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Maryland Department of Transportation Connected and Automated Vehicles (CAV) Update

Spring 2025 CV PFS Meeting

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About MD's CAV Program

- Maryland is proactively addressing emerging technologies that are reshaping the transportation sector with a particular focus on Connected and Automated Vehicles (CAVs).
- Initiatives align with the broader Statewide MD CAV Working Group efforts, advancing Maryland's vision to uphold and enhance transportation standards by fostering a
  - ✓**Safe**
  - ✓**Efficient**
  - ✓***and* Equitable**

  future through innovative and collaborative CAV solutions.

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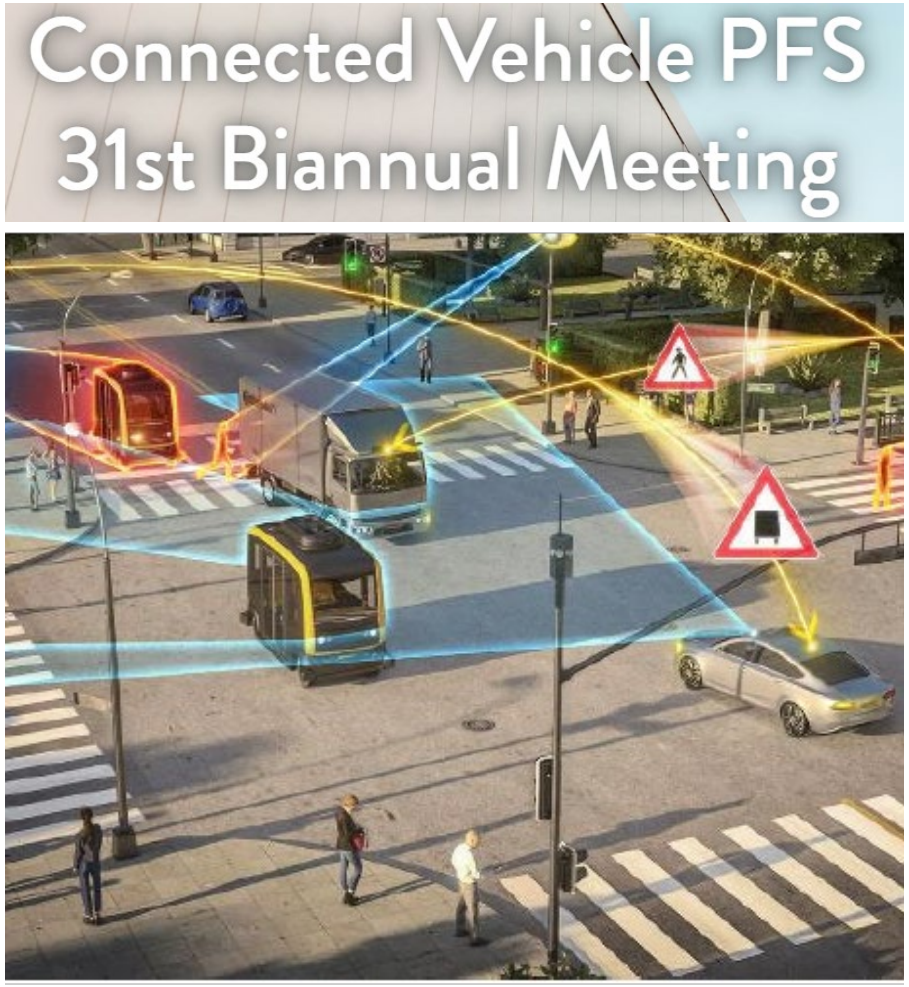
CAV Program (Cont'd)

- Evaluates the impact of CAVs and related emerging technologies on policy, operations, infrastructure and business processes;
- Identifies implementable emerging technology-based projects;
- Supports CAV foundational and deployment initiatives; and
- Leads CAV communication, outreach, and educational efforts.

Why Are We Here?

- Maryland is thrilled to continually play an essential role in the Connected Vehicle Pooled Fund Study (CV PFS), joining the ongoing national conversation about advancing CV technology and infrastructure.
- Today, we're here to explore the current state-of-practice, delve into the capabilities and benefits of this cutting-edge technology, and share our valuable experiences to date!
- Our collective efforts and collaboration will undoubtedly pave the way for a more connected and efficient transportation future.



