



Welcome to Today's Webinar

Tampa Hillsborough Expressway Authority (THEA) Connected Vehicle Pilot: Update at the Operational Readiness Milestone

Date: March 11, 2019

Time: 11:30 AM

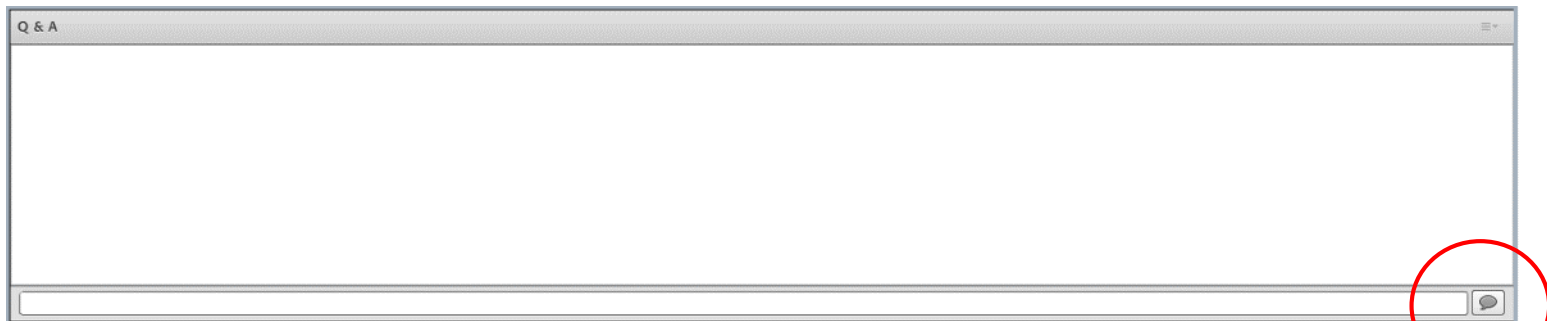
Listen through your speakers/VoIP

If audio cannot be heard 5 minutes prior to the start of this webinar, please dial into the webinar using the teleconference number provided onscreen.



Submitting Questions

- Use Q&A pod on the bottom of your screen.
- *Questions will be addressed after the last presentation, as time permits.*



Type your question and hit "send question."



Poll Question



Tampa Hillsborough Expressway Authority (THEA) Connected Vehicle Pilot:

Update at the Operational Readiness Milestone



**Govind Vadakpat, Ph. D., Research Transportation Specialist,
Office of Operations R&D, USDOT**



**Robert M. Frey, AICP, Director of Planning & Innovation,
Tampa-Hillsborough County Expressway Authority**



Dave Miller, Principal Systems Engineer, Siemens Industry, Inc.



Rafal Ignatowicz, Vehicle Integration Technical Lead, Brandmotion



**Steve Johnson, CISSP, CVP, Associate Vice President, Connected
Vehicle Program Manager, HNTB**

TODAY'S AGENDA



- Purpose of this Webinar
 - Provide an overview of THEA's approach to test and demonstrate that the deployed system operates as designed in a safe and secure manner.
 - Share results, baseline performance measures and security-related lessons learned from the tests and demonstrations.

- Webinar Content
 - Connected Vehicle Pilot Deployment Program Overview
 - Tampa (THEA) Pilot Operational Readiness Approach, Results, and Lessons Learned
 - Stakeholder Q&A

- Webinar Protocol
 - Please mute your phone during the entire webinar.
 - You are welcome to ask questions via chatbox at the Q&A Section.
 - The webinar recording and the presentation material will be posted on the CV Pilots website.





CONNECTED VEHICLE PILOT DEPLOYMENT PROGRAM

PROGRAM GOALS

Spur Early CV Tech Deployment



Measure Deployment Benefits



Resolve Deployment Issues



PILOT SITES



WYDOT

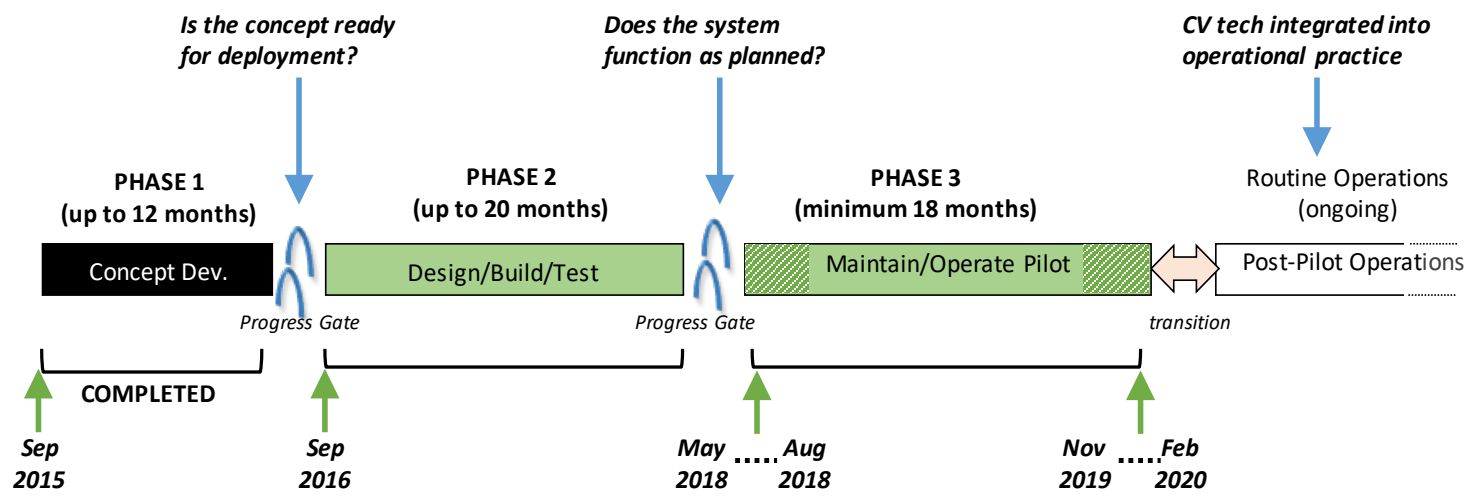


NYCDOT



Tampa (THEA)

