



CONNECTED VEHICLE PILOT Deployment Program



THEA Pilot Acquisition and Installation Experiences



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TODAY'S AGENDA



- Purpose of this Webinar
 - Provide an overview of the approach for identifying the type and number of devices, equipment, and software-based capabilities that needed to be acquired
 - Share experiences of engaging with vendors and getting the devices in hand and installed while adhering to a stringent installation schedule
 - Identify technical and other barriers and how they are being overcome

- Webinar Content
 - Connected Vehicle Pilot Deployment Program Overview
 - THEA Pilot Acquisition and Installation Experiences
 - 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



PILOT SITES



WYDOT



NYCDOT



Tampa (THEA)

STAY CONNECTED

- Participate in upcoming Webinars/Conference Presentations from the three Pilot Sites (see website for exact dates and times)

July 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019
◆ ◆ ◆		●		◆ ◆ ◆		●
Device Acquisition and Installation		ITE Annual Meeting		Operational Readiness		TRB

◆ Public Webinars ● Conference Presentations

- Visit Program Website for Updates: <http://www.its.dot.gov/pilots>
- Contact: Kate Hartman, Program Manager, Kate.Hartman@dot.gov





THEA CV Pilot Deployment Overview

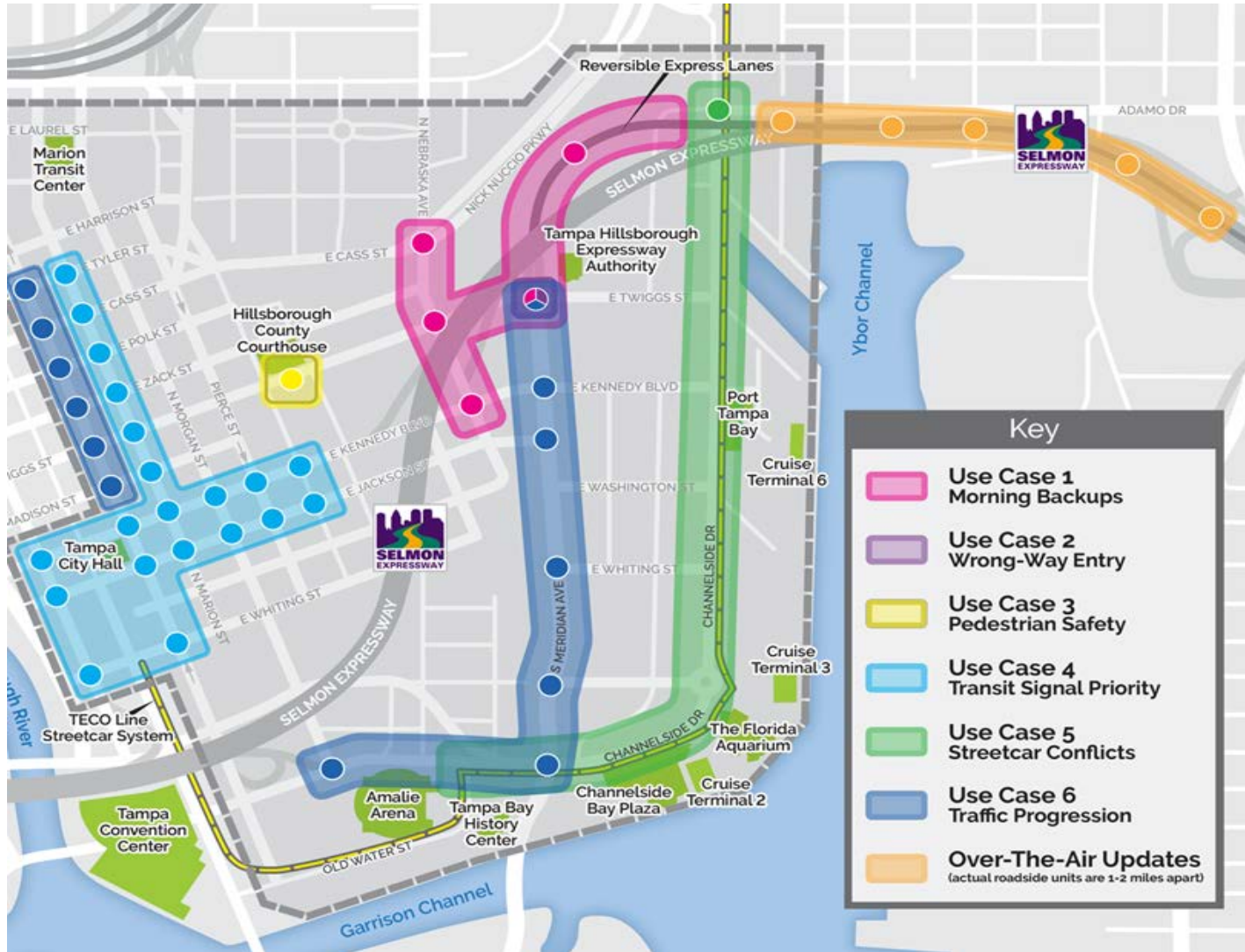


Rafal Ignatowicz Brandmotion

Dave Miller, Siemens



Pilot Site Overview: Location



Pilot Site Overview: Vehicles



1,600

Privately Owned Vehicles



10

TECO Line Streetcars



10

HART buses

Equipment Type	# Procured	# Installed
Vehicle OBU	1,610	1,580
Streetcar/Bus OBU	25	20
Antennas, 3 per vehicle	4,850	4,800



Pilot Site Overview: Roadside



PHOTO: SIEMENS

44

Roadside Units



PHOTO: SIEMENS

1

Pedestrian Detector



PHOTO: WAVETRONIX

1

Vehicle Detector



PHOTO: MsSedco

1

Wrong Way Detector

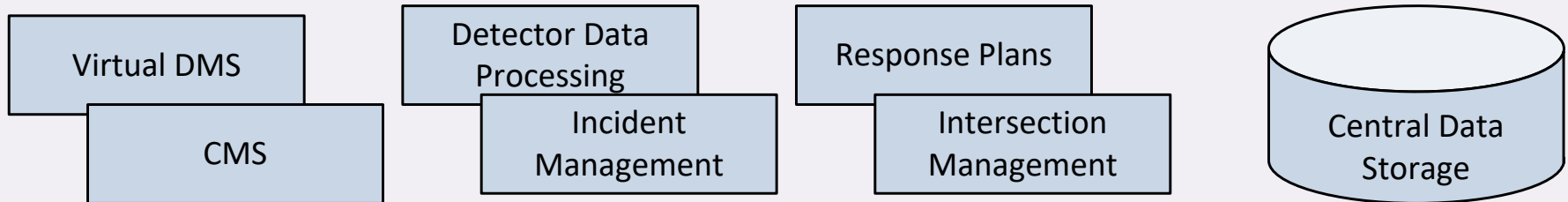
Equipment Type	# Procured	# Installed
RSU Kits	65	44
Pedestrian Detector Kit	1	1
Vehicle Detector Kit	1	1
Wrong Way Detector Kit	1	1