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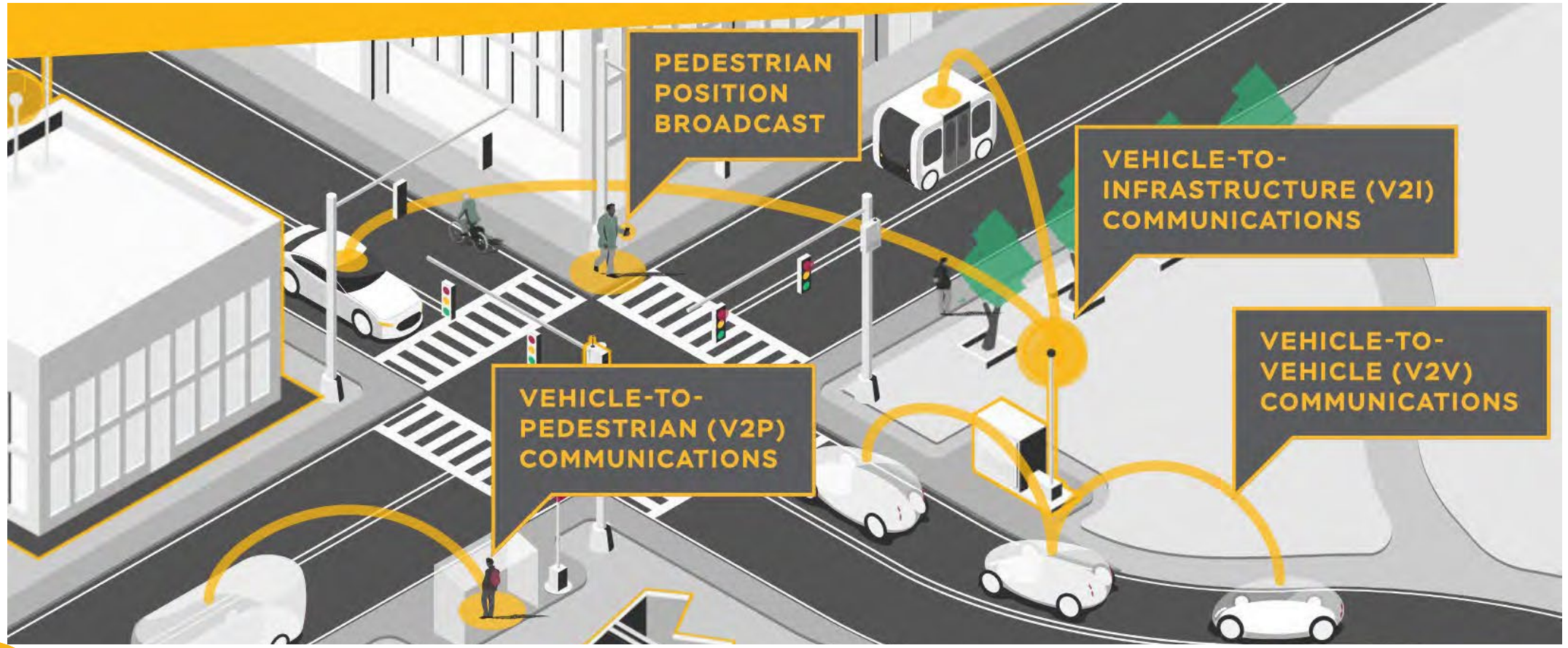
EXAMPLE OF A CONNECTED ECOSYSTEM

"V2X" (vehicle to everything) covers all forms of communication



Most Notable Win

- The successful creation of MD CAV Working Group (CAVWG) to include law enforcement, policy, freight, and technical subcommittees.
- Published a CAV Strategic Framework and made a call to action to all state and local agencies, private and academic partners, and the public to create implementation plans.
- The CAVWG provides a venue for all stakeholders to have a voice to share new concepts and ideas.
- The CAVWG has an active list of over 800 interested stakeholders and holds regular meetings several times a year regularly attracting over 100 in-person attendees.

CAVWG Subgroups

CAV Technical SubGroup

- Plan integration and deployment of technology
- Discuss operations, specifications, etc.
- Technical project coordination
- Sharing of physical and digital infrastructure needs
- Data exchange to leverage knowledge and analysis
- Collaboration of State and local agencies and subject matter experts

CAV Policy SubGroup

- Review national frameworks, guidance, policies, and laws
- Recommend best practices and taxonomy for CAV
- Recommend permit processes
- Develop policy plans for ADS/ADAS
- Coordination of all interested stakeholders

CAV Freight SubGroup

- Collaborate on freight solutions
- Discuss general freight, advanced technology, data, and network connectivity
- Coordination of all interested stakeholders

