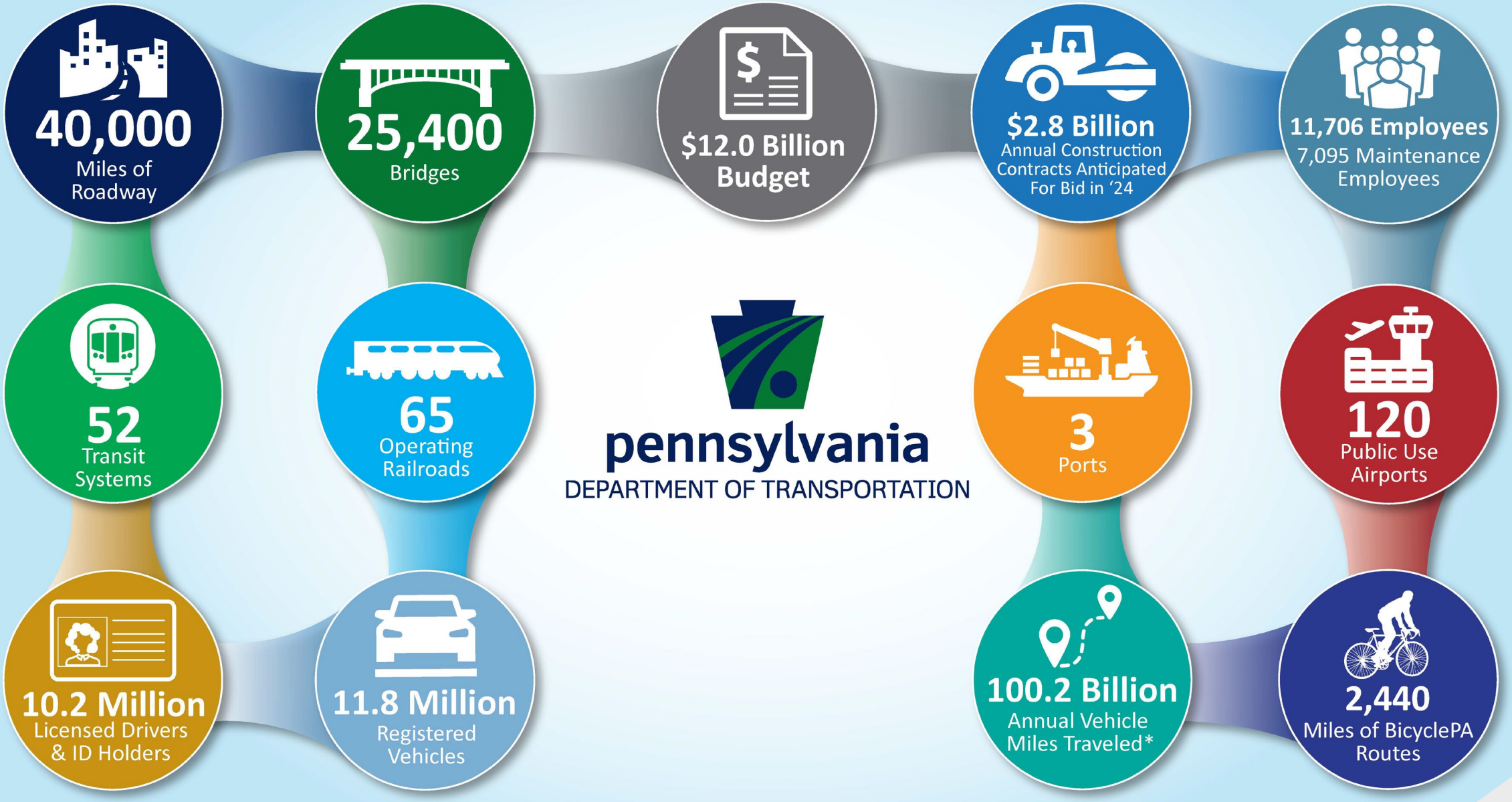
STATE PERSPECTIVE ON INFRASTRUCTURE SENSING

2024 UPISC

DERRICK HERRMANN, P.E. • • NOVEMBER 12, 2024

Pennsylvania
Department of Transportation

PENNDOT BY THE NUMBERS



*Total miles on all PA roadways

LB (8 -24)

TRANSFORMATIONAL TECHNOLOGY RESPONSIBILITY

Core:

Automated Vehicles

Platooning

Connected Vehicles

Personal Delivery Devices

PennSTART

Electrification

Support:

