

MDTA Dedicated Short Range Communication (DSRC) Pilot Project

V2I DC Strategic Initiatives Working Group

January 23, 2020

Agenda

- Introduction
- Project Background
- Implementation Details
- Architecture Concept
- Post-Installation Support
- Lessons Learned
- Open Discussion



Introduction

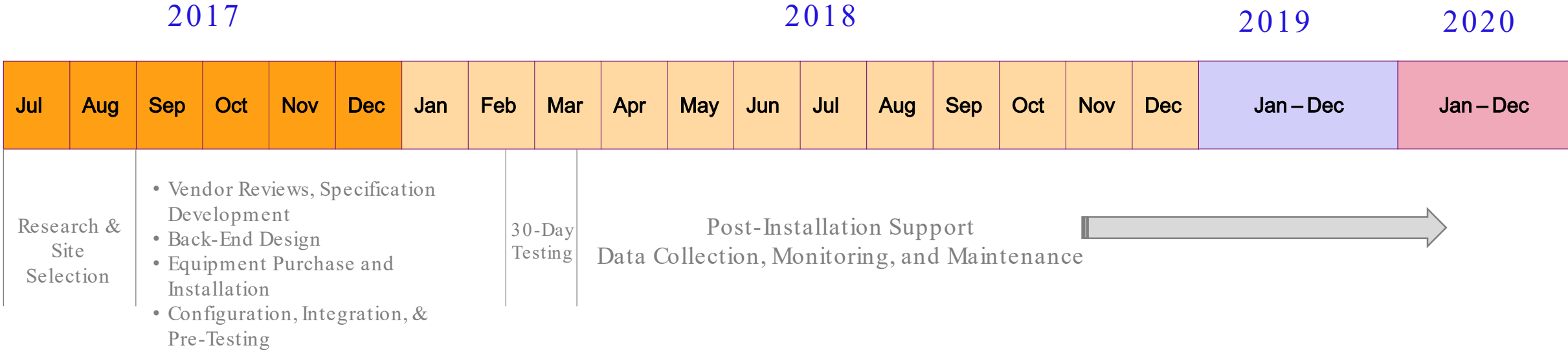
- Pilot initiative implemented by the Maryland Transportation Authority (MDTA)
- Design, install, and test Dedicated Short Range Communication (DSRC) equipment along MDTA facilities.
- Pilot Project Initiated in July 2017



Project Background

- Pilot Project to design, install, and test Dedicated Short Range Communication (DSRC) equipment along MDTA facilities.

Project Timeline



Phase 1 Pilot Project Goals

- Collect, store, and report on Basic Safety Message 1 (BSM) data received from up to 4 Roadside Units (RSUs)
- Gain better understanding of BSM1 message content and penetration of equipped vehicles
- Identify possible future applications/uses of DSRC BSM1 data
- Develop Backend Software, troubleshoot, maintain & monitor installed equipment



Implementation

- Four (4) RSUs
- Two OBUs in MDTA Vehicle Recovery Trucks
 - Cohda Wireless OBU
 - Lear Locomate OBU
- FHWA OBUs on short-term loan