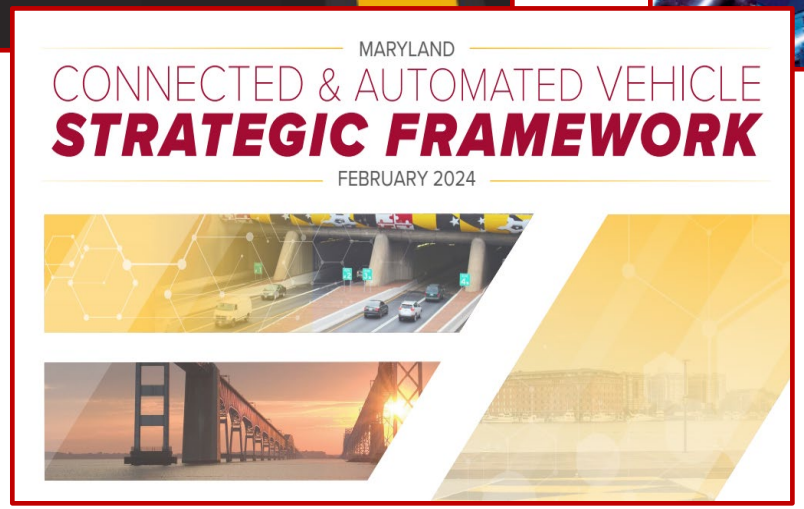
Emergency Responder SubGroup

- Coordination of emergency responders and subject-matter experts
- Assess CAV operational plans to support ER activities
- Collaborate on CAV training opportunities
- Update MD CAV Emergency Response Plan (annually)

Greatest Challenges

- Forthcoming regulatory debate on federal vs. state management of the machine driver and managing the driver licensing, motor vehicle code modifications, insurance, and enforcement issues.
- Lack of “visible” CAV testing within Maryland to familiarize citizens with the technology. Testing in Maryland may require cooperation and collaboration with multiple states that operate under a variety of regulations.
- Cross-jurisdictional challenges.
- Statewide/Regional market penetration of CAVs – knowing where CAV investments will produce the highest benefits and ROI.

Published Documents



Workforce Education: Lunch and Learn (L&L) Series

- Interesting - Engaging - Informative - Interactive

- Covers a Variety of CAV-related Topics - Provides Case Studies - Guest Speakers

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Example Topics: L&L Series

- **CAV 101**
  - ✓ Getting ready for testing and large-scale deployment
  - ✓ Collaboration
  - ✓ MDOT modal engagement

- **Identifying Safety Hotspots Using CV Data**
  - ✓ Explored how Connected Vehicle (CV) data can help MDOT identify safety hotspots by analyzing vehicle behaviors (hard braking, acceleration, speeding patterns, etc.).
  - ✓ Highlighted the massive scale, accuracy, and opportunity of CV data to support proactive safety measures, especially at intersections, school zones, and freeway segments. Overall, CV data enables agencies to predict crash risks and evaluate the effectiveness of countermeasures before crash patterns fully emerge.

- **CV Work Zones**
  - ✓ Discussed general efforts to enhance work zone safety and traffic management through Connected and Smart Work Zones (CWZs/SWZs), which leverage real-time data, CV technologies, and emerging national practices.
  - ✓ Highlighted applications like smart work zone trailers, automated truck-mounted attenuators, and smart vests to improve safety, reduce congestion, and increase reliability. MDOT is actively piloting new technologies and promoting collaboration to advance CWZ deployment statewide.