Shared Mobility

Smart Cities

Broadband

UAS

PENNDOT AND INFRASTRUCTURE SENSING

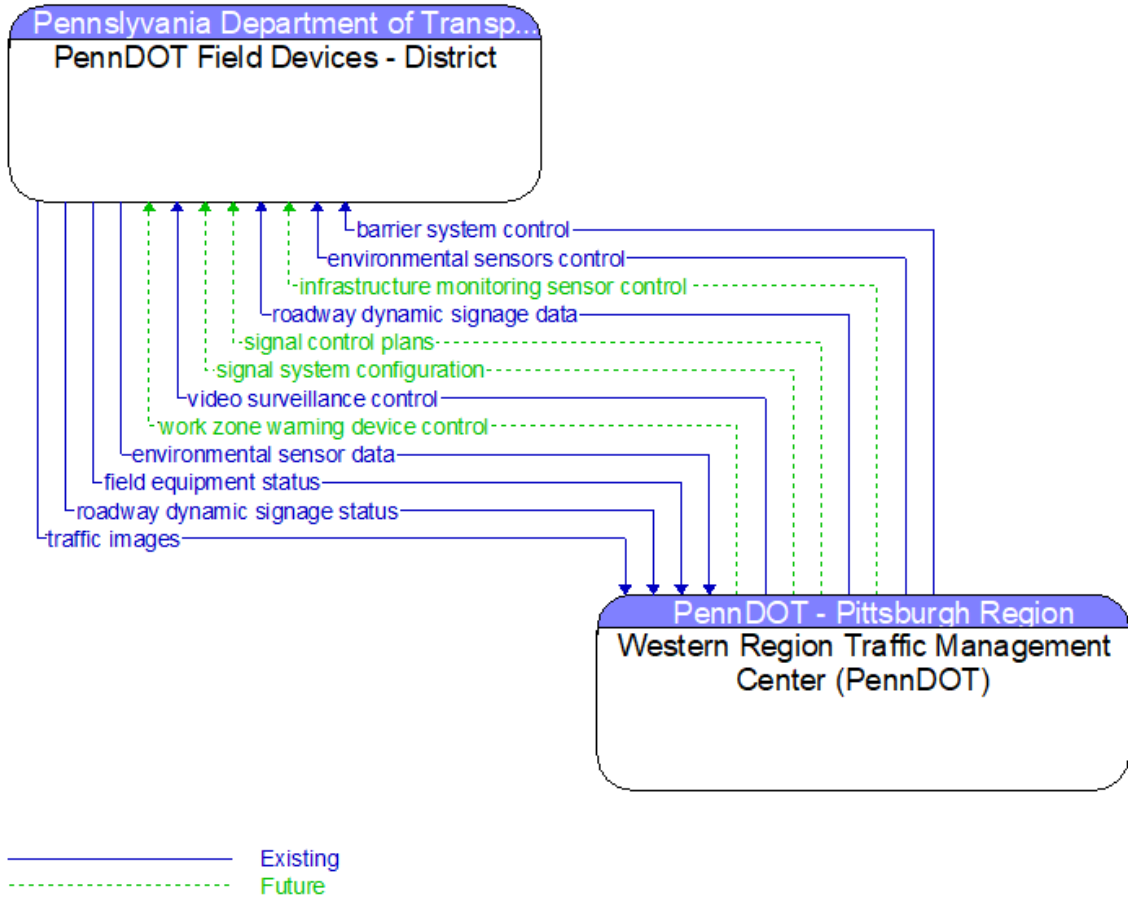
1. History with infrastructure sensing
2. Looking ahead
   - Safety – PennDOT's #1 Priority
   - Asset management
   - Long-range planning
   - Reducing congestion – traffic management
3. PennSTART
4. Connected and Automated Vehicles
   - V2X - Connected vehicles and infrastructure
5. Artificial Intelligence

HISTORY WITH INFRASTRUCTURE SENSING

- Traffic signals
- Traffic counters
- Structure monitoring
  - UAS Inspection
  - Bridge Instrumentation Pilot
- Live monitoring at our Traffic Management Centers
- Traditional ITS Devices
  - CCTVs, speed sensors, road weather information systems, etc.
- Digital monitoring (vehicle probe data)
  - Queue Detection Warning System