Bench Testing



FMT East Portal
Lear RSU



FMT West Portal
Cohda RSU



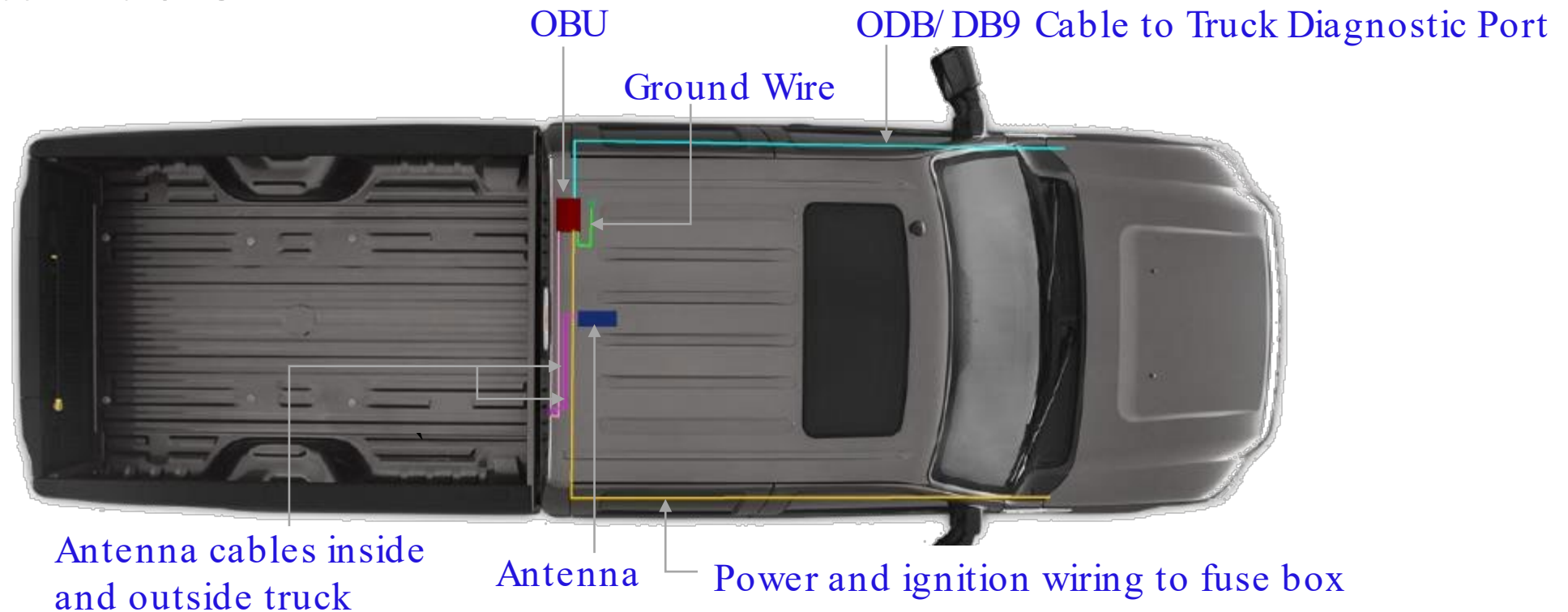
BHT North Portal
Lear RSU



BHT South Portal
Cohda RSU