PROGRAM SCHEDULE



U.S. Department of Transportation



THEA CV Pilot Deployment Overview

Bob Frey – THEA

PILOT SITE OVERVIEW



PARTICIPANTS AND INFRASTRUCTURE



Up to **1,100**
Privately Owned
Vehicles

8
TECO Line
Streetcar
Trolleys

10
Hillsborough Area
Regional Transit
(HART) buses

44
Roadside Units



MORNING BACKUPS



WRONG WAY DRIVERS



PEDESTRIAN SAFETY



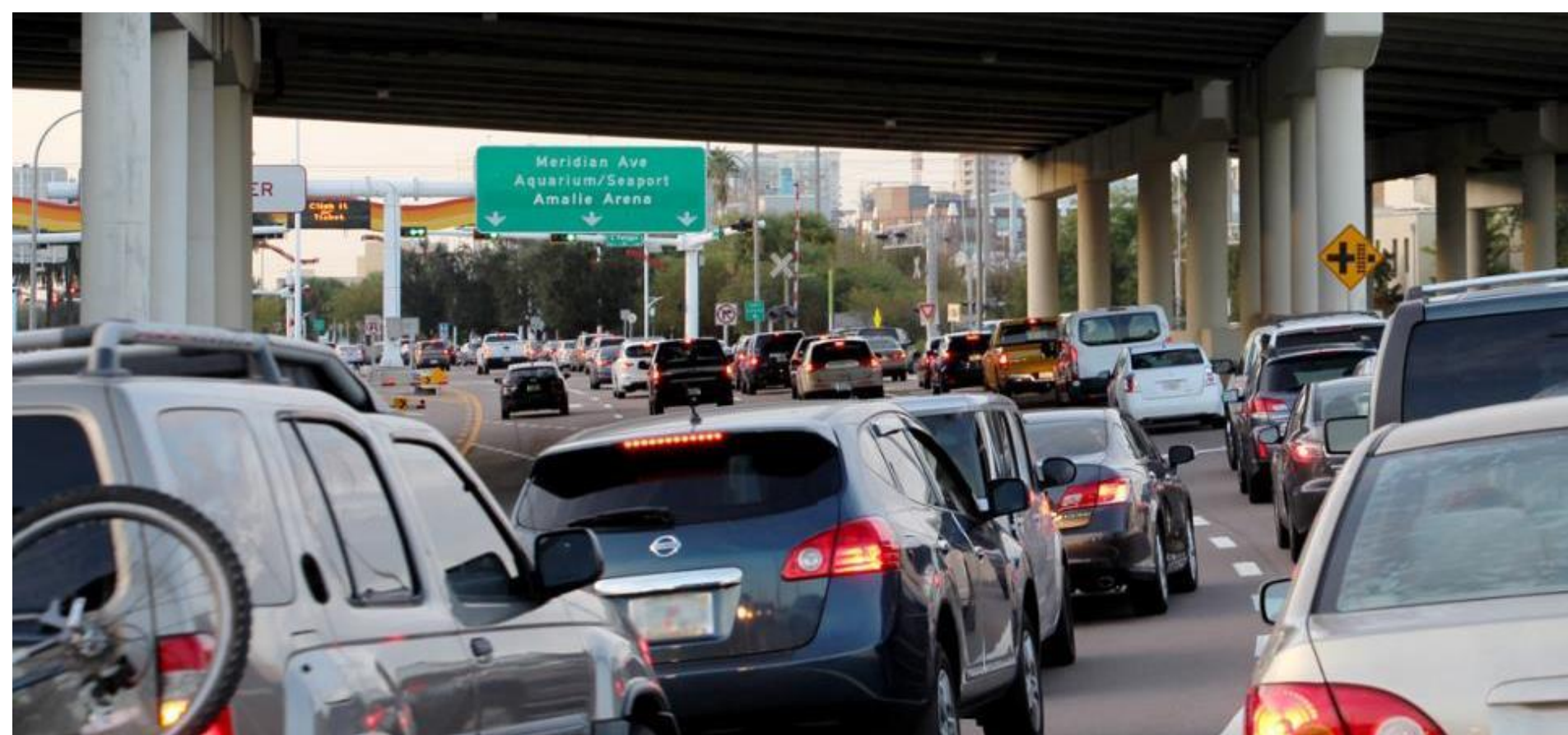
TRANSIT SIGNAL PRIORITY



STREETCAR CONFLICTS



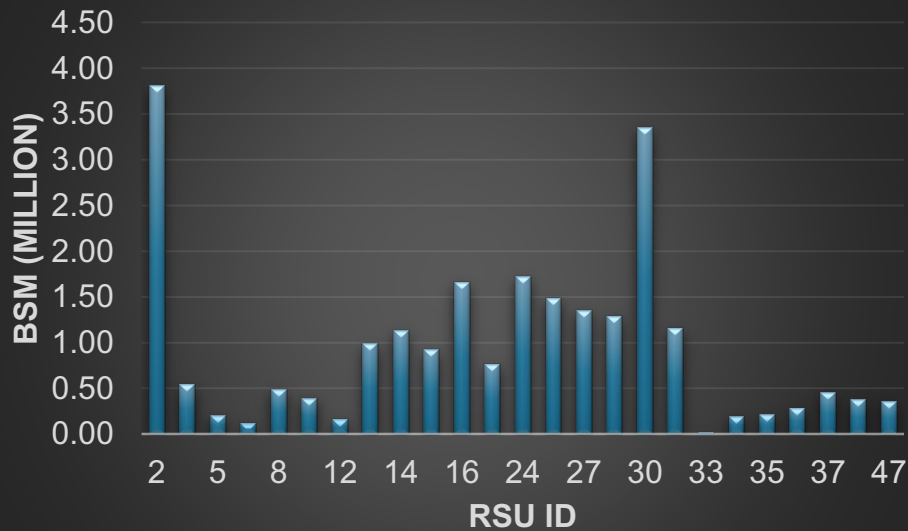
TRAFFIC PROGRESSION



12 MONTHS OF DATA COLLECTION / ANALYSIS



- 308 Participants Received Operating Firmware Update
- Initial Data Collection Underway
- Data being sent to ITS Public Data Hub
- Test Data Collection





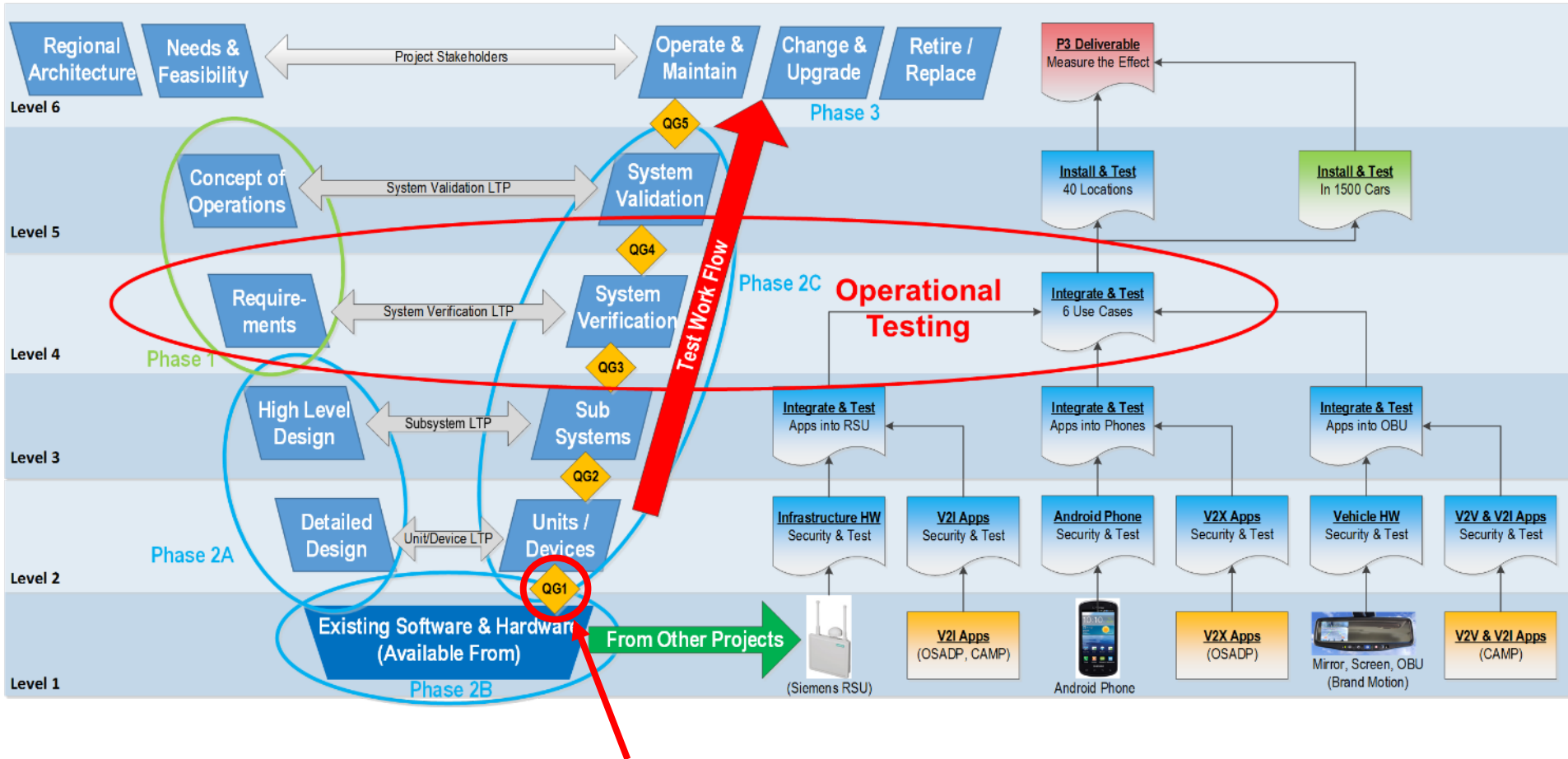
Tampa (THEA) CV Pilot Operational Readiness Approach