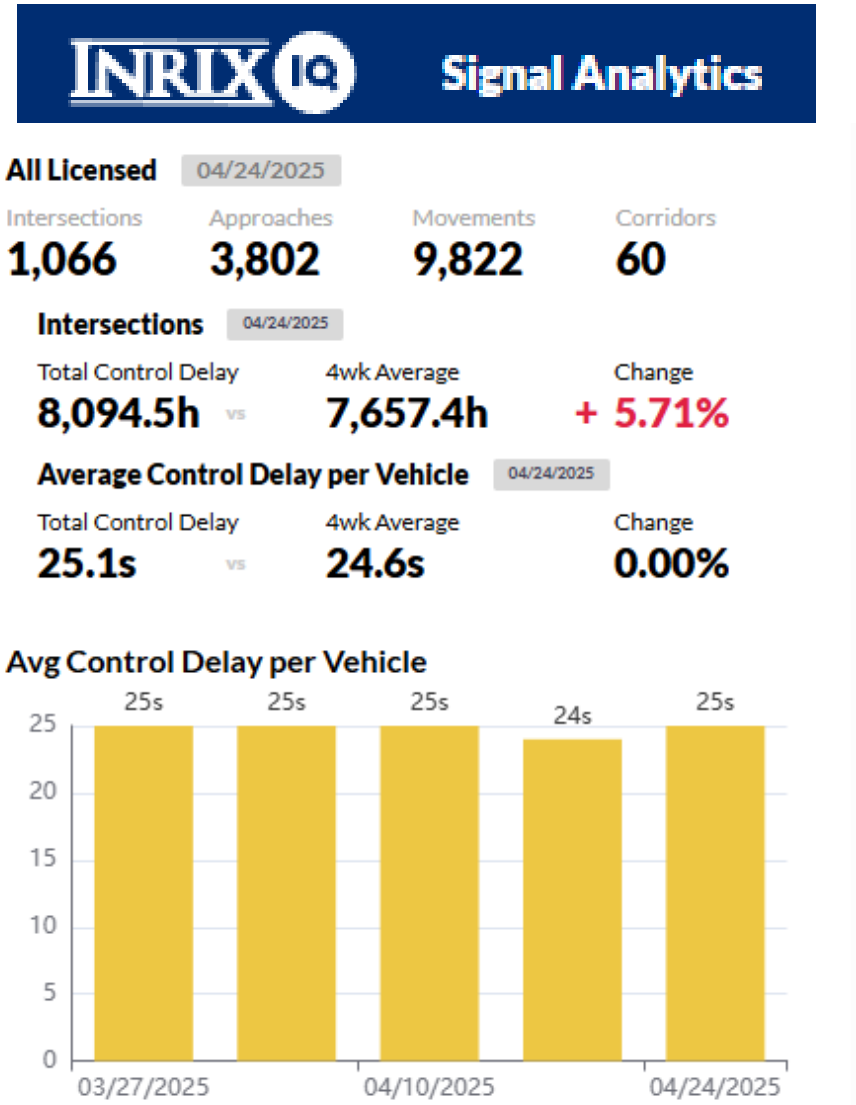
2024 CAV Accomplishments!

- MDOT now monitors major arterial corridors and over 1000 signalized intersections statewide using third-party CV data. This application allows personnel to identify and address operational and maintenance issues on-the-fly. It also gives staff an opportunity to schedule prioritized equipment repair, if/when necessary;
- Received federal funding authorization to begin the project planning and preliminary concept phase for the Rural Opportunities to Use Technology Enhancements along US-50 (ROUTE 50) ATTAIN grant project. Project includes CV-capable traffic signals and curve warning signs on MD's Eastern Shore;
- MDOT continues to coordinate with local agencies and partners on the need for and deployment of a statewide security certificate health monitoring dashboard for CV equipment. This aims to ensure that all CV Roadside Units (RSUs) and Onboard Units (OBUs) have valid certificates for secure message delivery and receipt;
- USDOT facilitated a Maryland Foundational Vehicle-to-Everything (V2X) Training workshop at Morgan State University on September 13, 2024, to introduce participants to key components that enable a V2X ecosystem, potential benefits of the technology, example use cases, and the messages and standards that support them while ensuring safety and privacy; and
- Previously mentioned L&L webinars (CAV 101, Connected/Smart Work Zones, Identifying Safety "Hot Spots" using CV Data, etc.).

Existing and Future Projects in Maryland

INRIX Signal Analytics

- Application uses third-party Connected Vehicle (CV) data and allows MDOT personnel to identify and address operational and maintenance issues on-the-fly.
- Dashboard with high-level overview of the subscriber network summarizing the performance of all intersections.
- Provides the capability to run custom queries for any user-specified date range and performance period.



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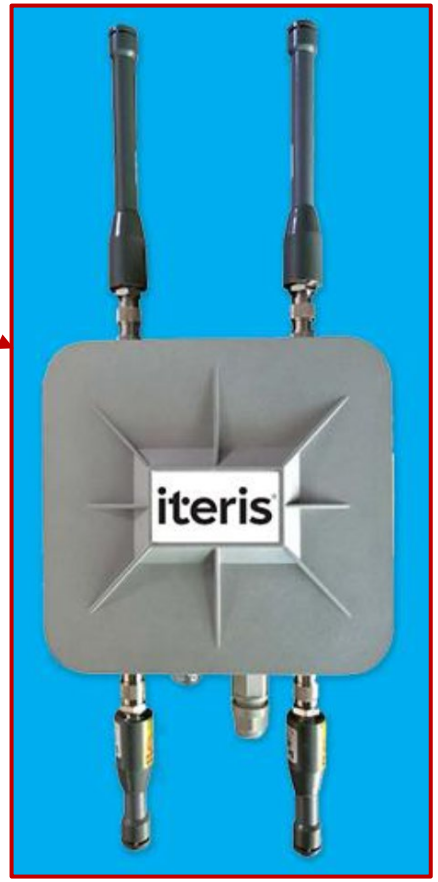
Security Credential Management System (SCMS)