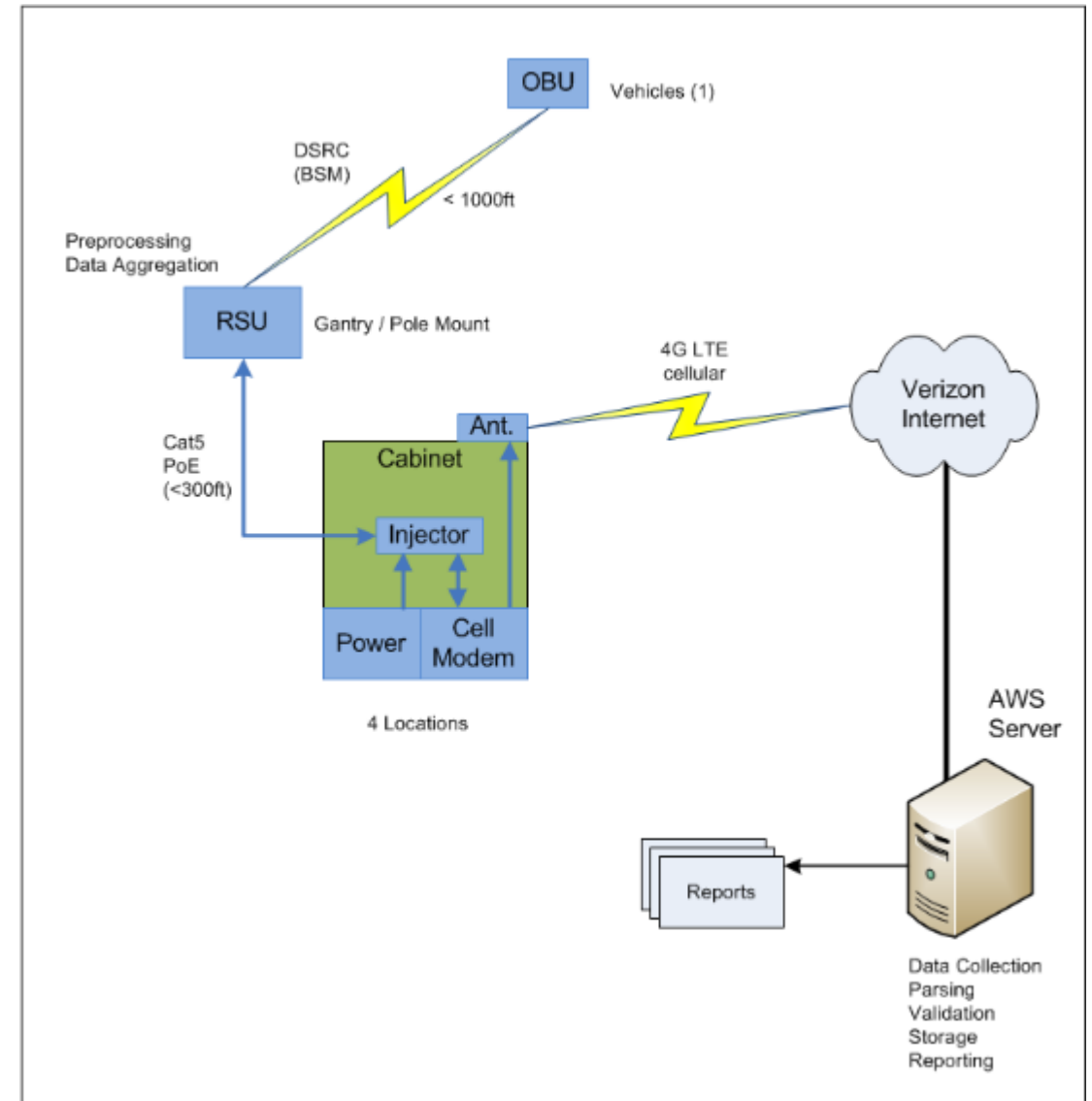
On-board Unit (OBU) Installation

- Two OBUs in MDTA Vehicle Recovery Trucks
 - Cohda Wireless OBU
 - Lear Locomate OBU