Speaker(s)

Dave Miller/ Rafal Ignatowicz



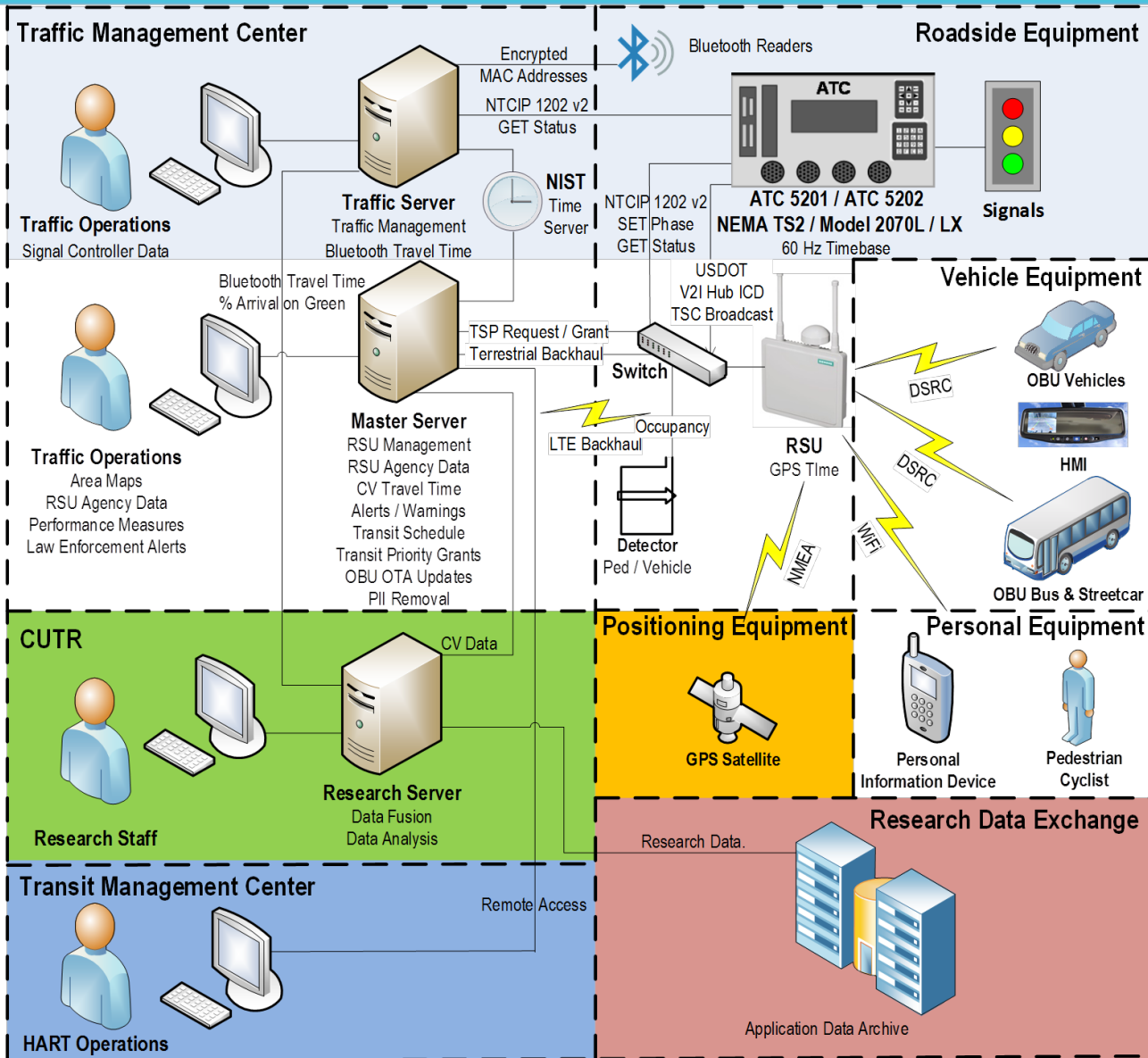
OPERATIONAL READINESS BRIEFING



April 20, 2017: Operational Readiness Briefing



OPERATIONAL READINESS SCOPE

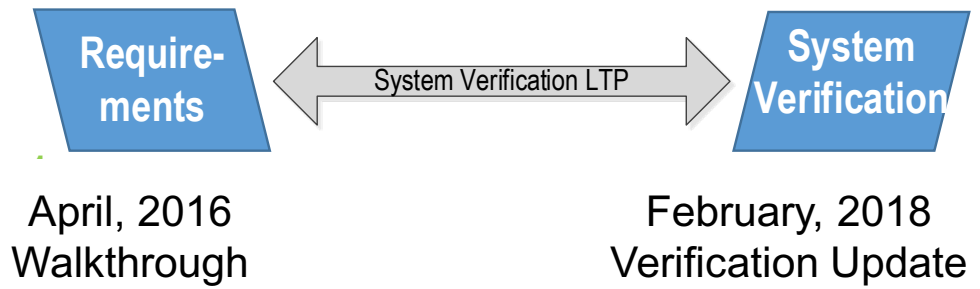


Operational Readiness (White)