- MDOT supports and prioritizes end to end security to protect ITS devices of connected vehicle messaging.
- The SCMS is a message security solution for vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication. It uses a Public Key Infrastructure (PKI)-based approach that employs encryption and certificate management to facilitate trusted communication.
- Agencies deploying road-side units or on-board units for C-V2X in Maryland are encouraged to register (at their own cost) for security purposes.

US 1 Innovative Technology Deployment Corridor

- 39 RSUs C-V2X/Bluetooth Technology
- Sends BSM, SPaT (20 intersections), TIM & O-D (17 locations)
- O-D and TIM through Advantage Argus (19 RSUs/17 locations)



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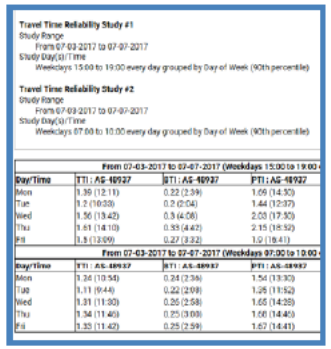
US 1 Innovative Technology Deployment Corridor (Cont'd)

Interactive, Real Time Speed Maps & XML

The BlueARGUS system provides an interactive and real-time speed map that allows the user to quickly access every link and all the corresponding information, such as travel-time, average speed and 48-hour performance graph. The real-time map can be viewed independently of the software via an encrypted link that the user can view the data compared to the speed limit or historical average to quickly see if there is reoccurring or non-reoccurring congestion - a great operational tool!

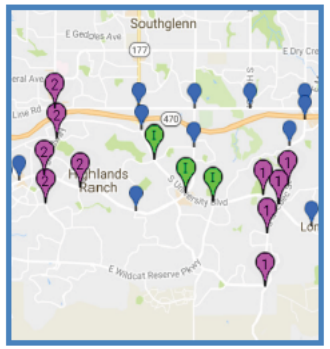
Report Scheduler and Historical Reporting

With the use of historical reports, the user can aggregate and compare data in virtually any combination of days, weeks, months or years. This is an extremely beneficial tool to measure the before and after travel-times of a new traffic signal software, the impact of a special event or incident or seasonal effects on travel-times and speeds. Now, the user can automate ALL performance measurement Reports with the NEW Report Scheduler.



Travel Time Reliability

TTR measures the travel-time index (TTI), buffer-time index (BTI) and planning-time index (PTI) of a driver's travel to best show the variability in their commute. In addition to average travel-time, TTR is a great performance tool that can be measured weekly, monthly, quarterly and/or annually by time of day and day of week.



Enhanced Origin & Destination Studies

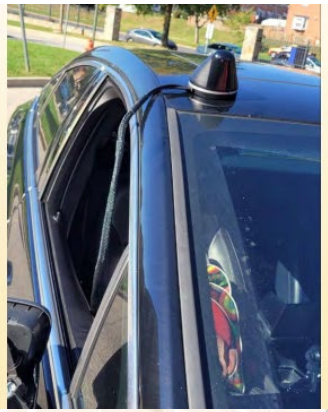
With the Origin & Destination Studies created in BlueARGUS users are able to determine the amount of through movements for a study area (Zones) or corridor, and monitor prevailing traffic patterns to assist on decisions related to route planning and congestion mitigation. With the new O/D Reports, a user can create as many traffic routes and zones as they wish, to compare number of matches and review trip details.