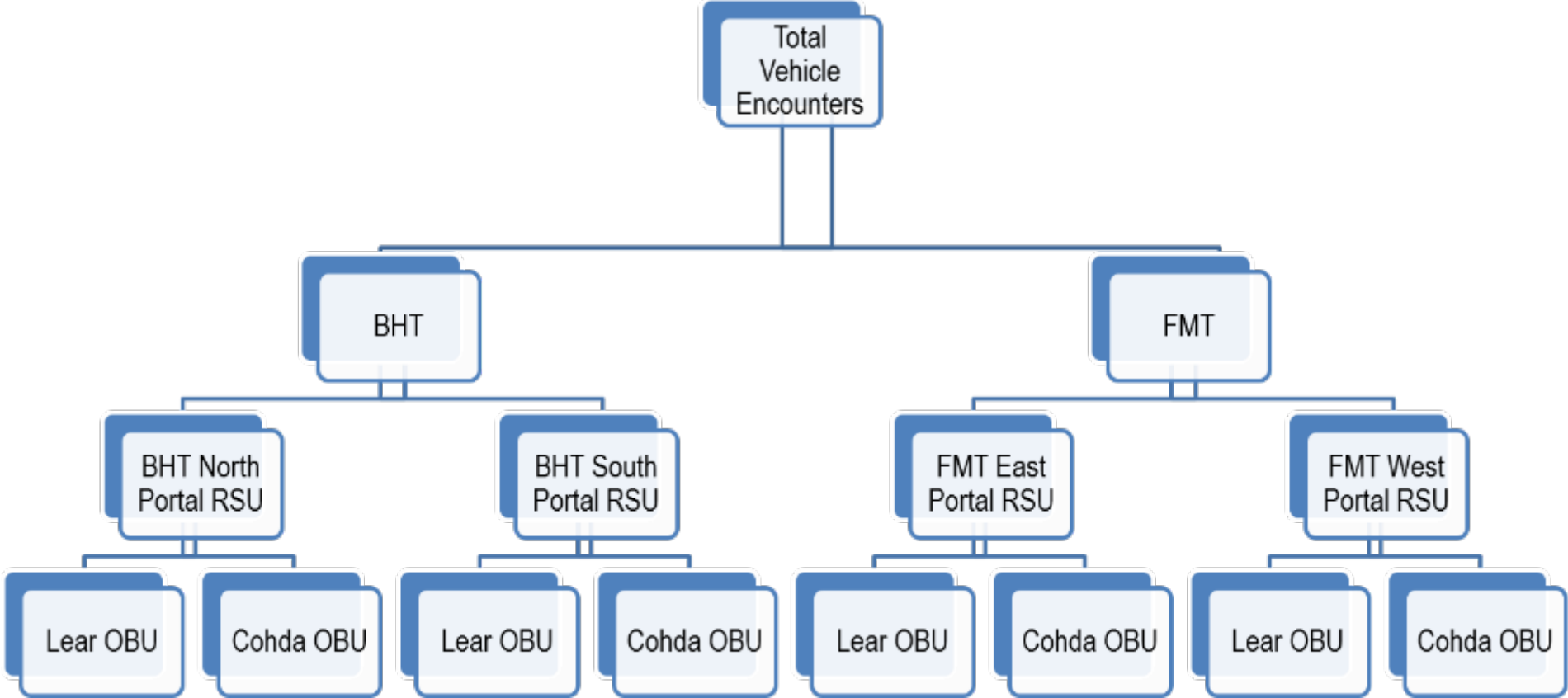


Architecture Concept

- Vehicles with OBUs send Basic Safety Message Part 1 (BSM1) @ 10 times per second
- Nearby RSUs receive BSMs
- RSUs transmit data to a cloud Server
- BSMs include the following information:
 - Vehicle position (latitude/ longitude)
 - Vehicle speed, acceleration, heading, and Brake status



Post-Installation Support: Data Collection



Post-Installation Support: Data Collection (Contd.)

All encounters of Lear OBU																
RSU	Time Logged	Encounter Begin	Encounter End	BSM Count	Old Location Count	Begin Lat	Begin Lon	End Lat	End Lon	Distance Traveled (Ft)	Avg Speed (MPH)	Avg Heading	Brakes Applied Count	Brakes Not Applied Count	Brake Status Unavail Count	Temp ID Count
FMT East Portal (Lear 1)	2018-09-19 14:18:09	2018-09-19 14:13:16	2018-09-19 14:17:28	2155	0	39.2688855	-76.5849235	39.2665090	-76.5609650	6822	9.75	62.28	0	0	2155	1
FMT East Portal (Lear 1)	2018-09-19 14:21:09	2018-09-19 14:19:22	2018-09-19 14:19:41	15	0	39.2665236	-76.5609661	39.2665101	-76.5609640	5	0.00	222.81	0	0	15	1
FMT East Portal (Lear 1)	2018-09-19 14:23:09	2018-09-19 14:21:16	2018-09-19 14:21:41	14	0	39.2665236	-76.5609507	39.2665178	-76.5609625	4	0.04	222.81	0	0	14	1
FMT East Portal (Lear 1)	2018-09-19 14:26:09	2018-09-19 14:25:16	2018-09-19 14:25:16	2	0	39.2665146	-76.5609623	39.2665146	-76.5609623	0	0.00	222.81	0	0	2	1

