



MD 214 PEDESTRIAN I2V DEPLOYMENT

Warren Henry P.E., PTOE

Asst. Division Chief,

Mobility Planning & Engineering Division (MPED)

Office of Transportation Mobility & Operations (OTMO)

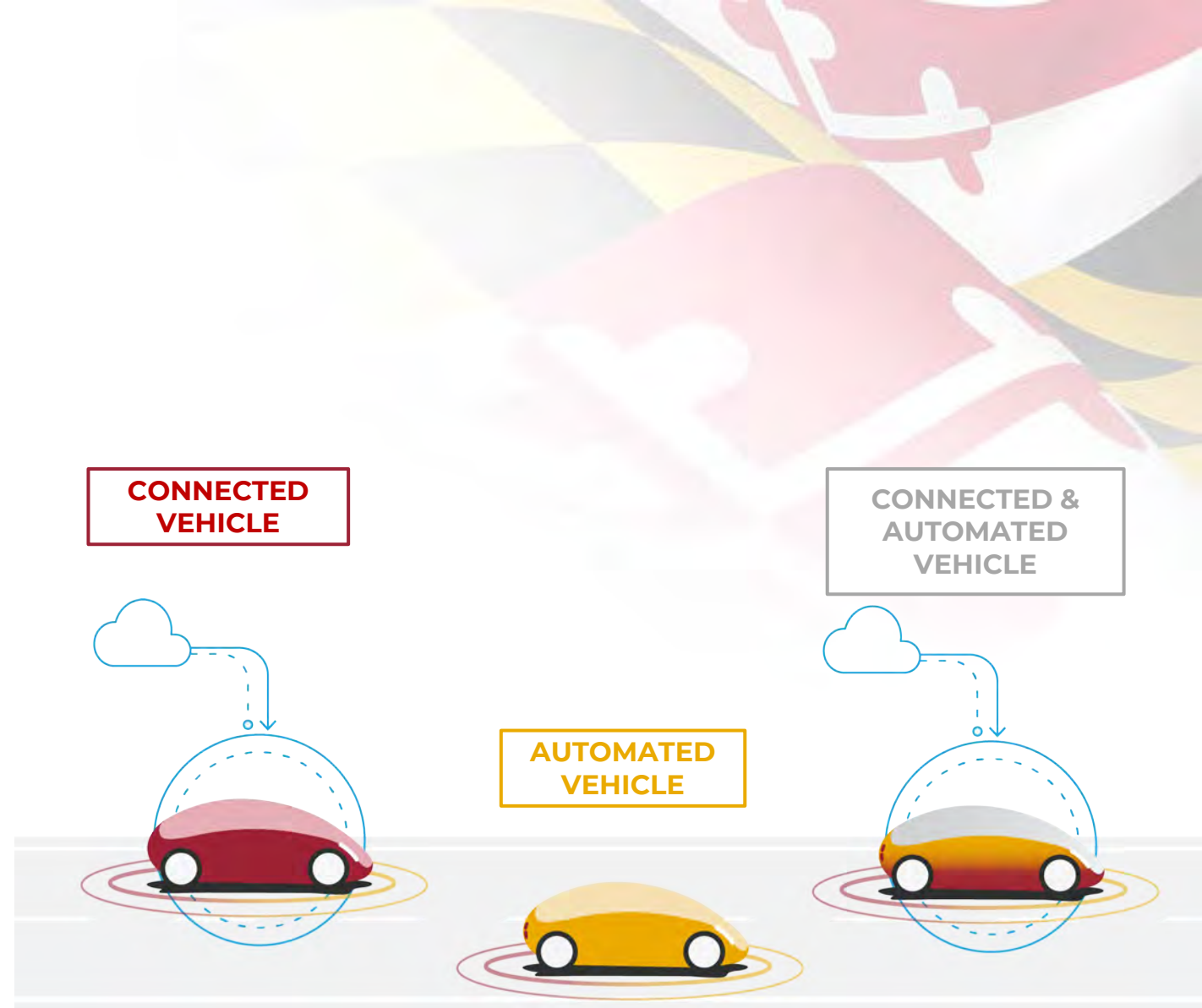
MDOT State Highway Administration

WHenry@mdot.maryland.gov

MDOT MARYLAND DEPARTMENT OF TRANSPORTATION

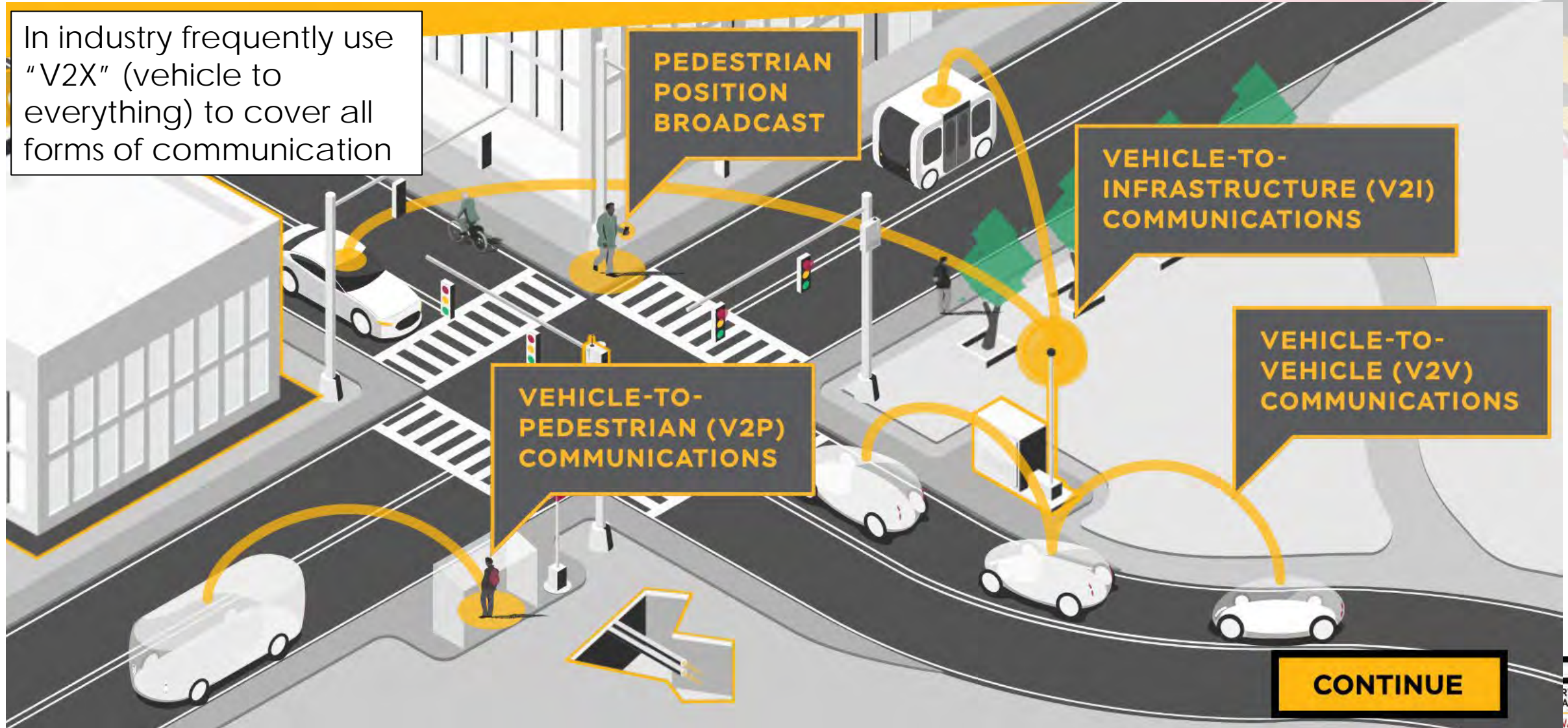
DEFINING "I2V"

- I2V = **I**nfrastructure-**t**o-**V**ehicle
- Reserved for connected vehicle communications
- Part of the broader **connected & automated vehicle** ecosystem
- Exchanges information in real-time from infrastructure to technology embedded inside a vehicle



EXAMPLE OF A CONNECTED ECOSYSTEM

In industry frequently use "V2X" (vehicle to everything) to cover all forms of communication



DEFINING: DSRC & C-V2X

DSRC

Dedicated Short Range Communication

A radio wave that transmits data directly from one point to another at a very low latency (e.g. 10 times per second)



C-V2X (existing networks)

Cellular - Vehicle to Everything

Similar to DSRC, the data is expected to transmit directly from one point to another; however, most of the technology is still not proven at scale.



MD 214: PROJECT DETAILS

Location

- MD 214 (Central Avenue) @ Addison Road

Funding

- Project is a 2019 State Transportation Innovation Council (STIC) grant award.

Technology

- Siemens dual mode roadside unit (RSU): DSRC and C-V2X capabilities.
- Bosch cameras for detection.
- ISS security credentialing for message exchanges.

Goals

- Pilot new technology for longer term standards development and staff upskilling.
- Deploy a dual mode DSRC/C-V2X radio for crosswalk safety.
- Identify barriers to the project delivery as it relates to connected vehicle technologies.
- Incentivize private industry to pursue connected vehicle technologies.
- Demonstrate Maryland is a player in the connected vehicle arena.

POINTS OF CLARIFICATION

Project Does NOT...

'Track' or record people in the crosswalk.

Act in place of the existing signal pedestrian crossing operations.

- Pedestrians crossing will continue to cross or request to cross normally.
- The signal will NOT change based on this connected vehicle application.

Force cars to stop.