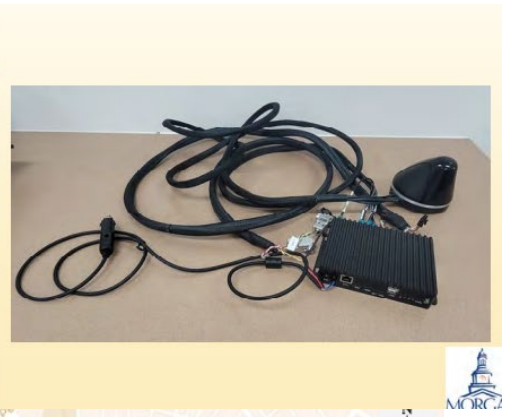
In-Vehicle Pedestrian Detection

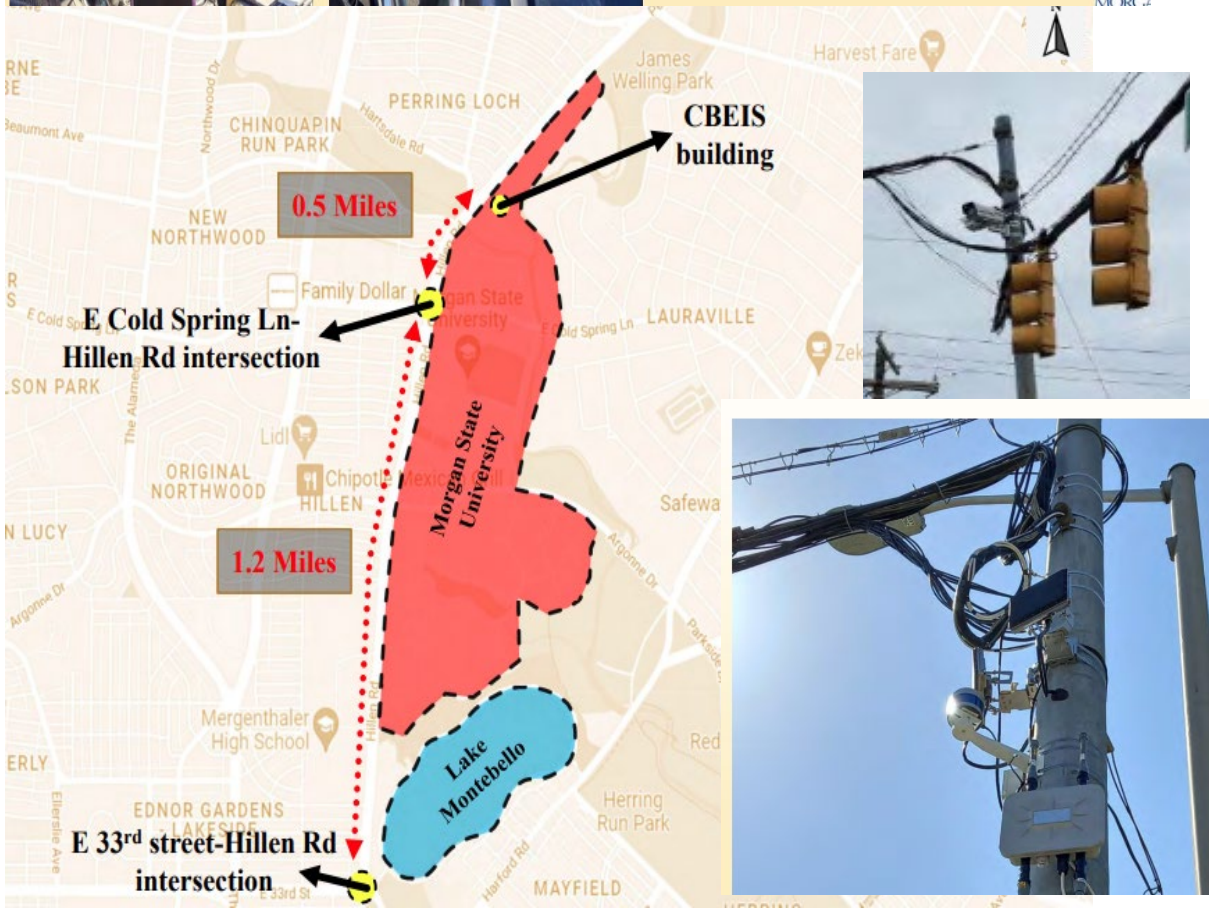
- **Location:** MD 214 (Central Avenue) @ Addison Road
- **Funding:** Project is a 2019 State Transportation Innovation Council (STIC) grant award.
- **Technology:**
  - Siemens dual mode roadside unit (RSU): DSRC and C-V2X capabilities.
  - Bosch cameras for detection.
  - ISS security credentialing 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.

CAV Testbed at MSU

- 1.5 + Mile corridor (Hillen Road) adjacent to MSU (*between E. 33rd and E. Cold Spring in Baltimore*).
- RSU, OBU, and Lidar technology
- BSM and SPaT
- CV Dashboard
- Investigating Vehicle to Pedestrian Conflicts using Post Encroachment Time (PET) Threshold
- Jaywalking conflicts using Lidar Sensors
- Near-miss crash events (Car-Car, Car-Truck, Car-Ped, etc.)