Pilot Site Overview: Master Server

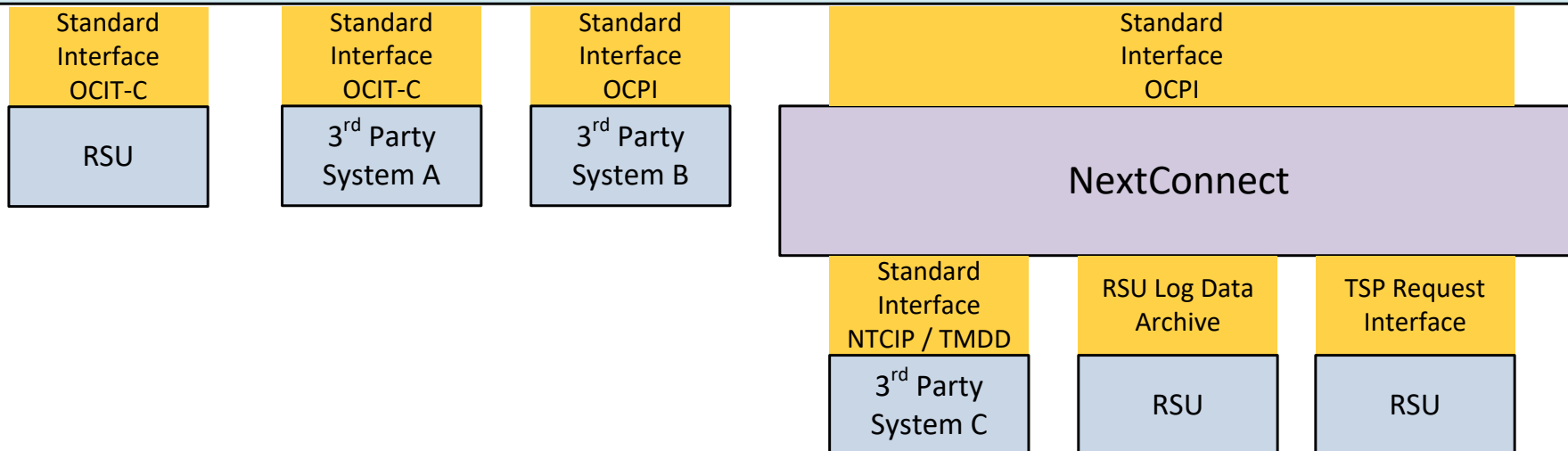


Sitraffic Concert

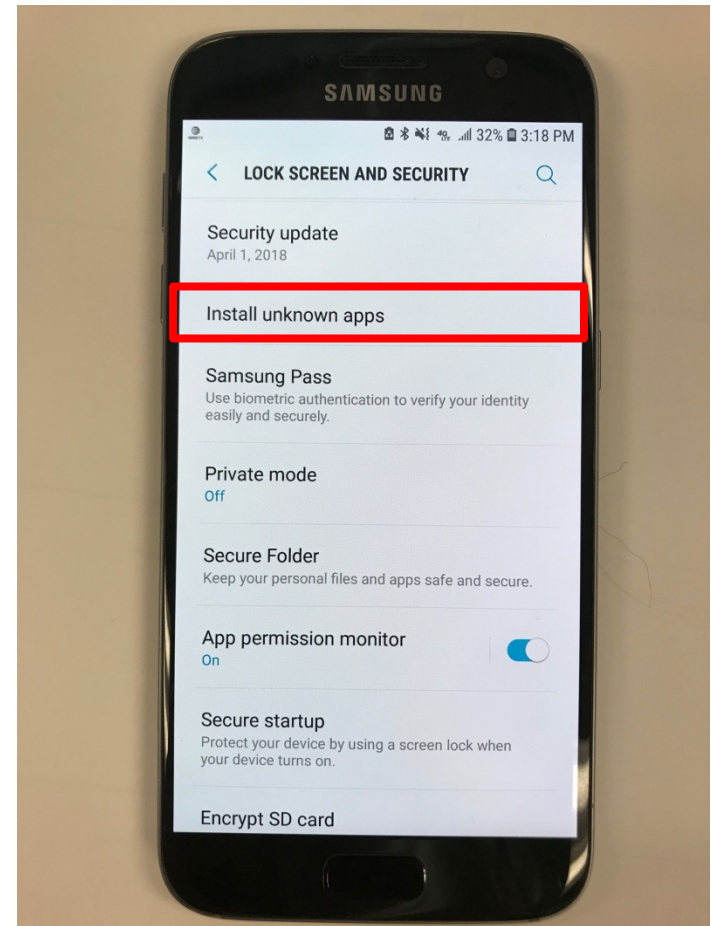


Middleware

SOURCE: SIEMENS



Pilot Site Overview: Personal Device



500+

Private Smartphones



Pilot Site Overview: Software Apps



App	RSU SW Object	OBU SW Object	PID SW Object	MS Software
WWE	Siemens	OBU Vendors		
PED-X	Siemens	OBU Vendors	Siemens	
ERDW	Siemens	OBU Vendors		
IMA		OBU Vendors		
EEBL		OBU Vendors		
FCW		OBU Vendors		
VTRFTV		OBU Vendors		
PTMW	Siemens	OBU Vendors	Siemens	
PCW		OBU Vendors		
I-SIG	OSADP	OBU Vendors		
TSP	OSADP	OBU Vendors		Siemens
PED-SIG	OSADP		OSADP	
PDETM	Siemens	OBU Vendors		Siemens