Post-Installation Support: Data Analysis

BSM Counts Summary at BHT

Private vehicles with 2016 Std OBUs

Other devices that are NOT 2016 Std BSMs

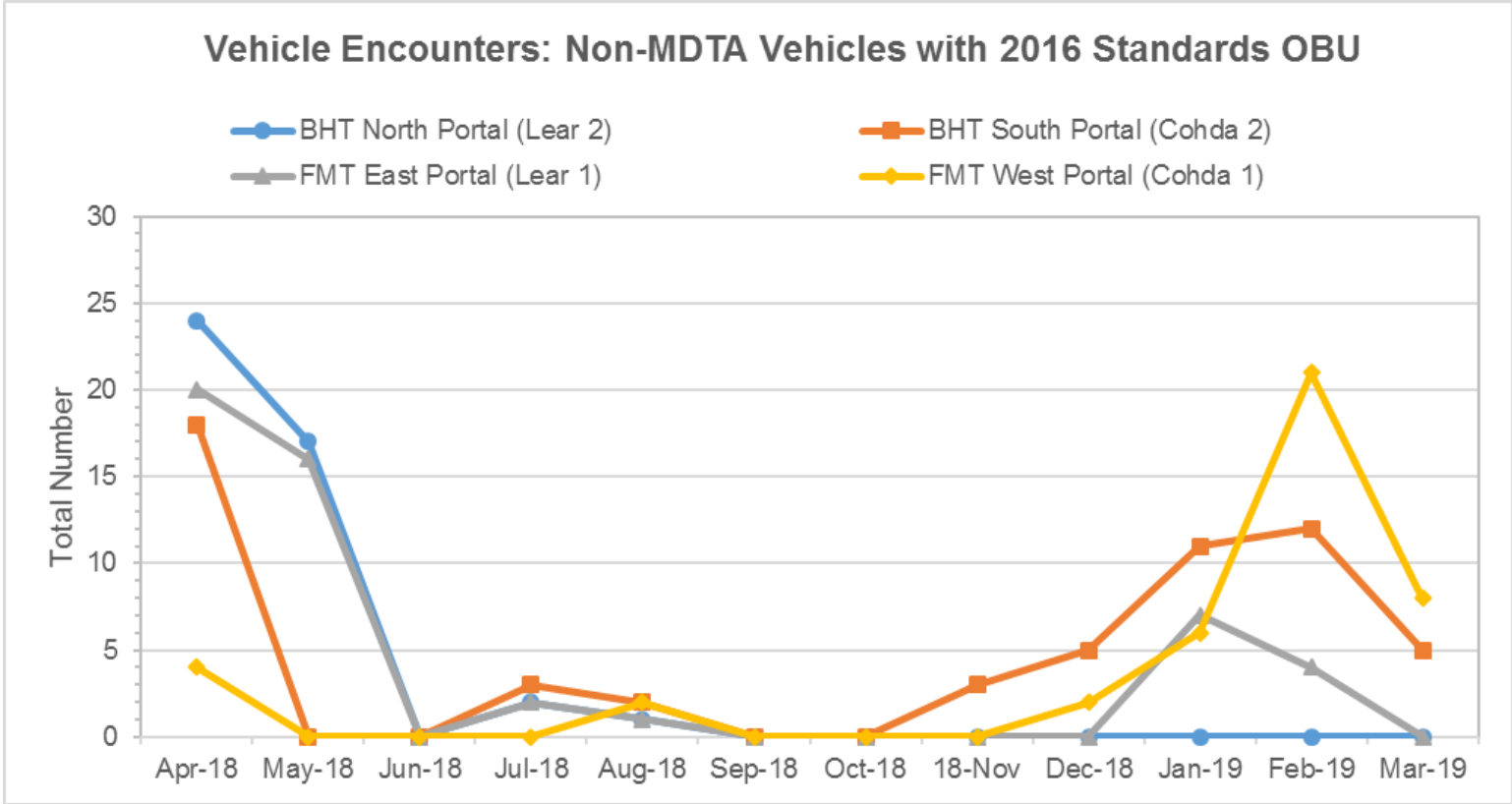
RSU->	BHT NORTH PORTAL (LEAR 2)				BHT SOUTH PORTAL (COHDA 2)			
	Lear OBU BSMs	Cohda OBU BSMs	Other BSMs	Unknown BSMs	Lear OBU BSMs	Cohda OBU BSMs	Other BSMs	Unknown BSMs
Apr-18	-	389,981	4,643	-	-	187,795	5,713	14,076
May-18	-	250,894	1,963	-	-	1,194	-	2
Jun-18	301,639	311,041	-	-	282,596	110,724	-	19,901
Jul-18	338,928	124,529	745	-	497,769	79,043	2,168	28,978