ASSET MANAGEMENT

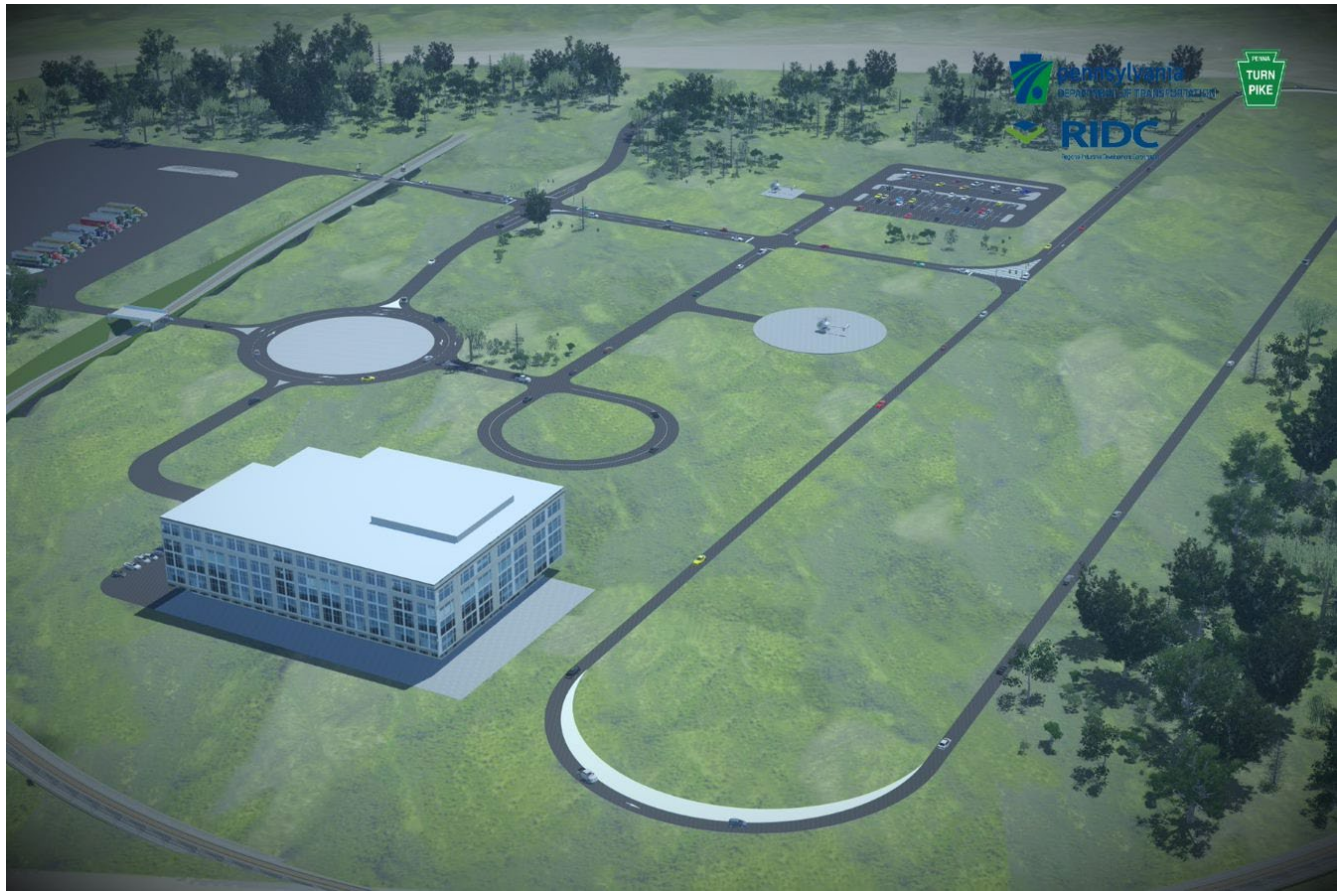
- Digital Infrastructure – use of digital twins
- Artificial Intelligence can help with asset management
- Sensor technology can supplement inspection, long-range planning, performance tracking, and life-cycle assessments
  - A lot of this is manual
    e.g. VideoLog and STAMPP