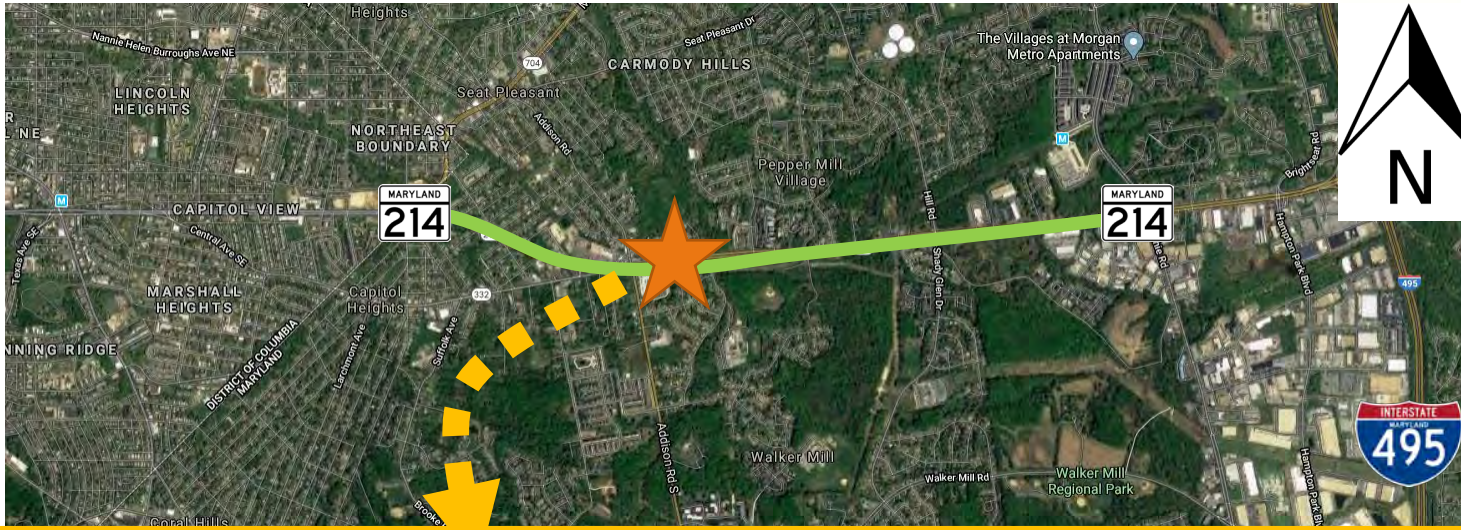
- It is still the responsibility of a driver receiving these notifications to act.
- Maryland law still applies, and this project does not change those laws!

PROJECT TIMELINE

- **Fall 2019:** Project idea submitted to STIC and funding awarded.
- **Spring 2020:** Invitation for bid released for vendor selection.
- **Fall 2020:** Project kick off after several month of procurement processes.
- **Winter 2021:** Submitted license requests to the FCC and received the experimental C-V2X license within 2 weeks, but no approval for the DSRC license.
- **Spring 2021:**
 - Installation of the RSU and sensors go up.
 - Troubleshoot for 2-3 weeks as the system failed to message out.
 - Error found (defective RSU) and CV2X activated.