OPERATIONAL READINESS VERIFICATION



Requirement Group	Related Section			
THEA-UC1-001	Con Ops			
Related Needs	1			
Parent Section	7.1.1			
Requirement Text				
I-SIG application at Twiggs and Meridian shall transmit southbound estimated queue data to the REL ERDW application.				
Requirement Text (Comments/Changes)				
Requirement Criteria		Yes		No/Rank
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test Demo.
6	If feasible and verifiable, by which method?			I-SIG_A
Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.				
Related Design Elements				
3.2.2.1.2 The ERDW application receives the currently estimated queue length (QLE) for the REL from MMITSS (I-SIG) through a local inter-process communication (IPC) interface provided by the ESCoS stack. MMITSS estimates queue lengths on intersection approaches monitoring BSMs of vehicles approaching the intersection.				
Design (Comments/Changes)				
Design Criteria		Yes		No/Rank
1	Is the design unambiguous?	X		
2	Is the design logically consistent with Parent(s), and sibling design components?	X		
3	Is the design feasible?	X		
4	Is the design verifiable?	X		
5	Is the requirement fulfilled by the design?	X		
Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.				
Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				



OPERATIONAL READINESS VERIFICATION



Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-UC1-001	I-SIG application at Twiggs and Meridian shall transmit southbound estimated queue data to the REL ERDW application.	7.1.1	1	NA	NA	NA	NA	2.2	NA	3.2.2.1.2	MMITSS (QLE) sends queue lengths on lanes to ERDW app	NA	NA
THEA-UC1-002	The drivers shall receive ERDW from ERDW application on the vehicles	7.1.1	1, 6	5.2.2	NA	NA	NA	2.2	NA	3.3.2.1	Drivers receive warning based on their speed and location in reference to the TIM received by the OBU from RSU	3.2.1	23002
THEA-UC1-003	I-SIG application at Twiggs and Nebraska shall transmit westbound-queue-length data to the CSW application on the REL per-lane.		Deleted										
THEA-UC1-004	The Electronic Emergency Brake Light warning (EEBL) application on the braking vehicle shall broadcast an EEBL warning when the vehicle deceleration exceeds predetermined value.	7.1.1	1	5.2.6	NA	NA	4.1.1.1.4	2.8	NA	3.3.2.7	Hard braking vehicle sends out a BSM with a hard-braking event flag to vehicles around.	3.1.1	20005
THEA-UC1-005	The EEBL application on the receiving vehicle shall receive an EEBL warning from the braking vehicle.	7.1.1	2	5.2.6	NA	NA	4.1.1.1.4	2.8	NA	3.3.2.7	EEBL app on the OBU receives BSMs from hard-braking vehicles around	3.1.1	20005



OPERATIONAL READINESS VERIFICATION



SyS REQ Document		Test Case Document		
Requirement	VM	TC	Configuration	Metric
THEA-SAF-001	I		As installed	Relevant standards
THEA-SAF-004	D		Installed RSUs	Maintenance
THEA-SAF-005	T	Safe_A	OBU Failure	Vehicle operation
THEA-SAF-006	T	Safe_B	RSU Failure	CU operation
THEA-SAF-007	I		PID Failure	PID operation
THEA-SAF-011	D		Crashed car	Vehicle operation
THEA-SAF-014	I		Vehicle with HMI	HMI operation
THEA-SAF-020	I		Vehicle installers	Certification, resume
THEA-SAF-020a	D		Participants	Training
THEA-SAF-021	I		Infrastructure. installers	Certification, resume