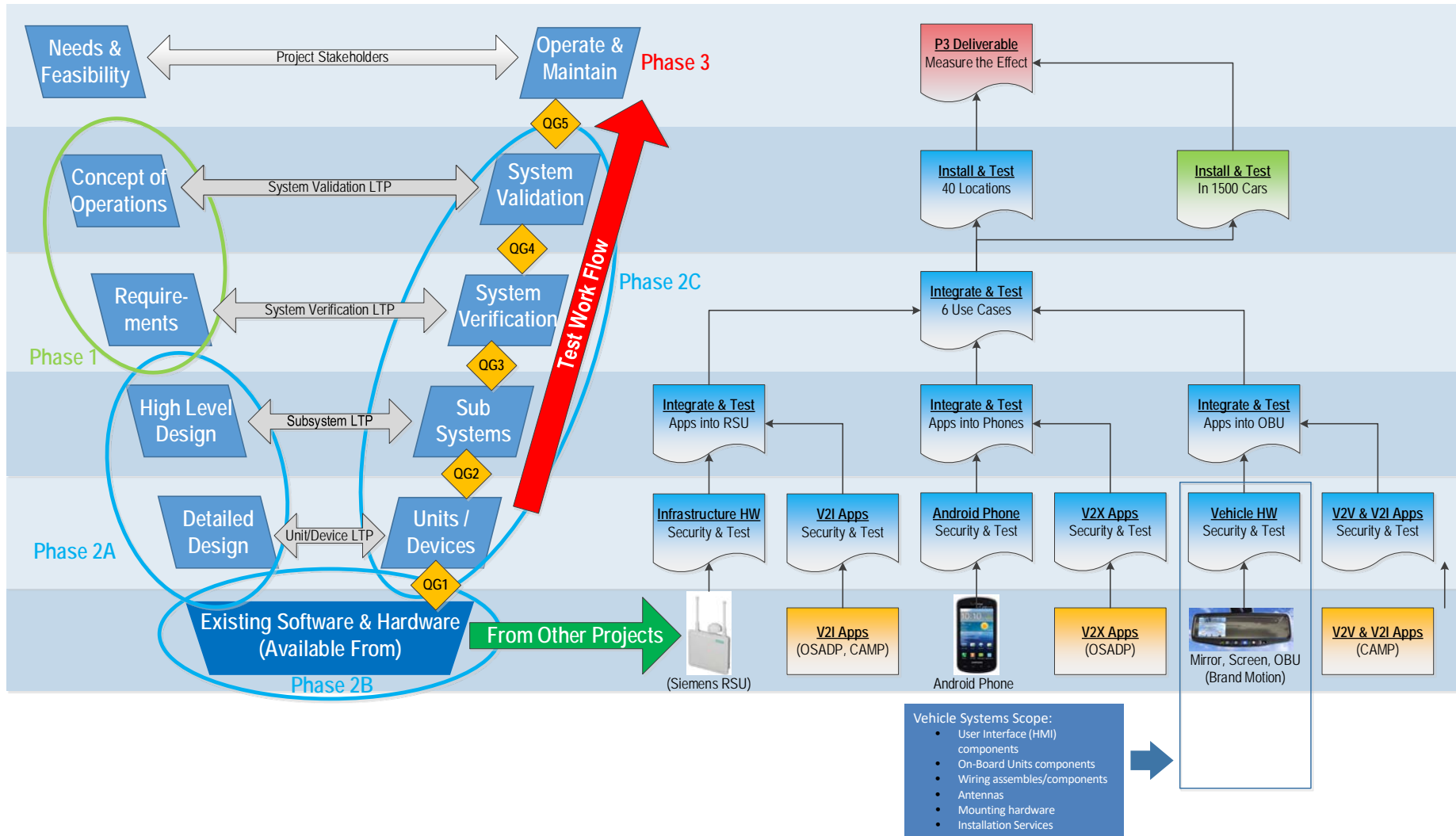
THEA CV Pilot Acquisition Experiences

Rafal Ignatowicz, Brandmotion

Dave Miller, Siemens



Vehicle System Acquisition Approach



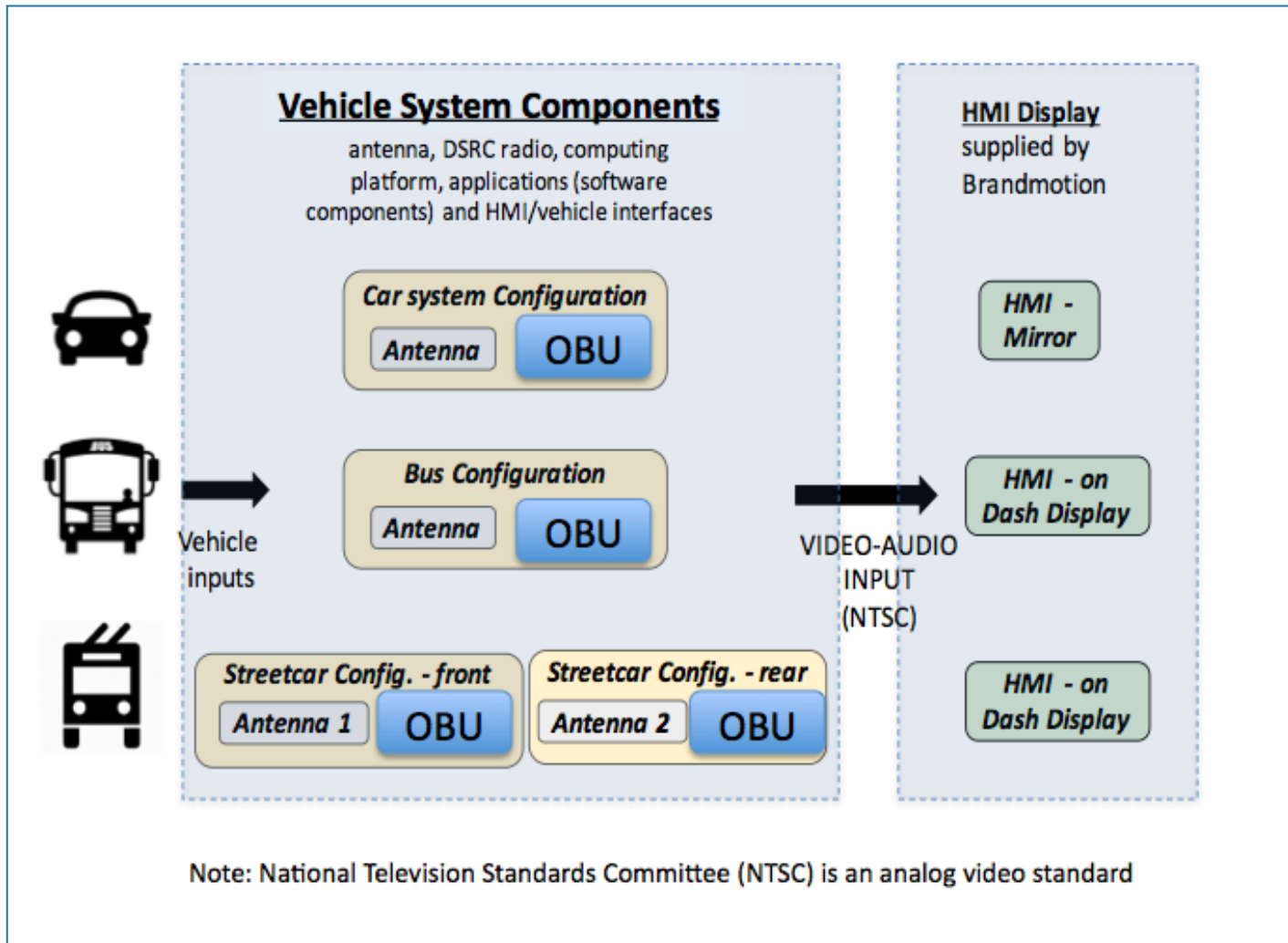
Vehicle System Acquisition Approach



Brandmotion's role in the acquisition was to source and procure the following:

- Human Machine Interface (HMI) components for cars, buses and streetcars
 - ^a Mirrors, Monitors, Speakers
 - ^a Driver display graphics and auditory design
- On-Board Units (OBUs) components (multiple suppliers)
- Wiring assemblies/components (Brandmotion and supplier sourced)
- GPS and DSRC Antennas (multiple suppliers)
- Mounting hardware
- Installation Services

Vehicle System Acquisition Approach



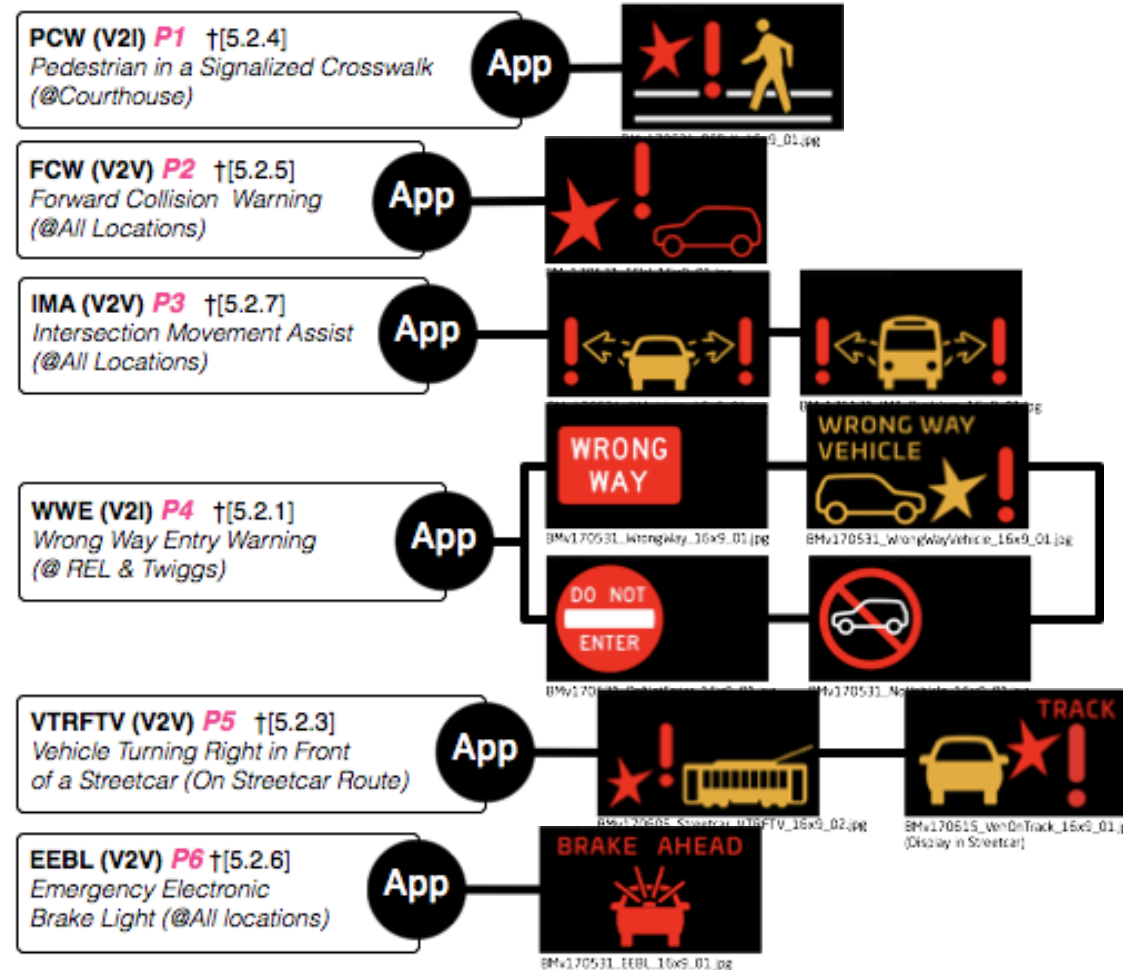
Vehicle System Acquisition Approach



HMI Design

- Screen Warnings combine US DOT road signage with symbols based on ISO 2575 design practices
- We are following SAE J2395 2002-02 to determine a Warning Message priority for the THEA Pilot. Our warnings are direct, highly relevant, and have an emergency time frame.