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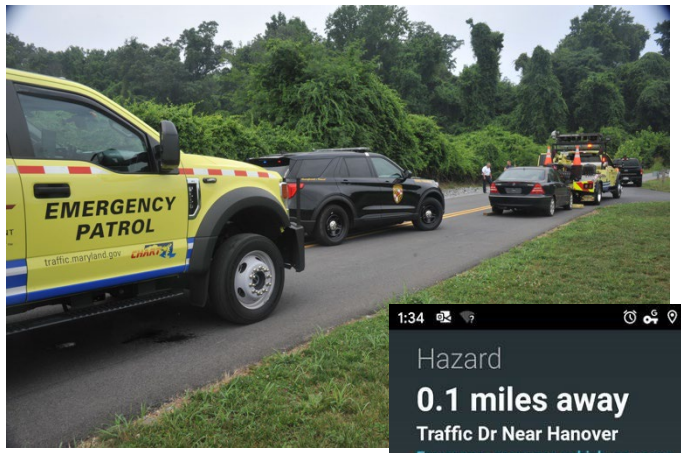
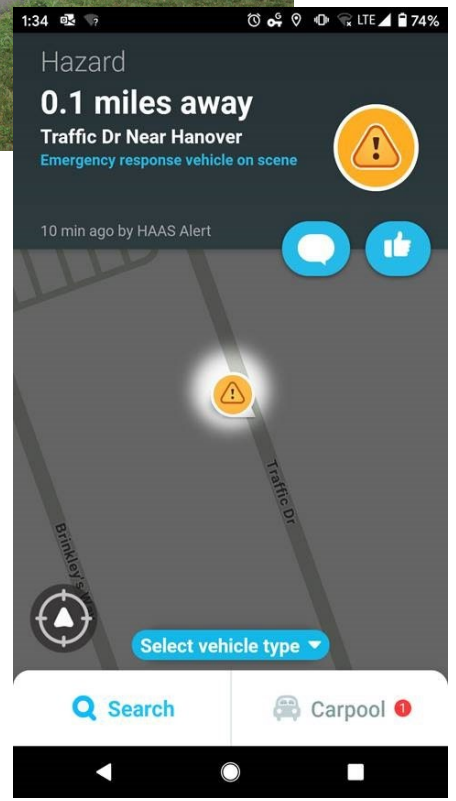
HAAS Emergency Vehicles Alerts

- Active deployment to provide real-time digital alerts to the traveling public
- Prevents accidents by notifying motorists (via mobile app) about emergency responder vehicles, potentially saving lives and reducing crashes
- Installed on over 175 MDOT Emergency Response Vehicles using existing AVL and a connection to the vendor's cloud service
- Before-and-after study shows a significant reduction in emergency responder involved incidents and near misses.
- Link to video of typical application: https://www.youtube.com/watch?v=ow2xk_WMvfo