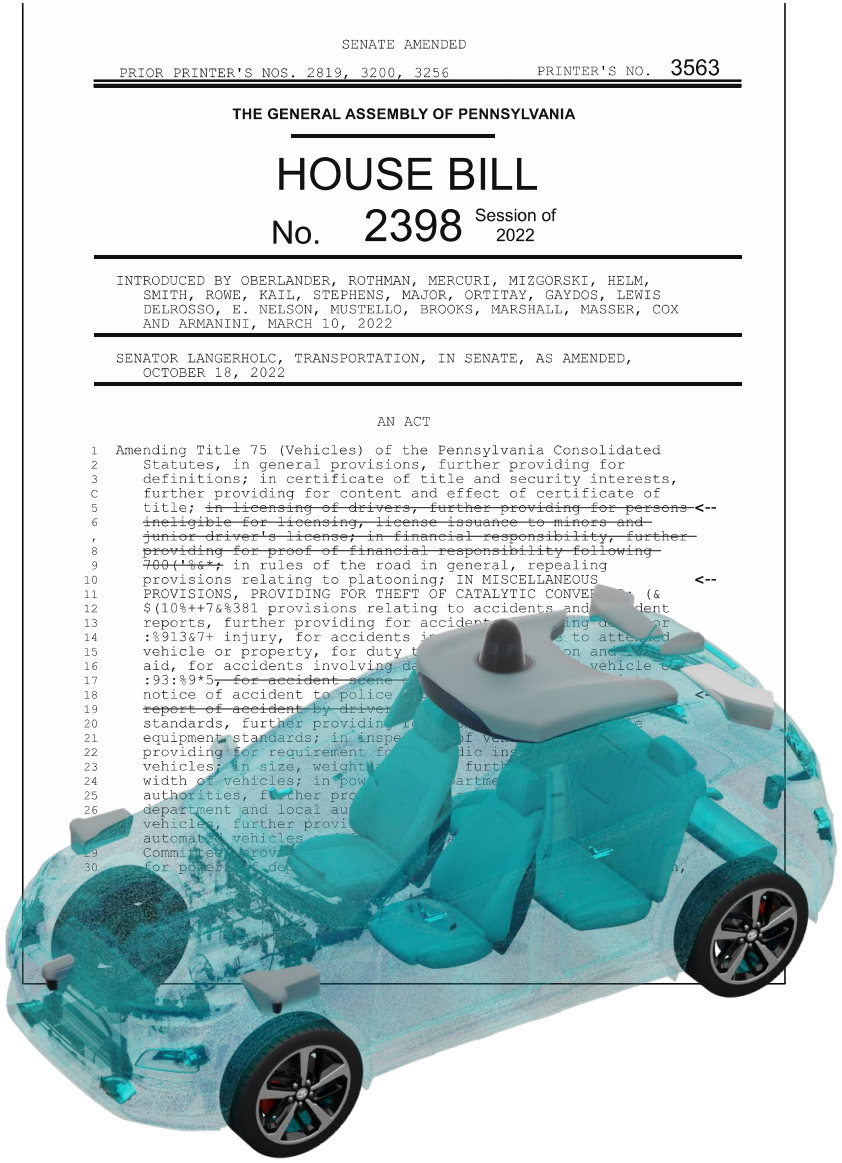
PENNSTART

Partnership between PennDOT, PA Turnpike, RIDC, and CMU

- **Mission**
  - Advance a state-of-the-art research, testing and training facility to address the transportation safety and operational needs of Pennsylvania and the Mid-Atlantic Region.
- **Focus Areas**
  - Connected and Automated Vehicles
  - Traffic Incident Management
  - ITS/Signals/Tolling
  - Work Zones
  - Commercial Vehicles
  - Transit
- **Systems Engineering Completed**
  - Construction – 2025
  - Anticipated Opening – 2026



HIGHLY AUTOMATED VEHICLES



SENATE AMENDED

PRIOR PRINTER'S NOS. 2819, 3200, 3256 PRINTER'S NO. 3563

THE GENERAL ASSEMBLY OF PENNSYLVANIA

HOUSE BILL

No. 2398 Session of 2022

INTRODUCED BY OBERLANDER, ROTHMAN, MERCURI, MIZGORSKI, HELM, SMITH, ROWE, KAIL, STEPHENS, MAJOR, ORTITAY, GAYDOS, LEWIS DELROSSO, E. NELSON, MUSTELLO, BROOKS, MARSHALL, MASSER, COX AND ARMANINI, MARCH 10, 2022