 - FCC approves DSRC license after several months' wait.
 - DSRC activated as a dual mode in parallel to the CV2X.
- **Summer 2021:**
 - Testing of the RSU messaging and sensors.
- **December 2021:**
 - Final Report.

PROJECT COST BREAKDOWN (ROUNDED)

Item	Cost
Vendor (RSU, sensors, system + maintenance for 12 months, and install staff time)	\$50,000
MDOT SHA project management and installation staff time	\$20,000
MDOT SHA Engineering Design	\$7,500
MDOT SHA Offices review, approval, and install (mixed staff and consultant support)	\$6,500
Total rounded cost	\$74,000



PROJECT LOCATION

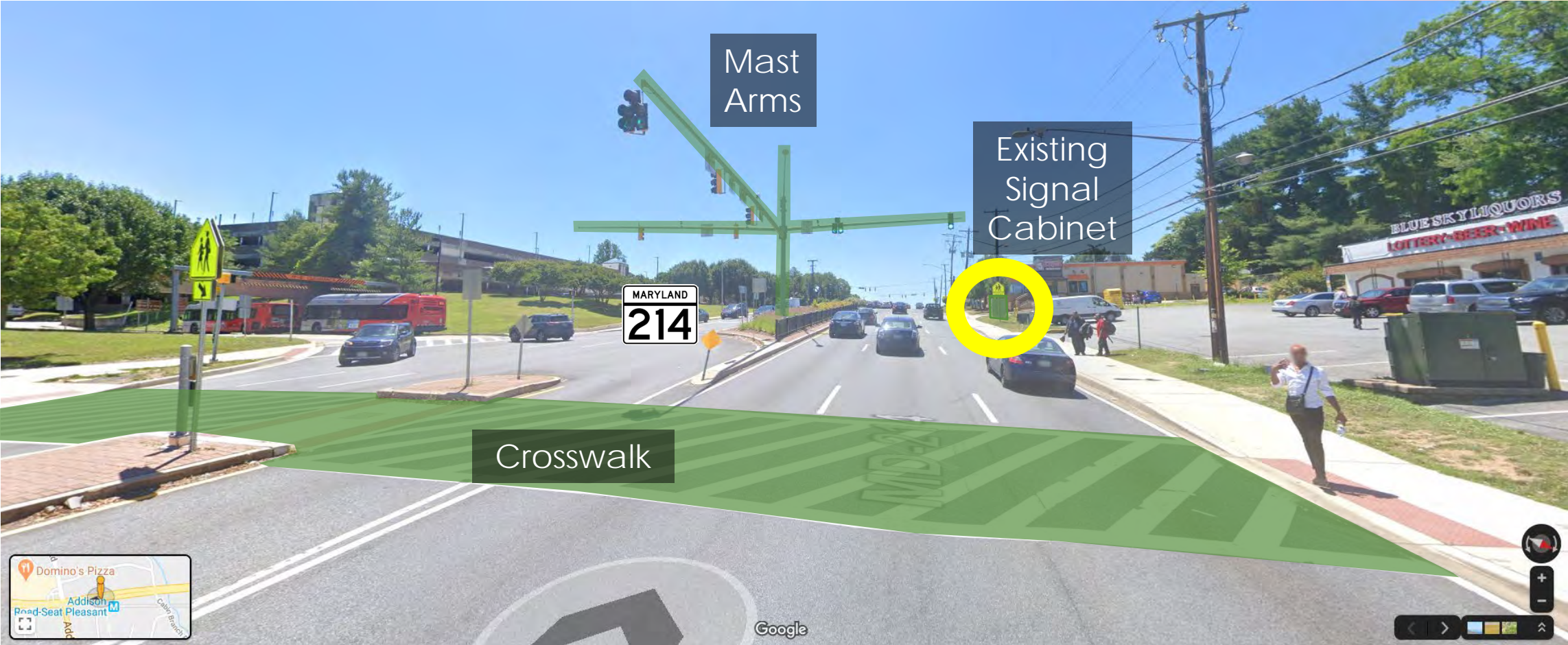
- Prince George's County, Maryland
- MD 214 at Addison Road – Seat Pleasant Metro Station
- One intersection only