Warning Priority Manager (P1 high > P2 > P3 > P4 > P5 > P6 low):



Vehicle System Acquisition Approach



Brandmotion used a process flow during the acquisition portion of this project that included the following key steps of engineering design, supplier selection, sourcing and testing, and process improvement.

Key aspects of the Brandmotion *Supplier Policy* include customer focus, quality assurance, supplier privacy and compliance and supplier requirements to address governance, conflict of interest, anti-corruption, adherence to applicable government regulations and quality record retention.



1. Create Product Design Assumptions - completed in Phase 1 with Tampa CVP input

- Product concept and key functional requirements

Vehicle System Acquisition Approach



Product Design Assumptions
Sep 2016

Request for Proposal
Oct 2016

Request for Quotation
Dec 2016

Supplier Selection
Jan 2017

Sourcing Commitment
Feb 2017

Finalizing Specifications
Jul 2017

Final Component Acquisition
Oct 2017

Post Program
Sep 2018

2. Initiate Request for Proposal as needed - completed early in Phase II with Tampa CVP input

- Identify potential partners/suppliers and specific targets
 - ª Identified key long lead and strategic components (e.g. OBU)
 - ª Brandmotion's strategy for success is early sourcing and partnerships
- Evaluate and source key suppliers
 - ª Directional specification
 - ª Warranty Requirements
- Refine design assumptions with supplier input
- Shortlist of interested and capable suppliers

Vehicle System Acquisition Approach



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Oct 2017

Post Program
Sep 2018

3. Required Request for Quotation to evaluate partners/suppliers - completed with Tampa CVP input and review

- Commercial/Legal requirements
 - a Business aspects/volumes
 - a Selection criteria
 - Musts: performance (based on technical requirements), timing (based on milestones), affordability/availability, application support, technical capability/track record.
 - Wants: Application quality (demonstrated), technical skills, delivery, previous experience, commitment and support, value added proposals
- Program requirements (timing)
 - a Customer input
- Technical Requirements/Specification
 - a Core engineering with Marketing Support

Vehicle System Acquisition Approach



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Post Program
Sep 2018

4. Supplier Selection - completed with Tampa CVP input

- Program musts (requirements) shall be met
- Program wants forced ranged and weighted (Kepner-Tregoe)
- Antennas were methodically tested and statistical analysis was applied in order to make the final selection (Reference SAE Paper)
- Evaluation matrix with sourcing team assessment, client input
- Appropriate feedback to non-selected suppliers

Vehicle System Acquisition Approach



Product Design Assumptions
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Post Program
Sep 2018

5. **Early Sourcing commitment for long lead components (OBU) – completed with Tampa CVP input.**
 - Sourcing letter or Memorandum of Understanding (MOU) to align agreement to program targets

Vehicle System Acquisition Approach



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Final Component Acquisition
Oct 2017

Post Program
Sep 2018

6. Finalize Specifications, and Statement of Work (SOW) with Program Timing - completed with Tampa CVP input

- Collaborative supplier involvement
 - ^a Weekly meetings and discussions to finalize specifications for hardware and software
 - ^a Monthly on site design reviews with all partners
- Non-disclosure agreement

Vehicle System Acquisition Approach



Product Design Assumptions
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Final Component Acquisition
Oct 2017

Post Program
Sep 2018

7. Program Execution, Final component acquisition

- Contracts
 - a Terms and conditions – reflect client requirements
 - a Service Level Agreement (SLA) to address technical support and other associated services
 - a SOW to define supplier, client and Brandmotion roles and timing for development/verification
- Development program
 - a Program managers selected
 - a Design reviews monthly with biweekly telecons
 - a Shared document process
 - a Verification testing
- Product/service delivery
 - a Issue Purchase Orders
 - a Complete acquisition matrix (part of the CIP)
 - a Validation
 - a Technical support



Vehicle System Acquisition Approach



Product Design Assumptions
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Request for Proposal
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Post Program
Sep 2018

8. Post Program, Phase III – Scheduled to begin September 1st, 2018

- Continuous Improvement
 - a Target improvement
 - a Lessons learned
 - a Supplier assessment/feedback
- Ongoing technical support
 - a Resolve technical issues
 - a Staffed Hotline
 - a Warranty

Vehicle System Acquisition Approach



Major vehicle system suppliers are as follows:

- OBU Suppliers:
 - Savari
 - SiriusXM
 - Commsignia
- Antenna Supplier:
 - Harada
 - SiriusXM (provides their own antennas for their OBUs)
- Common OBU Specification, across all suppliers was released July 2017 and to meet the program requirements
- Brandmotion acquired and assembled all vehicle system related components as a kit, that is all necessary components assembled/packaged together, for the installers at Hillsborough Community College (HCC) who is Brandmotion's installation partner

Vehicle System Acquisition Approach



Technical and other barriers

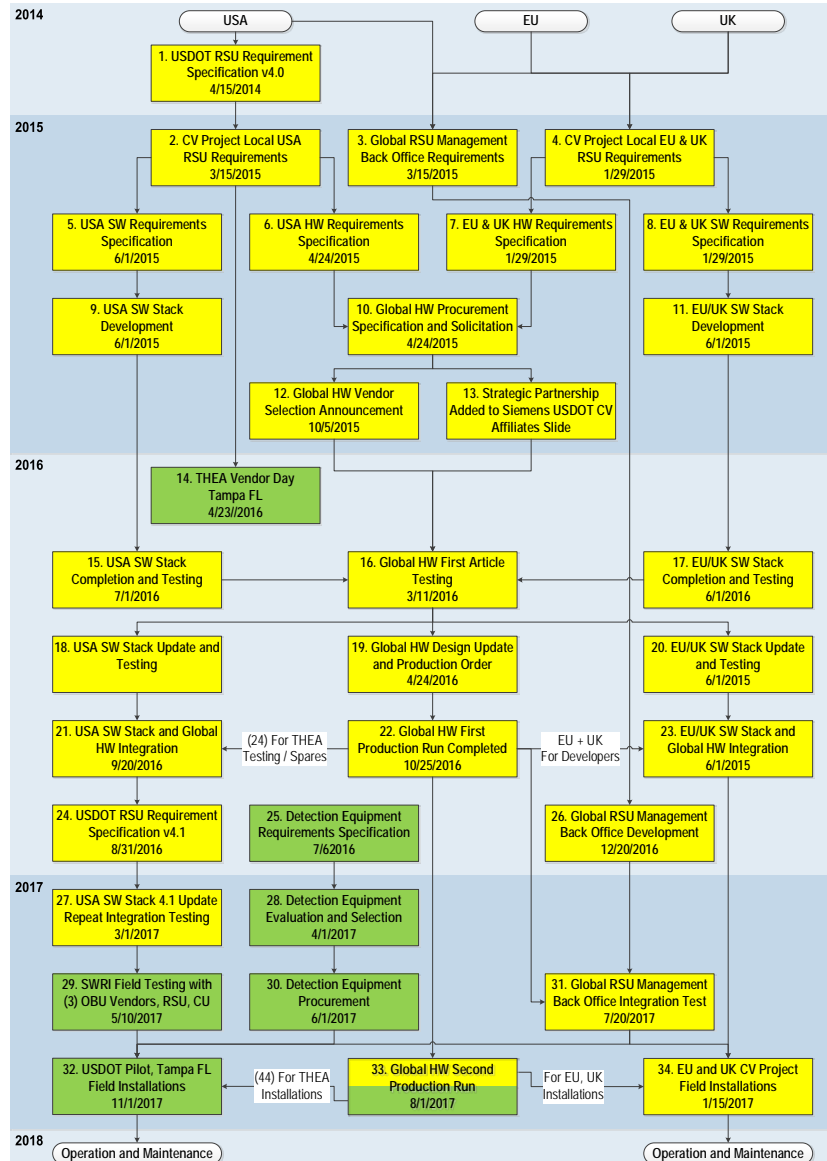
- Being at the forefront of innovation
 - Unspecified requirements
 - Changing standards