Vehicle Encounters at BHT

RSU->	BHT North Portal (Lear 2)					BHT South Portal (Cohda 2)				
Month	Total Encounters	VRT 838 (Lear OBU) Encounters	VRT 828 (Cohda OBU) Encounters	Other Encounters	Avg Dist Traveled (ft)	Total Encounters	VRT 838 (Lear OBU) Encounters	VRT 828 (Cohda OBU) Encounters	Other Encounters	Avg Dist Traveled (ft)
Apr-18	632	-	592	24	3624.23	317	-	294	18	1744.98
May-18	834	-	662	17	3382.68	5	-	5	-	1903.2
Jun-18	1357	765	592	-	3270.68	709	485	224	-	1972.43
Jul-18	1213	955	256	2	3000.14	849	693	153	3	2156.86

1. Lear RSU is not detecting BSMs from OBUs with older standards. The 2016 standards uses UPER coding which is very different from the J2735 2014 Standard.
2. Lear OBU was sent to vendor for repair on 4/30/18 and re-installed on 5/10/18.

Post-Installation Support: Non -MDTA Vehicle Encounters Trend



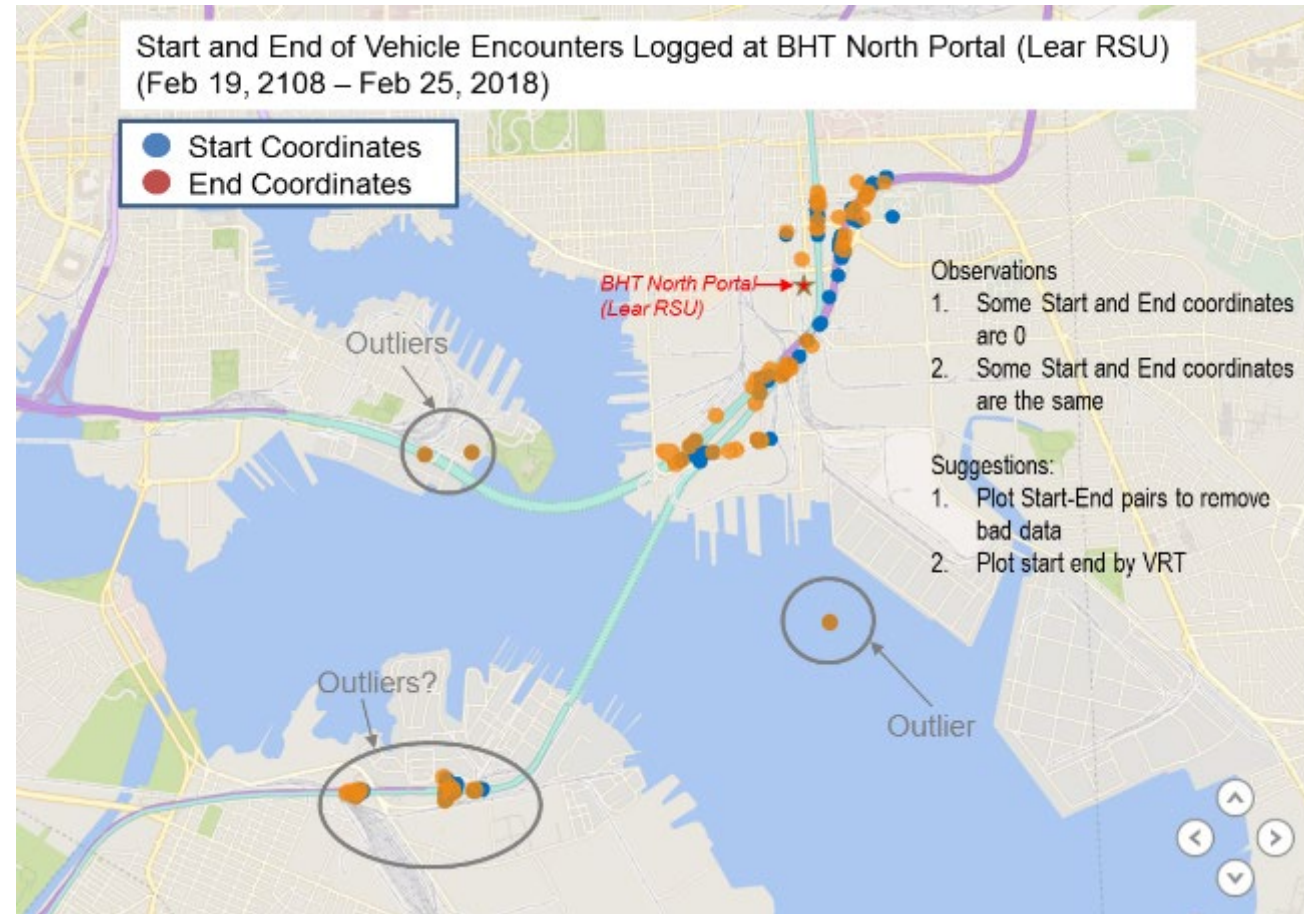
Lessons Learned

- Connected Vehicle (CV) Equipment and Vendor Maturity
 - Limited Tech Support, High cost. Vendor options with system integration capabilities expected in the future
- Equipment Installation Issues
 - OBU Size was large, installed under rear seat, antenna cables too short. RSU installation did not pose challenges



Lessons Learned

- Maintenance Facility and Test Equipment
 - Budget for spares and troubleshooting/repair of equipment
- FHWA Loaner Equipment Experience
- GPS Performance Around Tunnels
 - OBU loses GPS connectivity in tunnels leading to erroneous lat/long data. Potential solutions are to use GPS Repeaters, Beacons, differential correction receivers, or radio triangulation