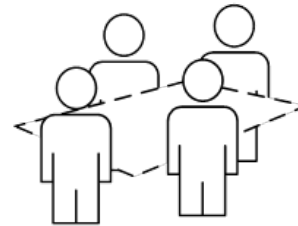
OPERATIONAL READINESS EFFORTS



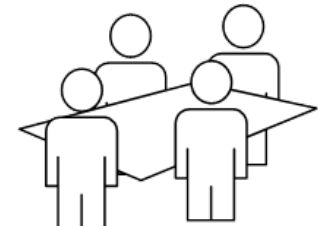
AUTHOR



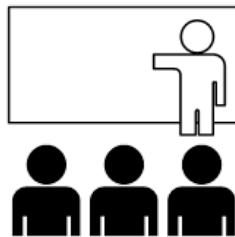
REVIEW



VIRTUAL MEETING



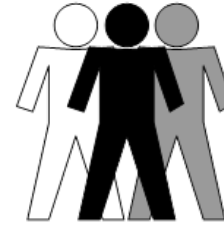
FACE TO FACE MEETING



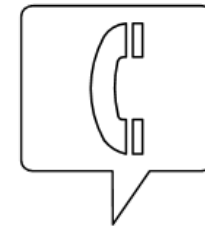
WEBINAR



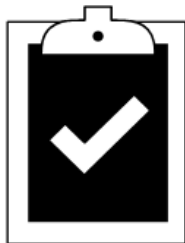
AGREEMENT



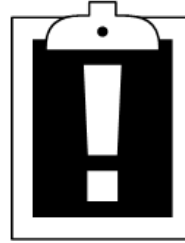
TRAINING



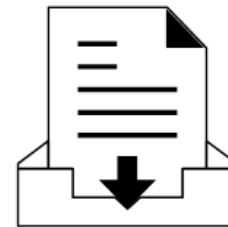
CALL



TESTING



ISSUES



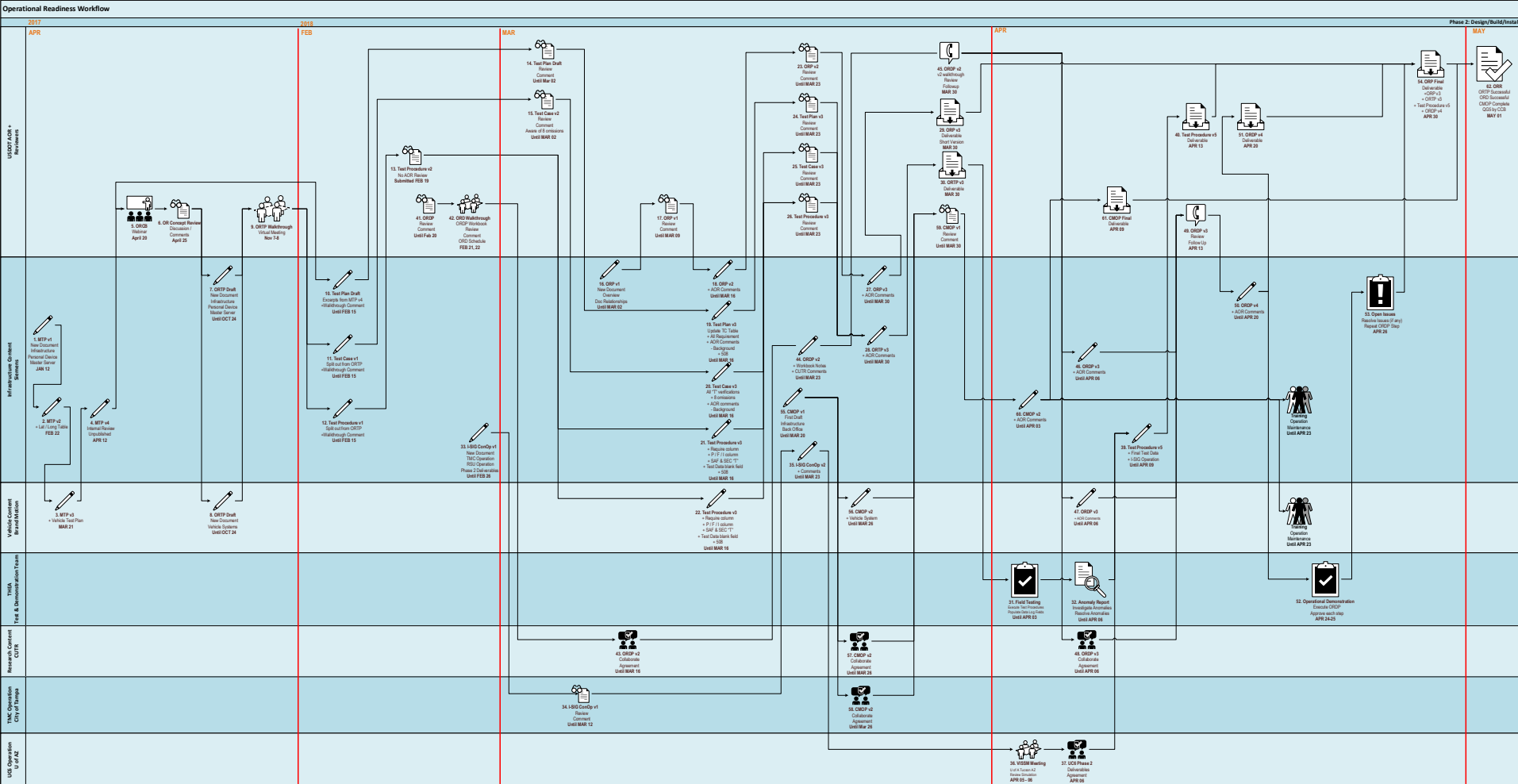
DELIVERABLE



CHECKLIST



OPERATIONAL READINESS WORKFLOW



OPERATIONAL READINESS TRAILS



Trail	Icon #	Description	Workflow Result
1	01-32,39,40	Testing workflow	Verifies “T” requirements
2	33 to 38	I-SIG workflow	Selectable I-SIG & Actuated plans
3	41 to 54	Demonstration workflow	Verifies “D” and “I” requirements
4	55 to 61	Operation and maintenance plan	Stakeholder staff set for Phase 3
5	62	Operational Readiness Report	Transition to project Phase 3



VERIFY BY TEST

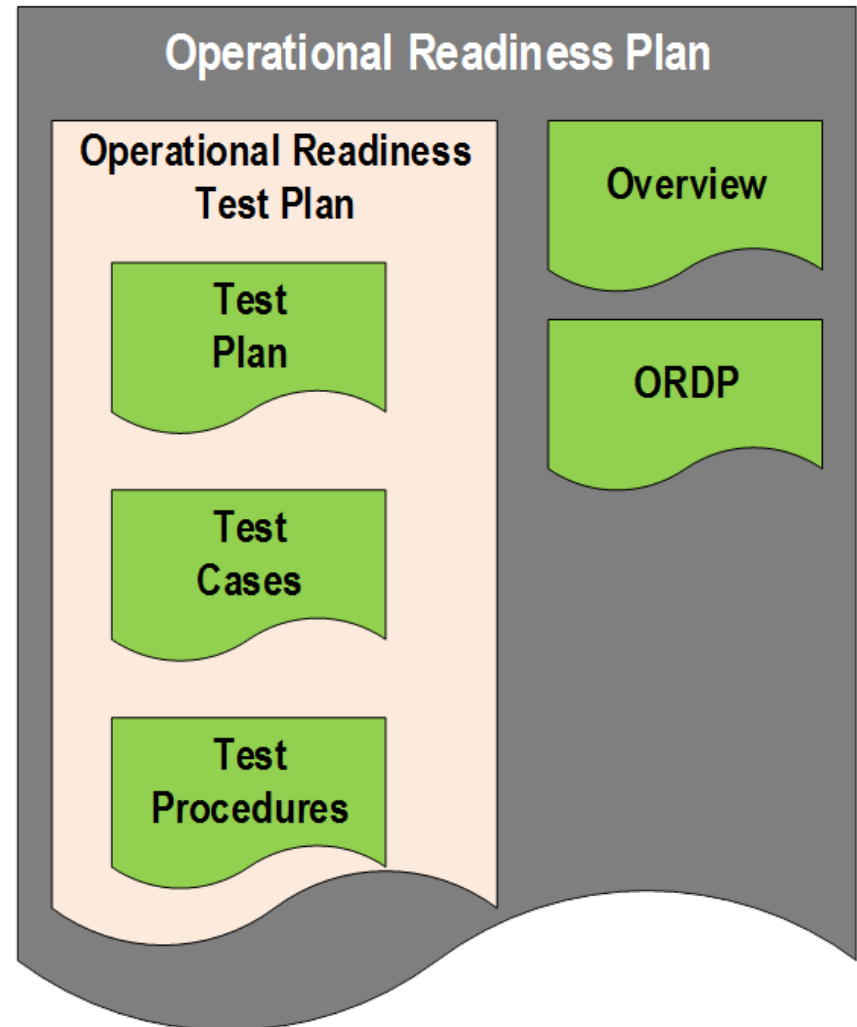
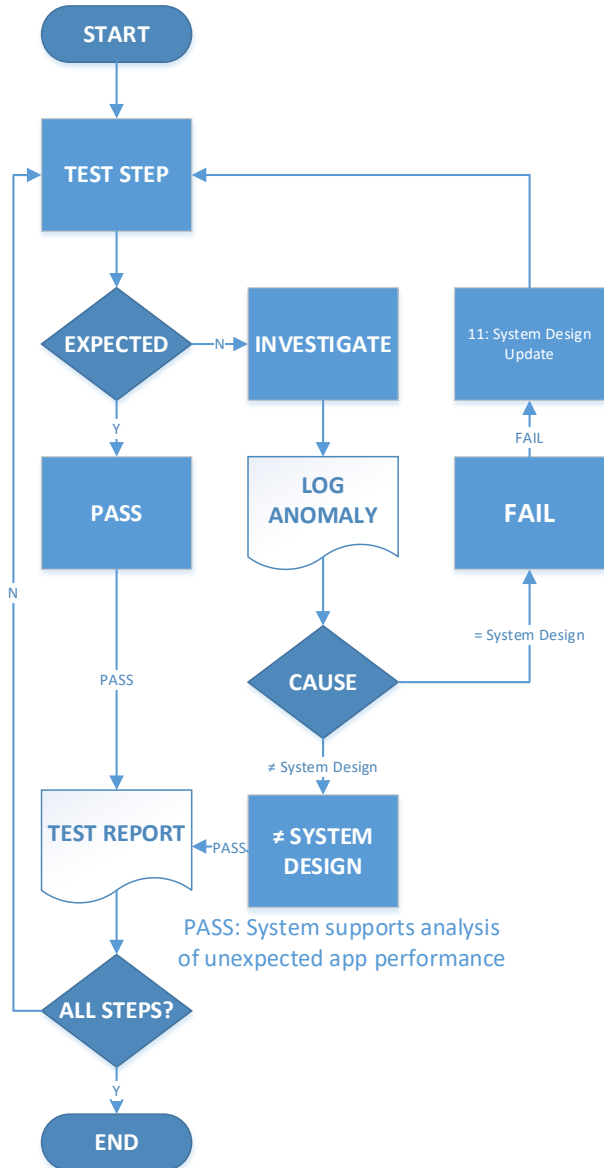