RSU Acquisition Approach



Pilot

~~Pilot~~



Ancillary Equipment Acquisition



Ancillary Equipment Acquisition

Pedestrian Detector	Vehicle Detector	Wrong Way Detector
Lidar: Metrotech	Radar: Wavetronix	Microwave: MsSedco
Lidar: Quanergy	Radar: Siemens	Radar: Wavetronix
Radar: Wavetronix	Video: Iteris	Radar: Siemens
Radar: Siemens	Video: Econolite	Video: Iteris
Video: Iteris	Video: Flir	Video: Econolite
Video: Econolite	Video: Gridsmart	Video: Flir
Video: Flir		Video: Gridsmart
Video: Gridsmart		

Master Server Acquisition



Master Server Acquisition

Hardware / Virtual Machine	Vehicle Detector
Physical Rack Server Host	(12) CPU Cores x 1.9 GHz
VM #1: Concert App Server	MS Windows™ Server x64
VM #2 Concert Workstation	MS Windows™ 7 x64
VM #3 NexConnect Server	MS Windows™ Server x64
VM #4 MS SQL Database Server	MS Windows™ Server x64
Workstation	Core i5-6400, MS Windows 7 x64



THEA CV Pilot Installation Experiences

Rafal Ignatowicz, Brandmotion

Dave Miller, Siemens



Vehicle System Installation Approach



- The installation of competed systems consists of three vehicle system types
 - 1600 participant/private passenger vehicles
 - 10 buses
 - 10 streetcars
- Hillsborough Community College is under contract to Brandmotion to provide installation services
 - Safe and accessible facilities
 - Brandmotion supplied certified installers
 - Installer candidates and student helpers
- Students at HCC are given an opportunity to expand their automotive knowledge while installing on participant vehicles as part of their studies/training to become certified mechanics
- Buses and streetcar installations are done with collaboration with HART, the local transit authority using Brandmotion's installers

Vehicle System Installation Approach



High-level inventory of vehicle equipment procured and installed

Equipment Type	Total to be Configured & Installed	Currently Configured & Installed
Vehicle OBUs	1600	500
Streetcar OBUs	10	10
Bus OBUs	10	5

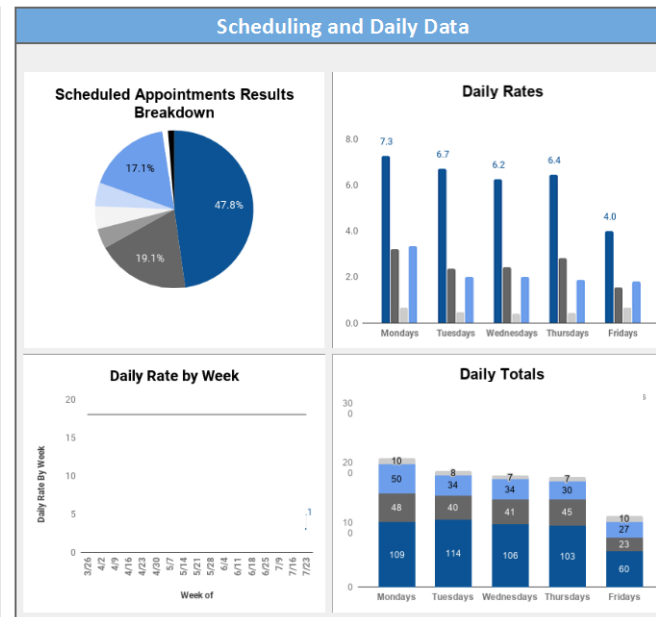
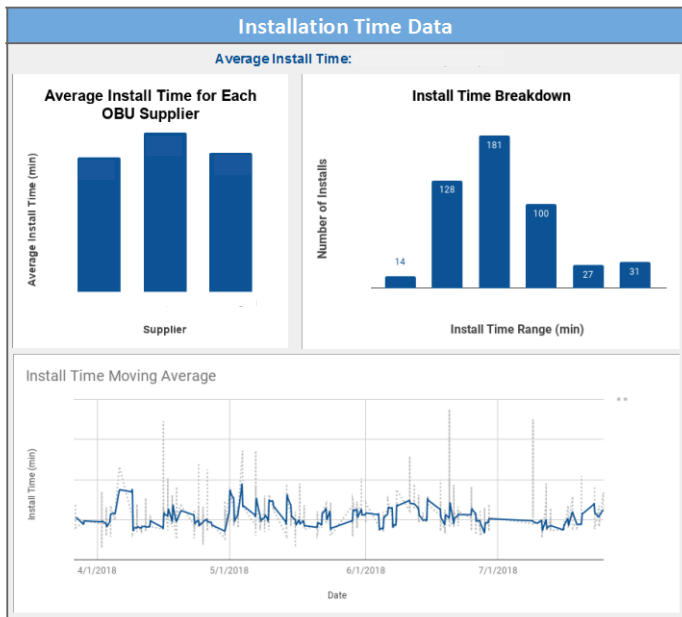
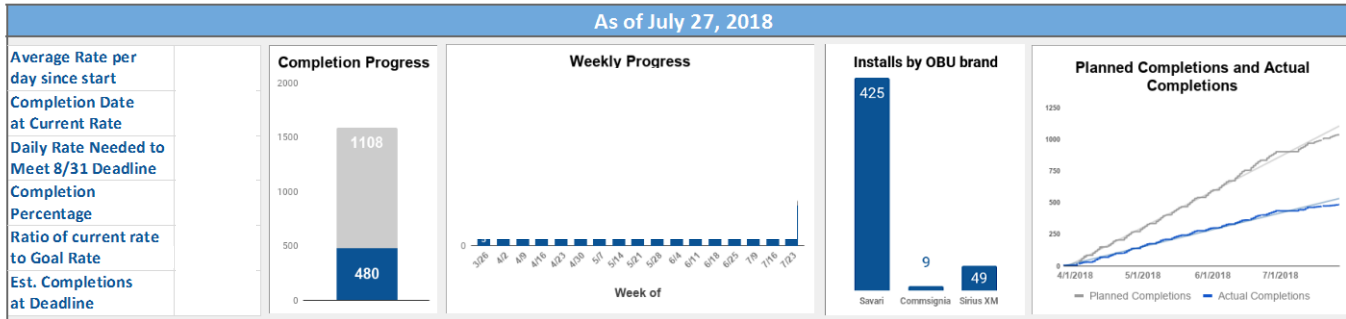
Vehicle System Installation Approach



Brandmotion created a dashboard as high level project management tool

Tampa CV Project Scorecard

As of July 27, 2018



Vehicle System Installation Approach



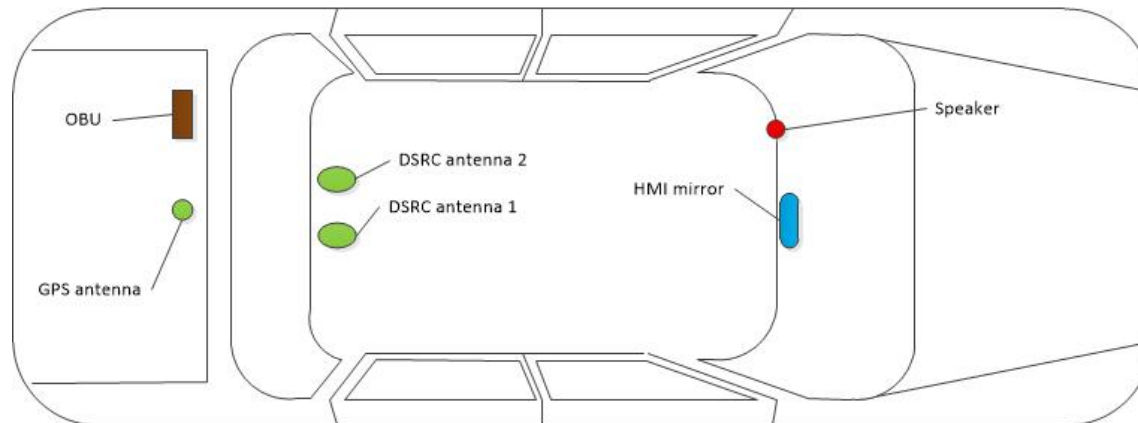
- Brandmotion communicated OBU technical information to the suppliers through a document, VEHICLE SYSTEMS - OBU COMPONENT SPECIFICATION, OBU_COMPSPEC_BM_THEA v2.2 which incorporated the requirements from the System Architecture Document (SAD) and the System Design Document (SDD).
- Brandmotion procures the Onboard Units under contract and Service Level Agreement from Commsignia, SiriusXM and Savari.
- The antennas are purchased from Harada
- Wiring, video adapters and display components are designed and procured separately by Brandmotion