Lessons Learned

- GPS Position Filtering and Map Matching
 - Current backend application does no filtering on raw BSM data and captures all data within the omnidirectional radius of the RSU receiving antenna.
 - Some form of map matching algorithm is desirable to filter out all but the desired BSM data from the freeway of interest.
- Architecture Upgrades
 - Current architecture is designed to perform data storage and processing on the backend using data transmitted by RSU. Network and cloud processing resources can get overloaded. A scalable architecture will be required if more devices are deployed.
- Network Evaluation
 - Future system expansion should consider migrating to an all-IPv6 network. MDTA cellular modems and service presently do not support IPv6.

Lessons Learned

- Vehicle ID – BSM Part II Message Support
 - The BSM Part 1 message includes only a temporary ID to identify the OBU. The temporary ID changes at any time and so is not a reliable unique identifier. Future developments should consider BSM Part II message support.
- UPS Power for RSUs
 - Future installations should consider UPSs for RSUs. GPS processing issues at Cohda RSUs were resolved with UPSs.

Next Steps

- Develop scope for Phase 2 (In-progress)
 - Primary Goal – Enhanced Data Collection
 - Deployment of additional Devices (RSUs and OBUs)
 - Data Processing Architecture and Network Evaluation
 - Applications Development
 - Collaborate and Share Lessons Learned
 - Phase 3 Applications Needs Assessment

Open Discussion



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