Requirement to Test Case Traceability Matrix

SyS REQ Document		UC	Test Case Document			
Requirement	VM		TC ID	Configuration	Metric	Pass
THEA-UC1-001	T	1	I-SIG_A	RSU receiving BSM	Queue Length	Accurate queue length log
THEA-UC1-012	T					
THEA-UC1-013	T					
THEA-UC1-014	T					
THEA-UC1-015	T					
THEA-UC1-017	T					
THEA-UC1-018	T					
THEA-UC1-028	T					
THEA-UC1-029	T					
THEA-UC1-030	T					
THEA-UC1-019	T		I-SIG_B	RSU receiving BSM	CALLS, OMMITS, HOLDS	Signal phase modification
THEA-UC1-022	T		ERDW_A	Manual queues	Speed advice TIM	Speed advice is proper
THEA-UC1-024	T					
THEA-UC1-026a	T					
THEA-UC1-002	T		ERDW_B	Manual queues	Speed advice location 1	Speed advice for location
THEA-UC1-023	T					
THEA-UC1-025	T					
THEA-UC1-004	T		EEBL_A	Forward hard brake	> Hard braking threshold	Hard braking warning
THEA-UC1-005	T					
THEA-UC1-006	T					
THEA-UC1-007	T					
THEA-UC1-008	T					



TEST WORKFLOW AND DELIVERABLES



TEST CASE EXAMPLE



2.2.2.2.2 ERDW Test Cases

Test Case UC1 ERDW_A

Table 17: Test Case UC1 ERDW_A

Initial Conditions	<p>Safety Management Test Conduct:</p> <ul style="list-style-type: none"> Closed roadway with law enforcement present Use of stakeholder vehicles Conducted by stakeholder participants Applications tuned to match Phase 3 study configuration
Objectives	<p>Test the following interfaces:</p> <ul style="list-style-type: none"> Queue length input to ERDW TIM output from ERDW <p>System Operation:</p> <ul style="list-style-type: none"> I-SIG is disabled Differing queue lengths are manually entered as inputs to ERDW using the RSU service console ERDW creates TIMs with the recommended speed per zone for light duty vehicle <p>Verify that:</p> <ul style="list-style-type: none"> ERDW is accepted ERDW displays entered queue length ERDW uses the displayed queue length to select TIM associated with that queue length based on ERDW configuration. Mathematical relation of TIM output to queue length input is configurable. Test Case verifies that the output TIM is issued as a configurable relationship to input queue. COTS test equipment receives and logs broadcast TIM TIM content (speed zones) equals the TIM configured for the queue length ERDW picks a different TIM which is associated with the second queue length based on ERDW configuration TIM content (speed zones) equals the TIM configured for the second queue length
Test Inputs	<p>Varying Input: 2 different queue lengths of vehicles</p> <p>Configurations: Location of zones, speed advice per zone configured per illustration for each of the 2 queue lengths</p>
Resources Needed	<p>RSU installed and communicating at Twiggs / Meridian</p> <p>OBUs equipped cars with drivers communicating</p>
Execution Conditions	<ol style="list-style-type: none"> MMITSS is disabled Queue length is entered manually via RSU browser UI

Requirement Verified	<p>THEA-UC1-022: The RSU ERDW application shall broadcast a recommended standard speed.</p> <p>THEA-UC1-024: The RSU ERDW application shall adjust the configurable speed recommendation zone(s) based on the southbound queue length from I-SIG application on Twiggs and Meridian.</p> <p>THEA-UC1-026a: The RSU ERDW application shall transmit the configurable speed recommendation zones to the THEA Master Server.</p>
Illustration	<p>ERDW_ppt_04s.ai/pdf/png 2017.10.09 John Kosinski</p> <p>ERDW_ppt_05s.ai/pdf/png 2017.10.11 John Kosinski</p>

TEST CASE SUMMARY



Use Case	Apps	Location	Data Before	Data During	Data After	Pass
Morning Backup	ERDW	Inbound REL	None	Alerts, Warnings, BSMs	Alerts, Warnings, BSMs	Data After = Demo
	EEBL	Inbound REL	None	Alerts, Warnings, BSMs	Alerts, Warnings, BSMs	Data After = Demo
	FCW	Inbound REL	None	Alerts, Warnings, BSMs	Alerts, Warnings, BSMs	Data After = Demo
	I-SIG	Twiggs/Meridian	South Phase	Southbound Phase	Southbound Phase	Calls, Omits, Holds
Wrong Way Entry	WWE	REL Entrance	None	Alerts, Warnings, BSMs	Alerts, Warnings, BSMs	Data After = Demo
	IMA	REL Entrance	None	Alerts, Warnings, BSMs	Alerts, Warnings, BSMs	Data After = Demo
	I-SIG	REL Entrance	North Phase	Northbound Phase	Northbound Phase	NB Omits
Pedestrian Safety	PED-X	Courthouse	None	Alerts,Warnings,BSMs,PSMs	Alerts, Warnings, BSMs, PSMs	Data After = Demo
	PTMW	Marion Ave	None	Alerts,Warnings,BSMs,TIMs	Alerts,Warnings,BSMs,TIMs	Data After = Demo
	I-SIG	Meridian Ave	None	PED Phase	PED Phase	PED Phase=Demo
	PED-SIG	Meridian Ave	PED Phase	PED Phase	PED Phase	PED Phase=Demo
Transit Priority	I-SIG	Marion Ave	Phase Timing	Phase Timing	Phase Timing	GREEN Extension
	TSP	Marion Ave	SRM,SSM,TIM	SRM, SSM, TIM	SRM, SSM, TIM	TIM = SSM
Streetcar Conflicts	VTRFTV	Channelside Dr	None	Alerts, Warnings, BSMs	Alerts, Warnings, BSMs	Data After = Demo
	PCW	Channelside Dr	None	Alerts, Warnings, BSMs	Alerts, Warnings, BSMs	Data After = Demo
	I-SIG	Channelside Dr	Phase Timing	Phase Timing	Phase Timing	Calls, Omits, Holds
Traffic Progression	I-SIG	Meridian Ave	Phase Timing	Phase Timing	Phase Timing	Calls, Omits, Holds
	PDETM	Meridian Ave	TMC Travel Time, Speed, Counts, Stops on Green	Concert Travel Time, Speed, Counts TMC Stops on Green	Concert Travel Time, Speed, Counts TMC Stops on Green	Concert Travel Time, Speed, Counts TMC Stops on Green

DEMONSTRATION SCENE



Use Case 1: Morning Backup

Demonstration 1: End of Ramp Deceleration Warning (ERDW) application

Purpose: Demonstrate the change in location of deceleration warnings as a function of queue backing up from Twiggs / Meridian onto the REL.

Test Cases: UC1 ERDW_A, UC1 ERDW_B

Requirements: THEA-002, THEA-UC1-022, THEA-UC1-023, THEA-UC1-024, THEA-UC1-025, THEA-UC1-026a,

Demonstrator: Phase 3 Participant Driver

Facilitator: Brand Motion

Observer Experience:

Observers ride in participant vehicle equipped with a mirror HMI. Vehicle travels inbound from the Selmon Expressway via the closed REL towards the live signalized intersection of Twiggs / Meridian representing the morning map. The observers note the MUTCD R2-1 speed limit signs installed at the roadside as well as the visible and audible operation of the HMI while traveling the complete length of the REL. A safety cone is set on the right shoulder of the closed REL representing the last car of the intersection queue if the REL was open to live traffic. Without live traffic, the queue length is manually adjusted as either normal or longer from I-SIG running at Twiggs / Meridian. Two demonstration runs:

Run 1: Cone set at a short distance from stop bar, representing the last vehicle in a normal queue for the posted speed reduction.