Vehicle System Installation Approach



- Each vehicle will have
 - Two DSRC antennas
 - GNSS antenna
 - An OBU hidden and installed in the trunk of the car
 - A mirror with a speaker up front for the interface with the driver

Car – BM Installed components
External ■ Hidden ■ Driver view ■



Vehicle System Installation Approach



- Antenna Configuration

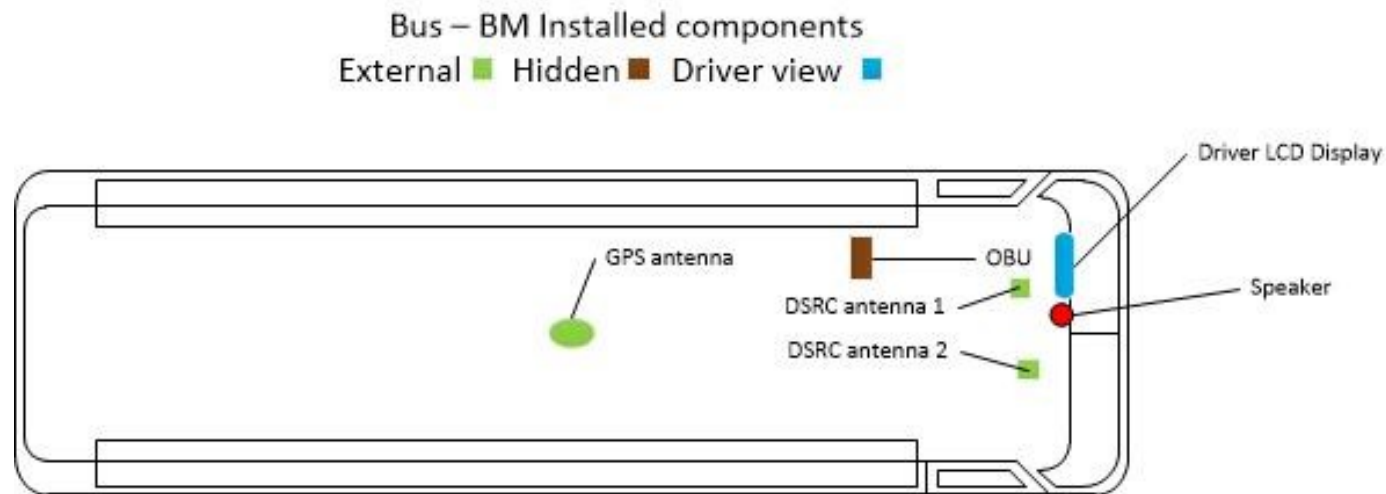
- Multiple antenna configurations are exercised during installation depending on vehicle type. Below is an example of one. Also, depending on the OBU and vehicle type, the OBU could be mounted in different locations.



Vehicle System Installation Approach



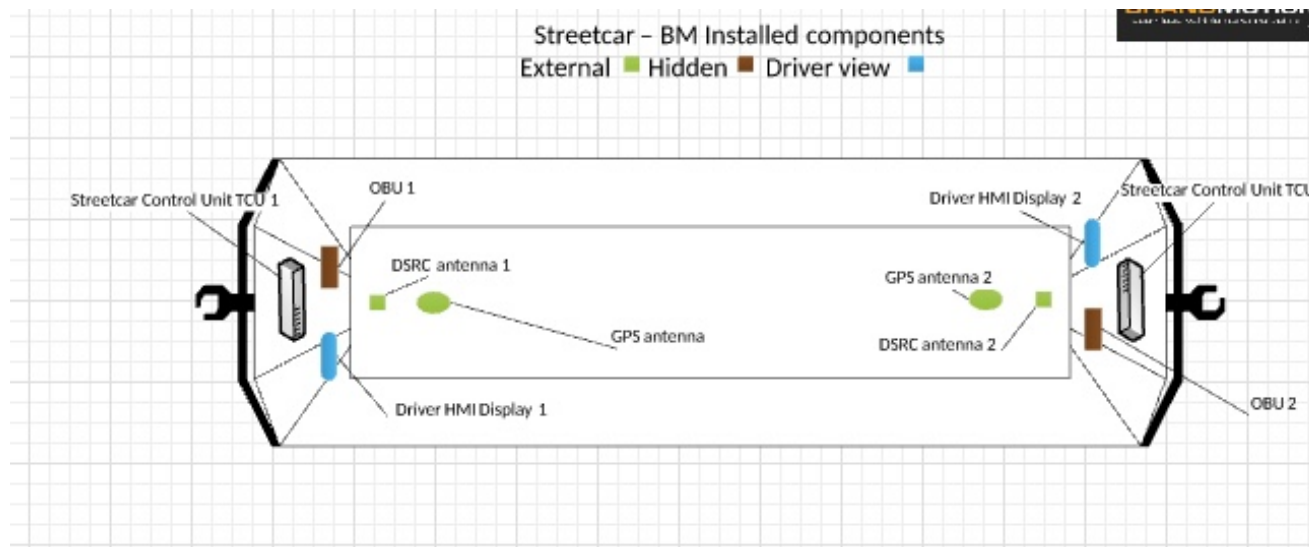
- Each bus will have
 - Two DSRC antennas
 - GNSS antenna
 - An OBU hidden and installed inside a cabinet
 - Display with a speaker up front for the interface with the driver



Vehicle System Installation Approach



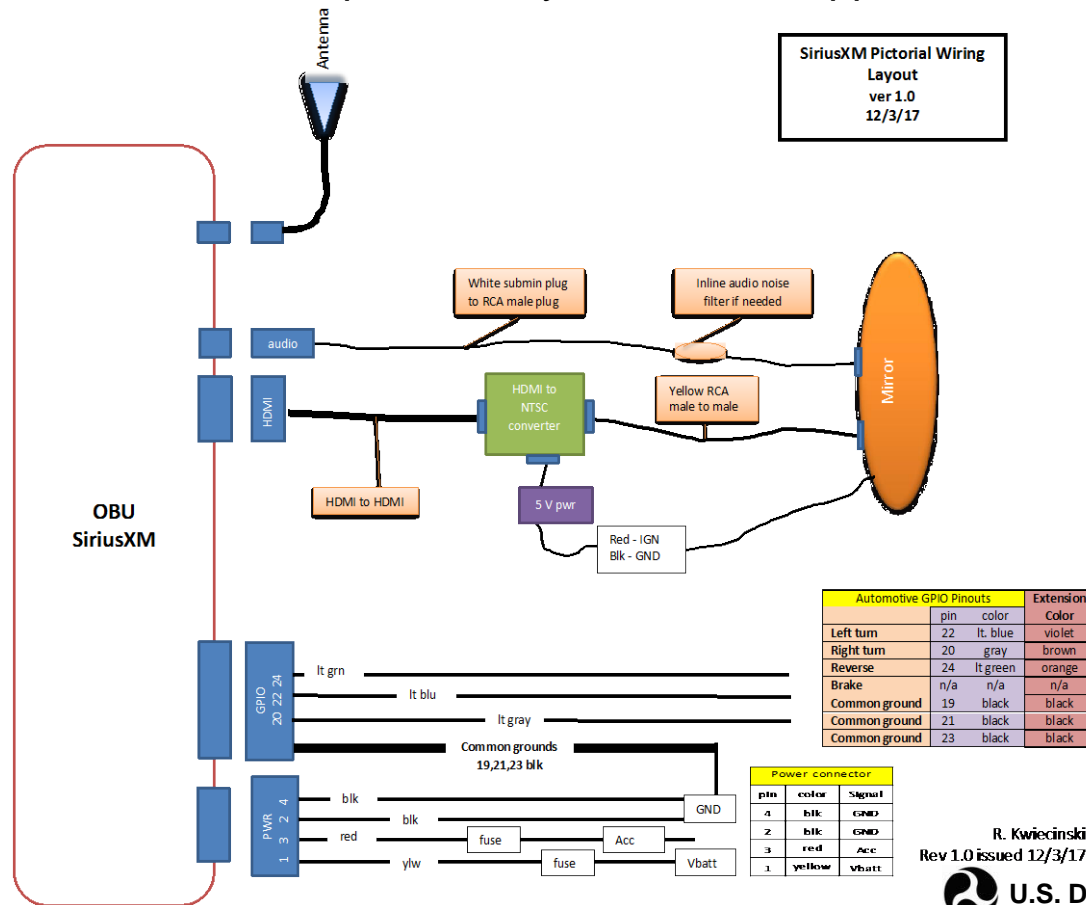
- The streetcar physical architecture requires two separate vehicle systems, as the streetcar reverses direction and the operator moves to the other end of the streetcar.
- Each streetcar will have
 - Four DSRC antennas
 - Two GNSS antenna
 - Two OBUs hidden and installed inside a cabinets
 - Two displays with a speakers on each end of the streetcar for the interface with the driver



Vehicle System Installation Approach



The OBUs will come pre-configured from the vendor for the vehicle type they will be installed on. The hardware from the OBU vendors will then be joined with wiring harnesses that match the vehicle type. Final software configuration will be done by the installer with the instructions provided by each OBU supplier.