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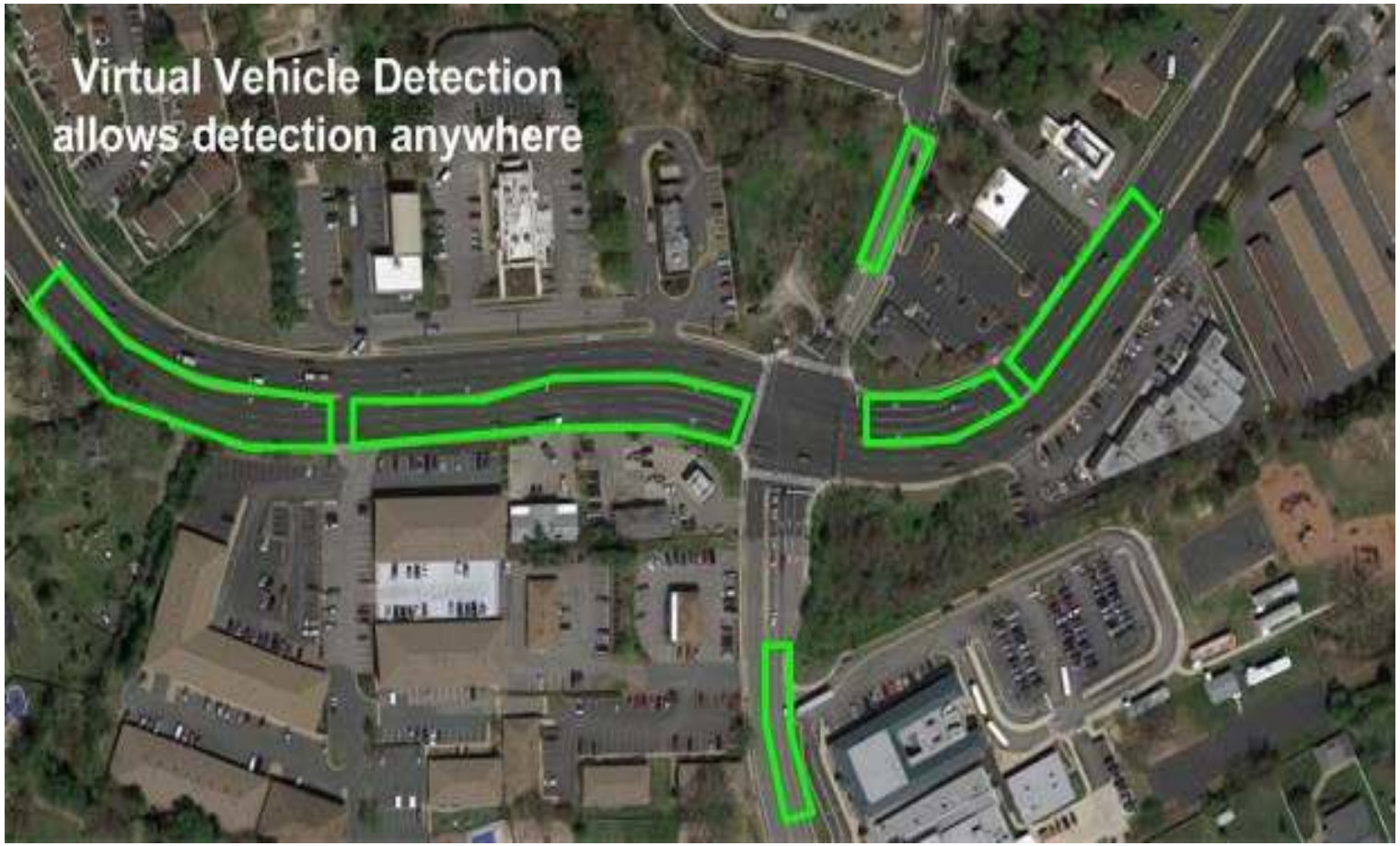
SAFETY CLOUD®
POWERED BY HAAS ALERT

Emergency Vehicle Traffic Signal Preemption

Preemption requests are based on the vehicle's GPS position and the pre-defined activation zones.



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Truck Parking Availability System (TPAS)

- Proposed deployment to manage commercial vehicle parking demand at MD-owned facilities (e.g., I-70 South Mountain Welcome Center)
- Jason's Law requires a survey of each State to evaluate parking, commercial motor vehicle traffic volumes, and to derive a system of metrics to measure truck parking in each State
- The TPAS aims to improve truck parking efficiency and safety while leveraging intelligent transportation systems for real-time monitoring and data sharing.

- Includes the following:
  - ➢Camera-based detection for in/out volumes
  - ➢Parking space management (availability, space turn-over, undesignated/illegal parking statistics)
  - ➢En-route TPAS space information and alerts (to engineers, dispatchers, and commercial vehicle drivers)
- The status as of April 2024 is a final report which includes a 45-month schedule covering design, construction, testing, and operational support.
- Also coordinating with industry partners for more cost-effective approaches and applications.

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Aberdeen Technology Deployment Corridor (I-95, US 40, etc.)

- Like the US 1 project, a high priority has been assigned to installing CV roadside infrastructure in locations where dedicated testing is taking place; the most prominent being in support of activities at the Aberdeen Test Center.
- Incorporates I-95, US 1, and US 40 from the Baltimore County/Harford County line on the southern boundary to the Susquehanna River (Tydings Memorial Bridge) on the northern boundary
- Project recommends that the Aberdeen Technology Deployment Corridor incorporate upgraded signal controllers to support future CV applications, C-V2X deployment at intersections in support of future CAV testing in and around the Aberdeen area.
- Fiber optic communication connectivity (with redundancy), and additional exploration of other ITS field devices to support enhanced incident management and traffic operations in the region (arterial DMS, localized RWIS deployment, mid-block detection, etc.) is being proposed.

Questions / Discussion

Thank you for your time!

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