Run 2: Cone set at a longer distance from stop bar, representing the last vehicle in a morning queue extending beyond speed reduction

Expectation:

Run 1, short queue:

White speed limit sign matches the HMI speed limit (white) graphic alert location.
Speed advice (yellow) graphic alert is issued at a distance before the cone location


Run 2, long queue:

Speed limit sign matches the HMI speed limit (white) graphic alert location.
Speed advice (yellow) graphic alert issued at a distance before the new cone location.



DEMONSTRATION STEPS



UC	#	Actions	Expected Result	Pass/Fail/Partial + Comments
1	1		No warning shown to driver	Pass ___ Fail ___ Partial ___ Comments:
2	2		End of Ramp Deceleration Warning (ERDW) safety application issues a “40 MPH” warning to the driver per the Human Machine Interface (HMI) spec 	Pass ___ Fail ___ Partial ___ Comments:



Tampa (THEA) Pilot Operational Readiness Test / Demonstration Results

Speaker(s)

Dave Miller/ Rafal Ignatowicz



TEST RESULTS OF OPERATIONAL READINESS DEMONSTRATION 1ST RUN



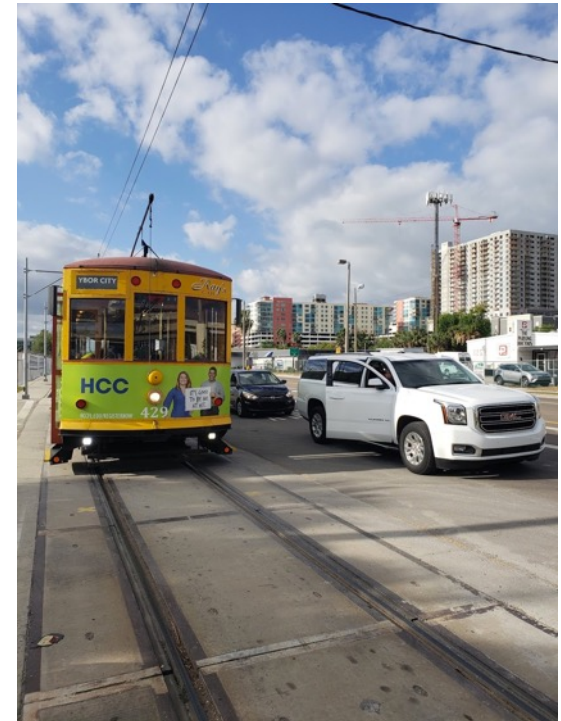
- Three OBU suppliers were tested: Commsignia, Savari and SiriusXM.
- Many on-site tests were run prior to the first run of Operational Readiness Demonstration (ORD) which took place on April 24th – 26th 2018.
- Biggest issue that was discovered during the ORD was HAMWAN radio interference on our channels.
- Due to the interference, most of the tests had to be re run at a later date.
- Forward Collision Warning (FCW), Emergency Electronic Brake Lights (EEBL), Intersection Movement Assist (IMA), Pedestrian Collision Warning (PCW), Vehicle Turning Right in Front of a Transit Vehicle (VTRFTV) demos were completed successfully.
- End of Ramp Deceleration Warning (ERDW) had issues after the morning demo was successful due to the Roadside Unit (RSU) suspending the application due to the HAMWAN interference.
- Wrong Way Entry (WWE) had issues due to GPS accuracy threshold settings found later.
- Transit Signal Priority (TSP) had issues with Geo fencing preventing the alerts to trigger.
- Due to many issues involving HAMWAN interference, efforts were made to resolve it and test again.



TEST RESULTS OF OPERATIONAL READINESS DEMONSTRATION 2ND RUN



- In the second run of demos which took place in June 2018, Savari and SiriusXM took part.
- Wrong Way Entry (WWE), End of Ramp Deceleration Warning (ERDW) and Vehicle Turning Right in Front of a Transit Vehicle (VTRFTV) were retested on the OBUs with success.
- HAMWAN interference was not present during 2nd run of the demo.



OTA AND DATA LOGGING



- Testing and refinement of data logging has been continuing in order to improve the upload speeds and reliability
- A platoon of 9 vehicles was tested in Tampa with successful data uploads
- Over-The-Air (OTA) firmware updates were broadcast to SiriusXM and Savari onboard Unit (OBU) participants with success (300+ vehicles updates in a week)
- Participant data is continually being uploaded to the RSUs from OBUs





Tampa (THEA) CV Pilot Lessons Learned from Operational Readiness Test/Demonstration

Speaker(s)

Steve Johnson/Dave Miller



LESSONS LEARNED - CYBERSECURITY



- Cybersecurity is a means to protecting data and other assets
 - Cybersecurity Principles were discussed in a Security Management Operational Concept (SMOC) Published by USDOT, JPO
- Privacy is a requirement to provide reasonable safeguarding of participant's Personal Identifiable Information
 - The overview of safeguards (controls) to be applied to the protection of PII was outlined in a Data Privacy Plan (DPP) Published by USDOT, JPO
 - The Procedures to be followed: Detailed steps to apply the controls, were prescribed in a Security Operation Procedures document. This document was classified and therefore not published
- “The greatest challenge to successful operations was not a typical Cybersecurity attack but an unintended one.”





Enter the Amateur HAM Radio Guy

- Didn't see that one coming
 - We had no clue about the Federal Communications Commission (FCC) Sub Part that allowed for HAM use as secondary licensee.
 - We discovered the interference quite by accident – Sniffer Logs.
 - We weren't sure what to do – reached out to both USDOT and Florida Department of Transportation (FDOT).
 - Close coordination with and advice from FDOT was critical in resolution.
 - ^a FCC Licensing is through FDOT State-wide license.
 - ^a Randy Pierce had dealt with the operator in prior engagements and was knowledgeable of FCC processes.
 - USDOT efforts comprised liaison with FCC (Jim Arnold) and tech assistance from Ed Fok and Volker Fessmann.
 - TAKE-AWAY: HAM Operators are “Licensed” in the spectrum. You must approach them as secondary, licensed users”, NOT “unlicensed intruders” They often know the rules better than you may. Use the State DOT FCC liaisons (experts).
- Wasn't accounted for during Security by Design
 - CIA, the big 3 of cybersecurity – Confidentiality, Integrity and AVAILABILITY.
 - The interference by Time-division multiple access (TDMA) network traffic was not anticipated and its introduction created a de facto Denial of Services (DOS) attack even though this was not the operator's intent.
 - The result of pervasive TDMA traffic in a Carrier-sense multiple access (CSMA) domain is decreased AVAILABILITY – degraded data throughput and errors.



Enter the Amateur HAM Radio Guy

- Being First Isn't all Roses – No Clear Standard of Proof
- Testing and Documented Impacts
 - Uploaded dummy data file multiple times in controlled conditions.
 - Baseline established while Florida simulcast group (FSG) was not broadcasting (clear channel).
 - When FSG resumed later, baseline test was repeated on a clear channel and channel in use by FSG. Conditions from original baseline were reproduced under controlled conditions.
 - Upload time and throughput were degraded by 50% in the presence of FSG. Error rate also increased exponentially.
 - The test results demonstrate performance loss in regards to data-logging. However, this is easily extrapolated to an increased error rate or dropped BSMs that would likely result in failure of critical safety applications. This is supported by the anecdotal evidence from the issues witnessed during 1st ORD attempt.