Vehicle System Installation Approach



Prior to Installation

- Potential participants sign up online and fill out a survey that provides Brandmotion with details about their vehicle.
- This information is then used to determine if the vehicle can participate in the pilot
- Some disqualifying features include removable roofs, all glass roofs, safety systems implemented in the rear-view mirror, etc.
- Once the vehicle is approved, the participant is able to come in for an installation

Vehicle System Installation Approach



Participant Appointments

- Two-hour appointment block is required for:
 - Inspection of the vehicle
 - Installation of antennas, on-board units, and rear-view mirrors to the participant's approved vehicle
 - Training session for the participant on the usage and intended reactions regarding the equipment and safety messages they will receive
 - Receipt and signature by the participant of an informed consent document regarding their participation in this human use study

For the bus and streetcar installations, HART will provide training to their drivers separately and the informed consent form will be from HART, not individual bus/streetcar drivers like it is for participant vehicles

Vehicle System Installation Approach



Installation Process

- The technician(s) will remove the existing rear-view mirror, placing the stock part in a container to be returned to the participant.
- The custom kit, provided by Brandmotion, will then be installed, including the OBU in the trunk or under dash of the vehicle, antenna(s) on the roof of the vehicle, wiring along the frame of the vehicle, and the rear-view mirror with video display along the windshield or ceiling of the vehicle.
- Following installation, the technician(s) will test the connection between the OBU and a stationary RSU located in the bay, or outside for clear sky reception. The technician will make certain data is received by the RSU, and that safety messages are received by the OBU, and transmitted to the screen in the newly installed rear-view mirror.

Once installation has begun, the participant will be trained in the use cases, warning system, and intended reactions. A series of videos will be shown to the participant, along with visuals for each individual safety message that will be displayed. The participant will also be informed of the control and treatment groupings, but will not be informed as to which set they will placed in during the test phase of the pilot.

Vehicle System Installation Approach



Warranty

- Sparing strategy keeps a stock of all parts for timely service. Brandmotion has warranty agreements in place with the OBU suppliers that include Service Level Agreements (SLA), which provide technical support over the life of the pilot. The warrant agreement requires replacement parts for all defects. The contingency plan is for the OBU suppliers to provide onsite technical support if and when needed. The SLA has performance measurement requirements to ensure timely response to problems.

Vehicle System Installation Approach



Technical and other barriers

- Working with the public
 - Participants showing to appointments
- Changing standards
- Certifications
- Multiple OBU suppliers
 - Managed collaboration among competitors
 - Application development
 - Component delays
- Training of HCC students
- Installation complexities
 - CAN Decoder

Infrastructure Installation Approach



Equipment	Installer
RSUs	Siemens Service, Southeast Operations
Pedestrian Detector	Siemens Service, Southeast Operations
Vehicle Detector	Siemens Service, Southeast Operations
Wrong Way Detector	Siemens Service, Southeast Operations
Master Server	Siemens ITS, Austin TX
Cyber Security	Siemens Corp. Technologies, Princeton NJ
PID Apps	Private PID user

Infrastructure Installation Approach



MAP Files, Application Installation



SIEMENS
Ingenuity for life

RSU Control Application

English

Status Network Wireless GPS Monitor ITS Extra System Extension

Services

OK - 265 Units

Device

OK - its-10-01-b8: up 15:04:34 17.03a.13527 arm-imx6 T(e):30C T(w):30C

Load

OK - Load average: 0.33, 0.13, 0.10

Memory Usage

OK - 87.18% free

Date & Time

OK - TC: N/A GPS: N/A NTP: OK(647/647)

Database

OK - DB is alive 784 nodes

Connections

OK - eth0:dhcp:routeable br0:dhcprsv:routeable cw-llc:off:off eth1:bridge:no-carrier eth2:off:off wifi0:bridge:carrier

VPN Connection

UNKNOWN - not enabled

Bluetooth

UNKNOWN - Disabled

LTE Connection

UNKNOWN - Modem disabled

MAC 80211p

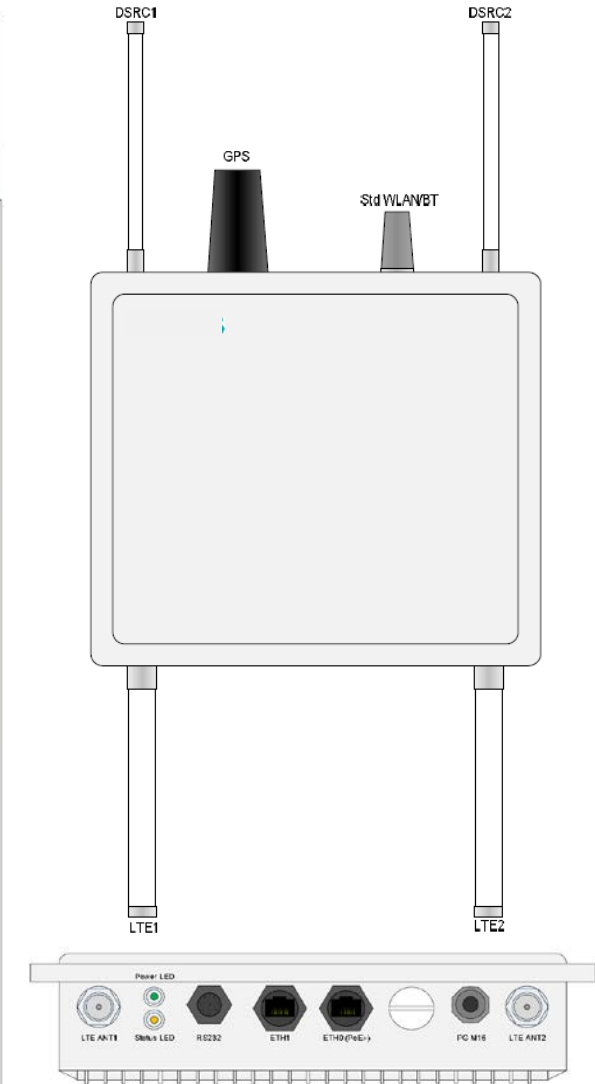
OK - WAVE: CCH(00:0d:41:10:02:b8:1873713,3869747) SCH1(00:0d:41:10:02:b9:5226155,0) SCH4(00:0d:41:10:02:bb:5226155,0) SCH6(00:0d:41:10:02:ba:5226155,0)

ITS 1609 NET

WARNING - no registration PPS: 1490991838

Controller proxy

UNKNOWN -



Infrastructure Installation Approach



Infrastructure Installation Timeline



Process	Dates
RSU Site Survey	July 2017
RSU MAP Files, Install Apps	July 2017 to October 2017
RSU Installation	August 2017 to November 2017
Vehicle Detector Site Survey	July 2017
Vehicle Detector Installation	March 2017
Wrong-Way Site Survey	July 2017
Wrong-Way Installation	August 2017
Pedestrian Detector Site Survey	July 2017
Pedestrian Detector Installation	August 2018
Master Server Network Design	June 2017
Master Server Installation	September 2017 to October 2017
Master Server Security Scan	July 2018

