing Standard and API
- Ground truth (reference) volume data – how accurate
  - Deploy count equipment during data collection period
- Processing data
  - How efficiently can Coalition process up to nine data sets (5 Travel Time and 4 Volume) – goal is to invite others as well

Timeline

- Brief and prep vendors : +2 weeks
- Coordination with North Carolina
  - Make calibration data available from North Carolina
  - Collect four weeks of permanent and temporary counts
  - Deploy travel time and count equipment
- Data and Metrics –
  - Implement data collection from vendors with CATTWorks Georeferencing protocol
  - Select metrics from literature review
- Goal – Report on progress in September

Quarterly Targets / Pace

Current Quarter Apr 2022 – Jun 2022	Next Quarter: Jul 2022 – Sep 2022	Next Quarter: Oct 2022 – Dec 2022	Next Quarter: Jan 2023 – Mar 2023
TAC Meeting – April 12	TAC Meeting – July 2022	TAC Meeting – Oct 2022	TAC Meeting – Jan 2022
TAC Overview	PA Travel Time Results	Initial volume test results	Travel Time Results?
GA Travel Time Results	Volume lit review	OD Lit review	OD test plan
TAC Organization	Volume test plan		
Discussion of Priorities	TDM data comparison		
Activities – to Jun 30	Activities – to Sep 30	Activities – to Dec 31	Activities – to Mar 31
Complete PA report	Initial volume test	Plan 2nd volume test	Initial OD test?
Test volume sensors	OD lit review	Traditional validation?	Plan second volume?
Volume lit review		OD test plan?	Other?
Volume test plan		Other?	
TDM data comparison			

Next Steps

Proposed Deliverables – Next TAC

- **Next TAC meeting - October 11, 2022 (1:00pm-2:30pm, ET)**
- Agenda
  - **Results/Status of first volume data validation - NC**
  - OD Literature review
  - Volume (with travel time) course adjustments (as needed)
- Update on targets and priorities – TAC feedback
  - Discussion of Volume Validation priorities
  - Next quarter targets

Wrap Up

QUESTIONS?

Thank You!

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