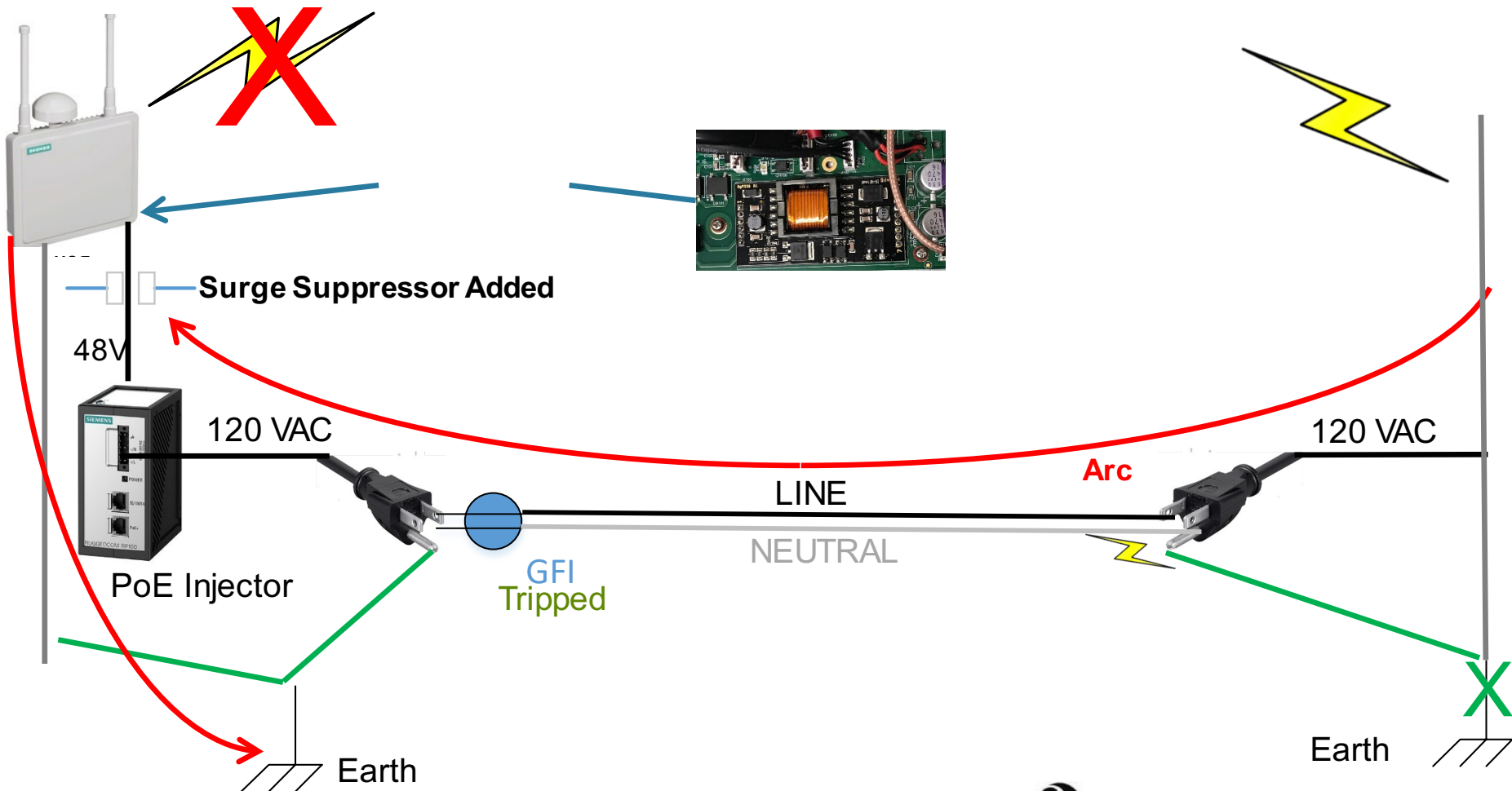
Current Conditions and Next Steps

- Current Conditions
 - Interference that can be tied directly to FSG has not been documented since November order by FDOT
 - One period of LLC traffic was recorded by SXM over a 3 hour timeframe, in a single location. We believe this may be related to an upgrade to network equipment in support of PCW at the Courthouse. The new devices required a firmware update via OTA from the manufacturer with a proprietary channel in the high 5.8 range. The timeframe loosely correlates and we suspect bleed over to DSRC 176.
- Next Steps
 - Continue periodic, scheduled scans for interference.
 - Share White Paper on DSRC Interference created during early steps to address issue
 - Share info on additional interference from FSG or other 3rd parties with all sites, as well as other CAV stakeholders. AASHTO has taken a strong interest and asked for a follow up presentation to the larger membership after initial presentation to CTSO committee.
 - Publish final report in Spring 2019. (USDOT and Pilot sites followed by wider distribution after review)

LESSONS LEARNED - ELECTRICAL STORMS



Condition: RSU Damage



STAY CONNECTED



Join us for *Using Connected Vehicle Technologies to Solve Real-World Operational Problems Series* at

<https://www.its.dot.gov/pilots/>

- Discover more about the CV Pilot Sites
- Learn the Essential Steps to CV Deployment
- Engage in Technical Discussion

Visit the Pilot Site Websites for more Information:

- NYCDOT Pilot: <https://www.cvp.nyc/>
- Tampa (THEA): <https://www.tampacvpilot.com/>
- Wyoming DOT: <https://wydotcvc.wyroad.info/>

Contact for CV Pilots Program:

Kate Hartman, Program Manager

Kate.hartman@dot.gov

Contact for Pilot Sites:

- Kate Hartman, WYDOT Site AOR
Kate.Hartman@dot.gov
- Jonathan Walker, NYCDOT Site AOR
Jonathan.b.Walker@dot.gov
- Govind Vadakpat, THEA Site AOR
G.Vadakpat@dot.gov





Questions and Answers

Please Type your questions in the Q & A pod and we will answer as time allows.

Contacts:

Govind Vadakpat , Ph. D.

Research Transportation Specialist
Office of Operations R&D
G.Vadakpat@dot.gov

Robert M. Frey, AICP

Director of Planning & Innovation
Tampa-Hillsborough County Expressway Authority
bobf@tampa-xway.com

Steve Johnson, CISSP, CVP

Associate Vice President
Connected Vehicle Program Manager
stejohnson@HNTB.com

Dave Miller

Principal Systems Engineer
Siemens Industry, Inc.
miller.dave@siemens.com

Rafal Ignatowicz

Vehicle Integration Technical Lead
Brandmotion
rignatowicz@brandmotion.com



Feedback

- A feedback form will be emailed to all participants following the webinar. Please take a few minutes to fill it out – we value your input. The form contains information for those requesting Professional Development Hours (PDHs).
- To receive notifications of upcoming webinars, send an email to ITS_Help@dot.gov with “Add to mailing list” in the subject line.

Thank you!



Contact and Resources

- Contact us at: ITS_Help@dot.gov
- ITS PCB: <http://www.pcb.its.dot.gov>

Thank you!