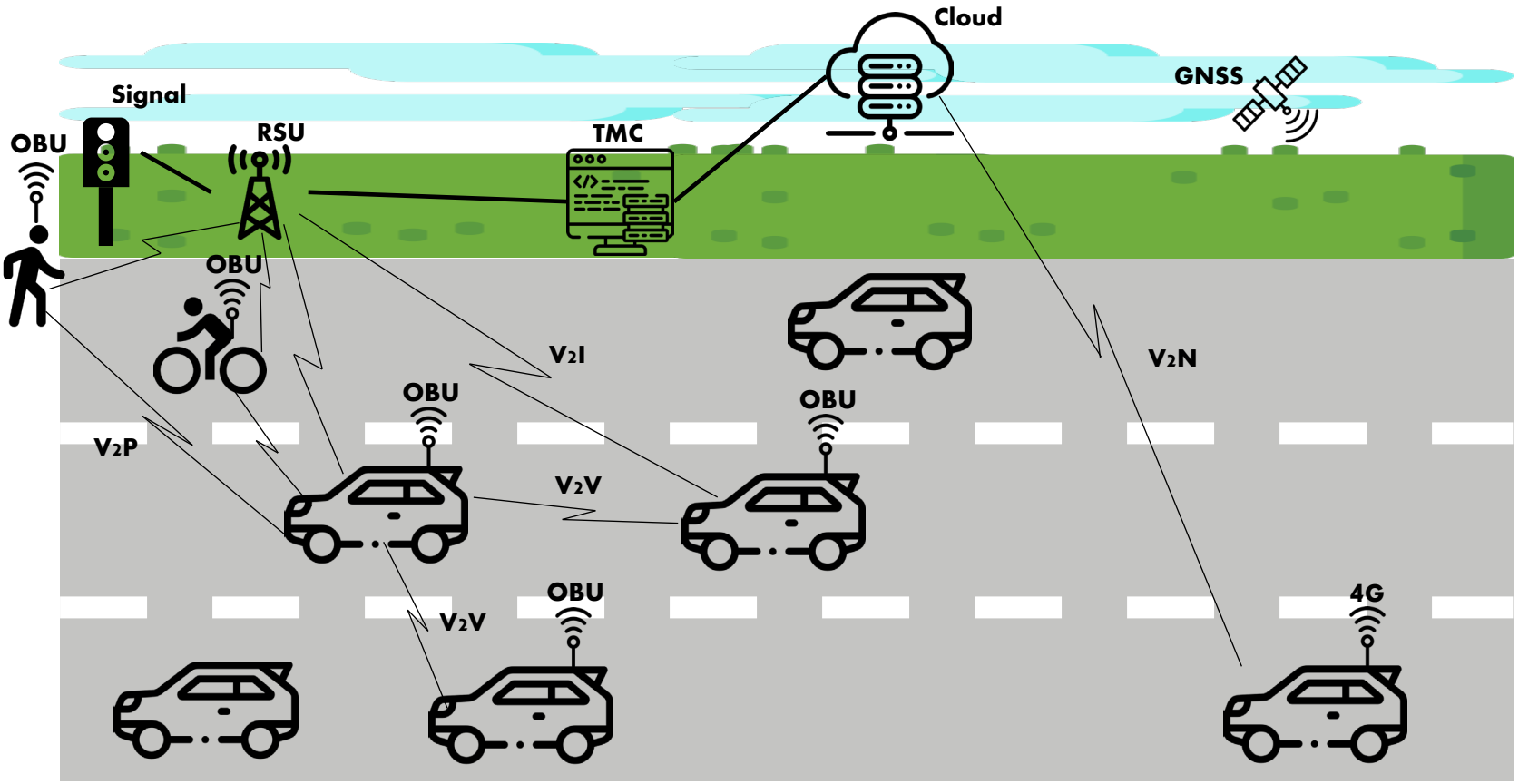
SENATOR LANGERHOLC, TRANSPORTATION, IN SENATE, AS AMENDED, OCTOBER 18, 2022

AN ACT

Amending Title 75 (Vehicles) of the Pennsylvania Consolidated Statutes, in general provisions, further providing for definitions; in certificate of title and security interests, further providing for content and effect of certificate of title; ~~in licensing of drivers, further providing for persons ineligible for licensing, license issuance to minors and junior driver's license; in financial responsibility, further providing for proof of financial responsibility following 700('%&*;~~ in rules of the road in general, repealing provisions relating to platooning; IN MISCELLANEOUS PROVISIONS, PROVIDING FOR THEFT OF CATALYTIC CONVE... (& $(10%++7&%381 provisions relating to accidents and ...dent reports, further providing for accident ...ing d... or :%913&7+ injury, for accidents i... ...e to att...d vehicle or property, for duty t... ...on and ... aid, for accidents involving da... ...vehicle o... :93:%9*5, for accident scene ... notice of accident to police ... report of accident by driver ... standards, further providing f... ...e equipment standards; in inspe... ...of ve... providing for requirement fo... ...dic ins... vehicles; in size, weight ... furth... width of vehicles; in pow... ...artme... authorities, further pro... department and local au... vehicles, further provi... automated vehicles ... Committee provi... for powers and dep... ...n,