LOCATION SELECTION PROCESS

- Prince George's County has a high rank in pedestrian severity and crash rate
- Simple intersection design
- Intersection signal infrastructure is fairly new
 - New mast arms & poles with low weight (i.e. can support additional sensors)
 - Communication and power connections available
 - New signal cabinet – met space needs for this type of deployment
 - History of crash & recommended mitigation: no signal (prior to 2017), signal (2017/2019), DSRC/CV2X (2021+)

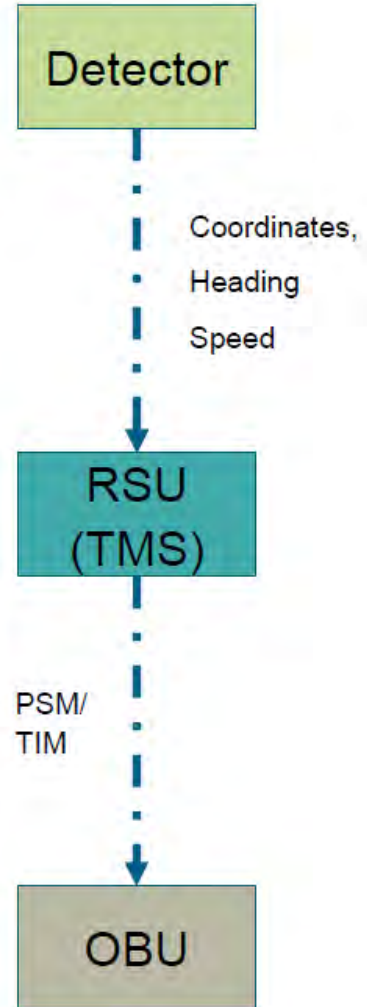
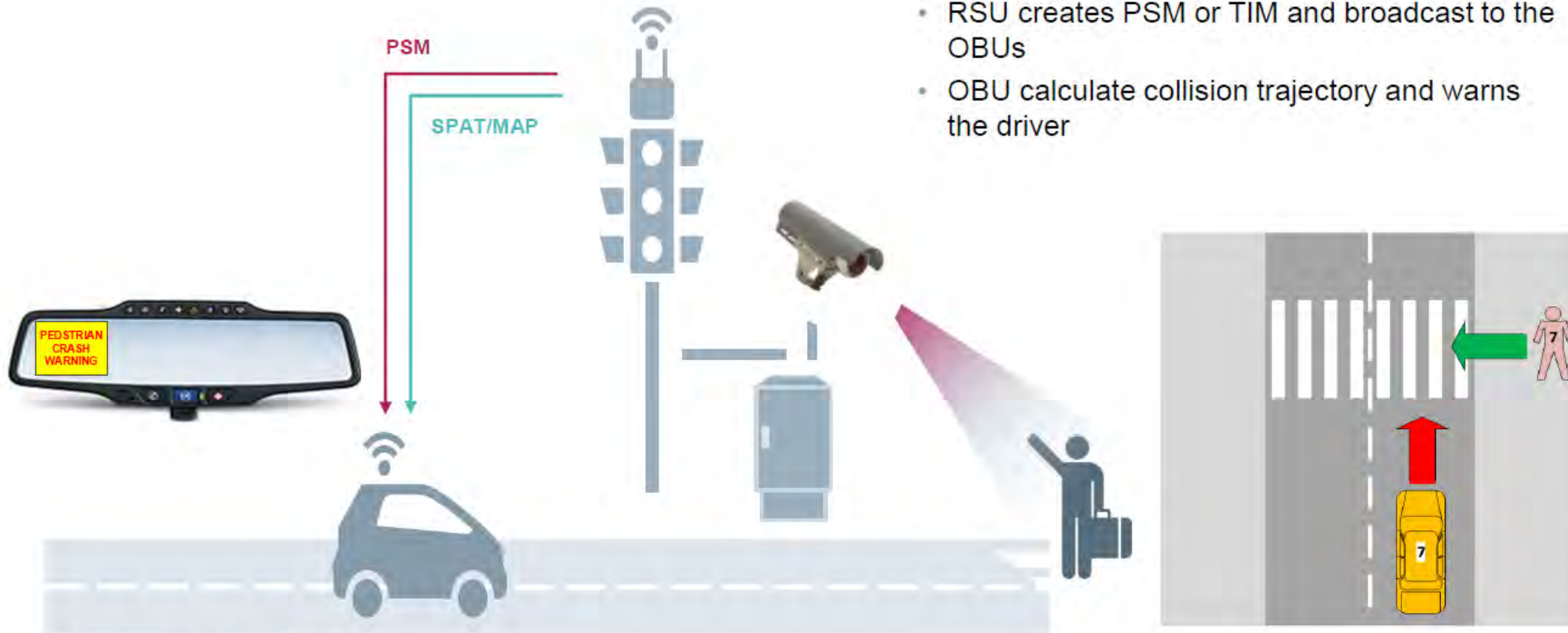
INFRASTRUCTURE LAYOUT