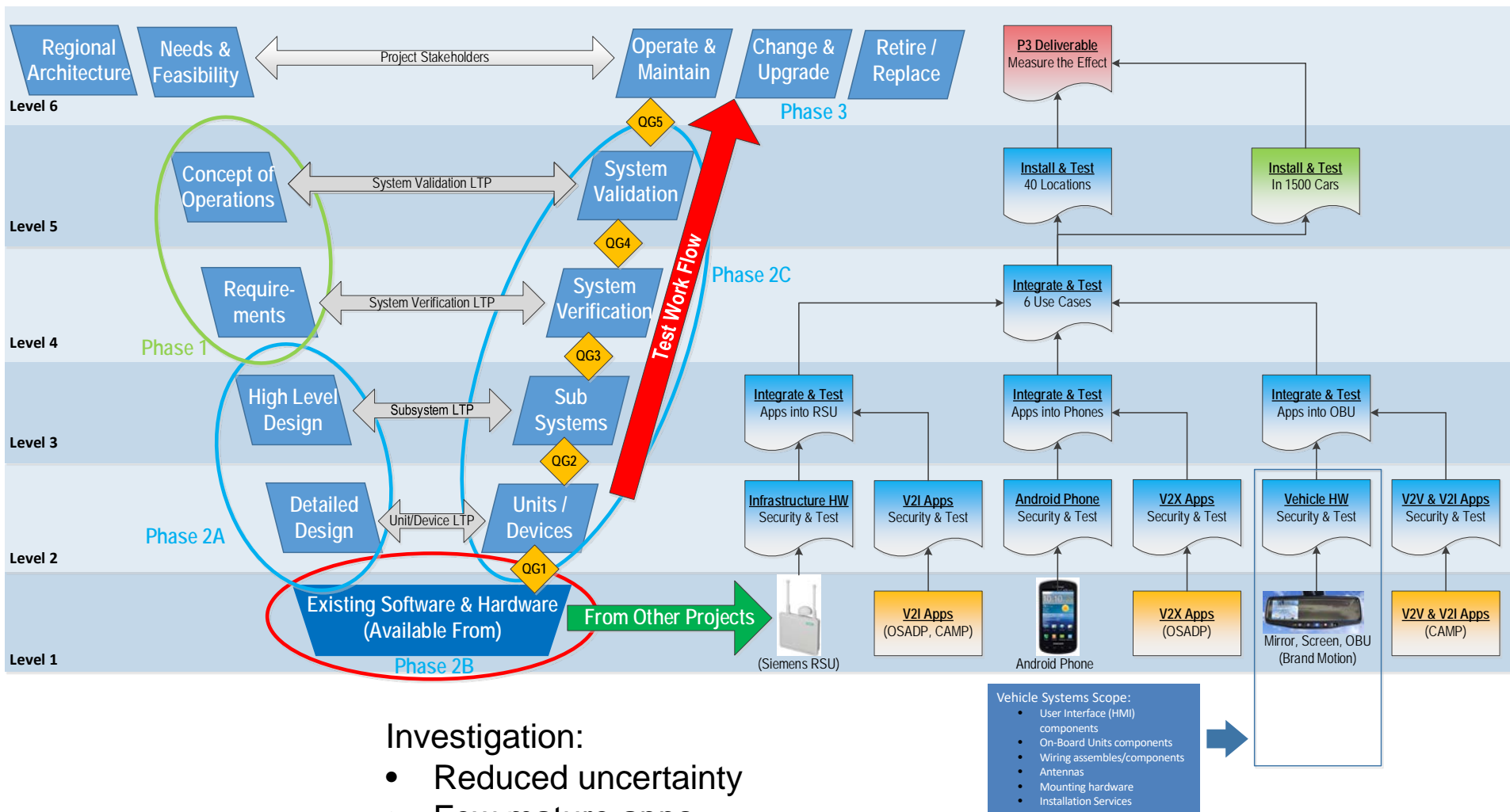
Installation Risk Mitigation



Technical Barrier	Mitigation
Wind loading	Extended antennas for line-of-sight
HamWAN Interference	Identified source, cooperating to resolve
OBU software updates	Over the Air updates RSU → OBU
Infrastructure power	Permitting
Fiber connections	RSU cellular backhaul
SCMS delivery	Private SCMS



Workflow: Early Investigation

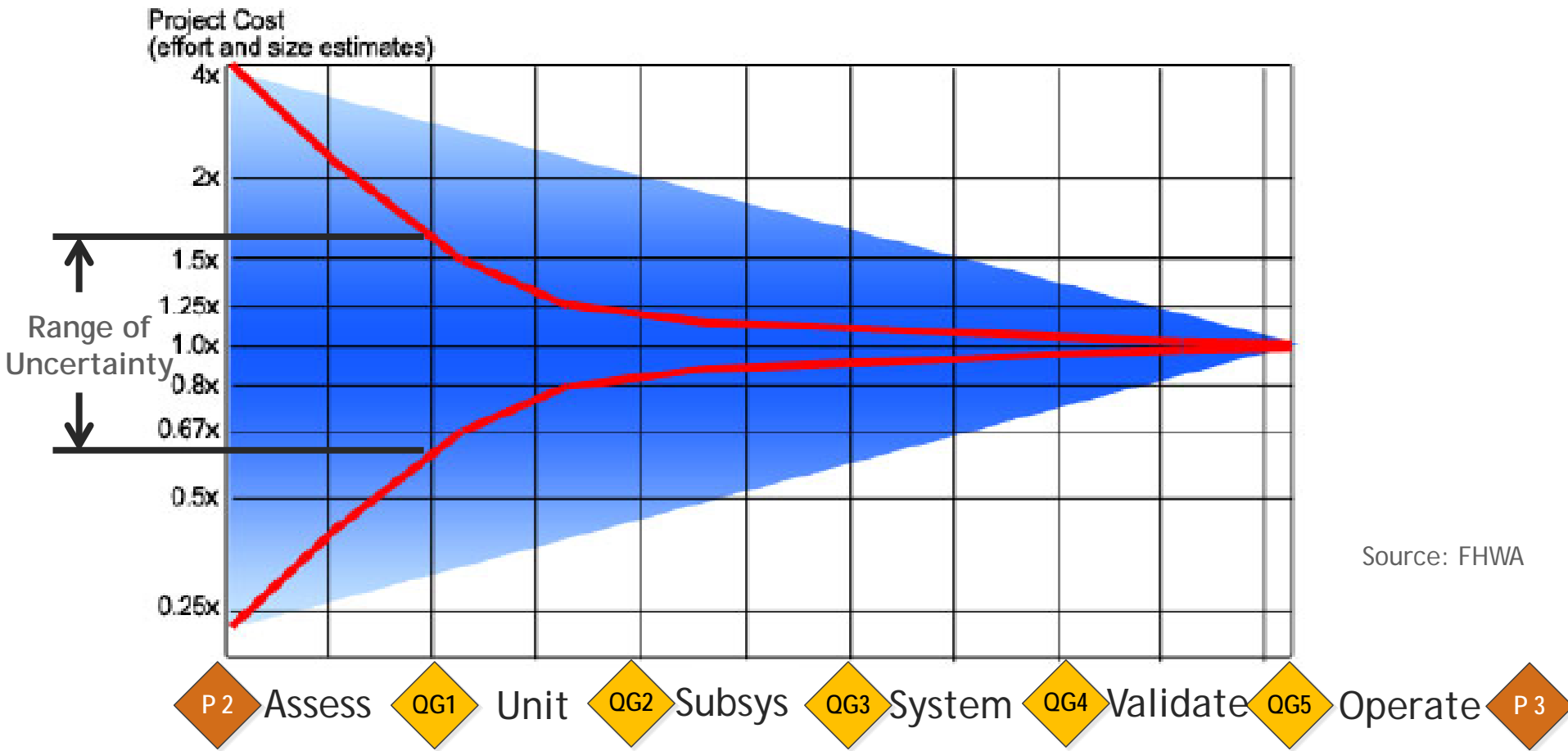


Investigation:

- Reduced uncertainty
- Few mature apps
- No OBU specifications



Installation Risk Reduction



Site Surveys, OBU specifications, others

Contact Information



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STAKEHOLDER Q&A



- Please keep your phone muted
- Please use chatbox to ask questions
- Questions will be answered in the order in which they were received

STAY CONNECTED



Join us for the *Ready to Design, Build, and Test Operational Systems Series*

- 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://wydotcwp.wyroad.info/>

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