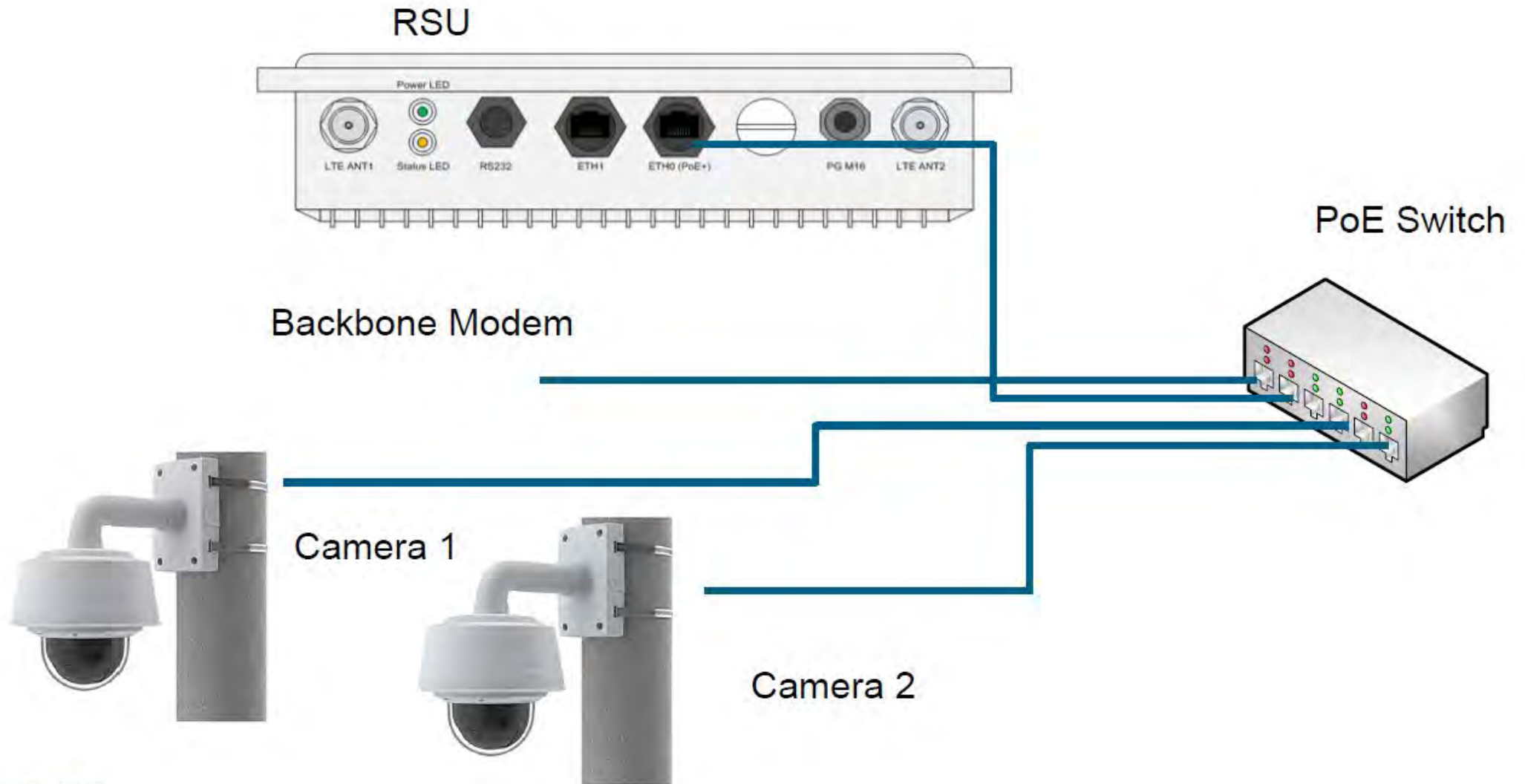
DETECTION & NOTIFICATION

Pedestrian Collision Warning

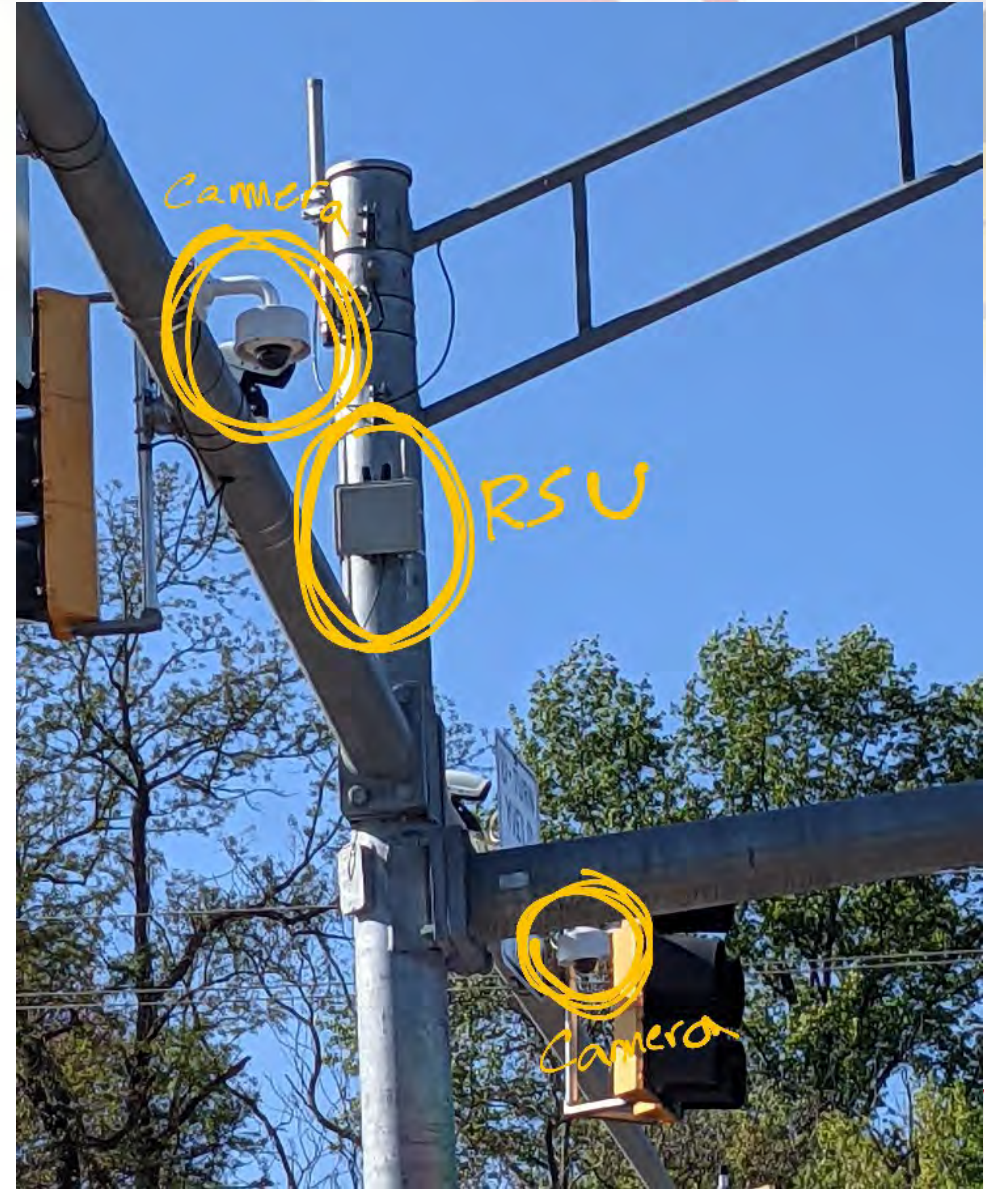
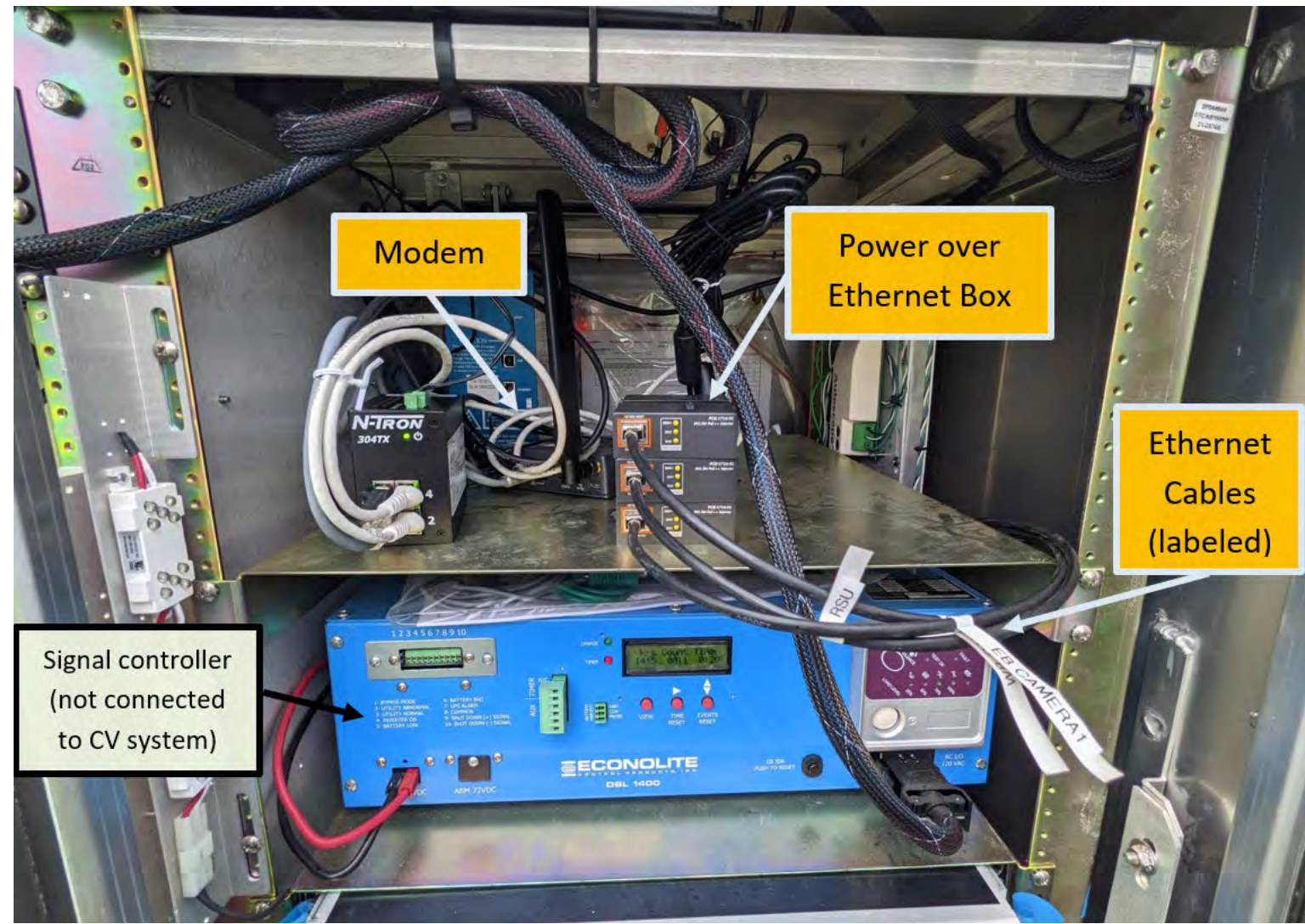
- Camera/Sensor Detector to track the pedestrian
- Detector provides pedestrian location, speed and heading to RSU
- RSU creates PSM or TIM and broadcast to the OBUs
- OBU calculate collision trajectory and warns the driver



TECHNICAL SETUP



WHAT DOES IT LOOK LIKE?



POTENTIAL VENDORS

Sensor Vendors:

- Miovision
- Gridsmart
- Iteris
- Continental
- Mobileye
- Bosch
- FLIR Systems
- DENSO Corporation
- Aptiv PLC
- Panasonic
- Derq
- Alpine

RSU Vendors & Deployers:

- Econolite
- Cohda Wireless
- Lear Systems
- Kapsch Group
- Norbit Group
- Siemens
- Danlaw
- Commsignia
- DENSO
- WaveMobile
- TraffiCast

Other Deployment:

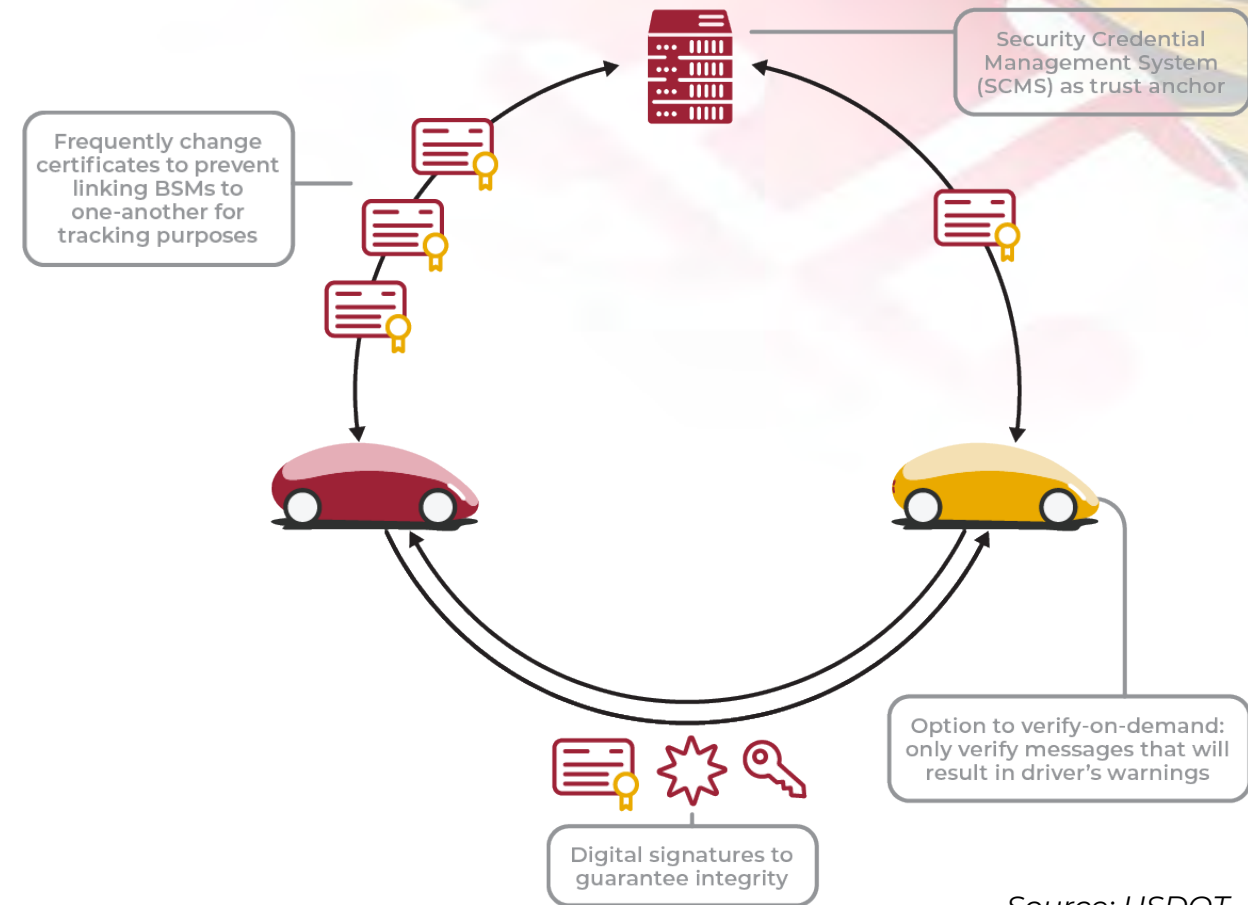
- Consultants

SECURITY CREDENTIAL MANAGEMENT SYSTEM (SCMS) FOR CYBERSECURITY

The SCMS provides the mechanism for V2X devices to exchange information in a trustworthy and privacy-protective manner using digital certificates.

SCMS Benefits

- **Ensures integrity** - users can trust that the message was not modified between sender and receiver
- **Ensures authenticity** - users can trust that the message originates from a trustworthy and legitimate source
- **Ensures privacy** - users can trust that the message appropriately protects their privacy
- **Helps achieve interoperability** - different vehicle makes and models will be able to talk to each other and exchange trusted data without pre-existing agreements or altering vehicle designs






Source: USDOT

<https://www.ghsiss.com/v2x/marylanddot/>

HOW FAR DO PSM REACH?



Legend

-  RSU Location (approximately 23 feet high)
-  PSM received without package loss
-  PSM occasionally received, frequent package loss and complete loss before this section

LESSON LEARNED: BID & COST

- The cost of the vendor to provide the RSU and installation staff time was higher than anticipated and the miscellaneous costs tallied up to the aforementioned total (\$74,000).
- As a first-time deployment MDOT SHA staff had to upskill, however future costs are expected to be lower.
- The invitation for bid was successful in attracting companies to notice that Maryland was “engaged” in the CV field.

LESSONS LEARNED:

- Installation through MDOT SHA resources helped staff learn how to install RSUs.
- Installation of the Bosch camera sensors was not difficult, as staff frequently installs cameras for traffic incident management.
- Software tuning and message verification were done almost entirely through the vendor.
- Internal staff upskilling, apart from knowing how to remote into the cameras and the RSU, are still limited.



LESSONS LEARNED: TESTING

- Requiring that all OBUs be registered over the Maryland SCMS limits the rate of deployment.
- Original Equipment Manufacturers (OEMs) have not mass scaled in-vehicle units, nor registered them in SCMS, meaning it is unlikely they will be providing in-vehicle notifications to the public any time soon.
- This severely hampers an IOOs ability to improve safety through CV technologies.



Show only these records: TX WSA TX Traffic TX Drop Details

RX WSA RX Traffic RX Drop IPv6

Stop auto scroll Clear Filter logs Copy to clipboard

16:33:44.674	80:SCM4	PSID:8807(PLAIN)	80211	XHIT	Len=126/118	Pow=46	Rate=6000	TID=3
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16:33:46.675	80:SCM1	PSID:8807(PLAIN)	80211	XHIT	Len=49/41	Pow=46	Rate=6000	TID=3
16:33:47.674	80:SCM4	PSID:8807(PLAIN)	80211	XHIT	Len=126/118	Pow=46	Rate=6000	TID=3
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Show only these records: TX WSA TX Traffic TX Drop Details

RX WSA RX Traffic RX Drop IPv6

Stop auto scroll Clear Filter logs Copy to clipboard

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Questions?
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