- Act 130 of 2022
  - Driverless Guidelines Published 10/23/24
  - Private individual HAV operation not currently legal in PA
- Identification of vulnerable road users
  - Walk cycles at signalized interactions
- Use of tethered UAS, smart vests, and V2X in workzones
  - Identification of TCD and construction personnel in workzones

CONNECTED VEHICLES

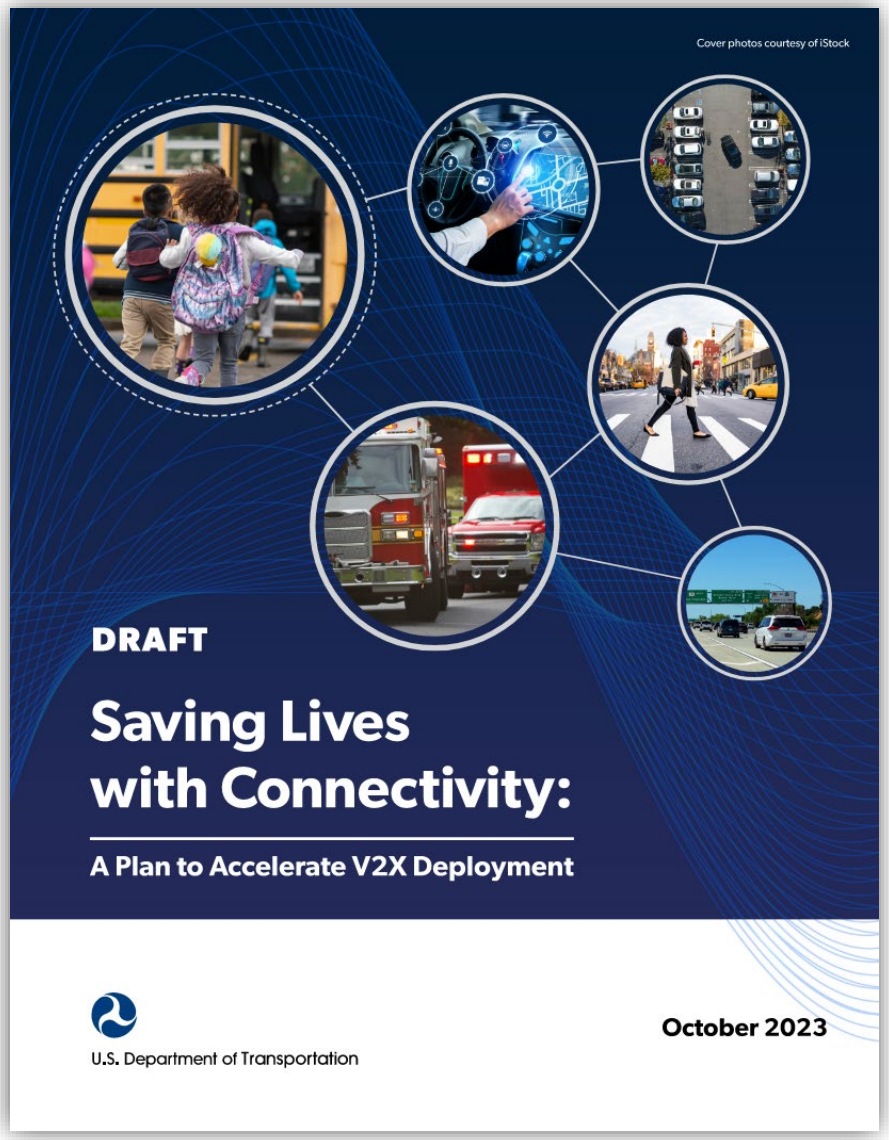


APPLICATIONS (EXAMPLES):

- V2I
  - Red Light Violation Warning
  - Curve Speed Warning
  - Spot Weather Impact Warning
- V2V
  - Forward Collision Warning
  - Do Not Pass Warning
  - Vehicle Turning Right in Front of Bus Warning
- Also V2P and others

CONNECTED VEHICLES

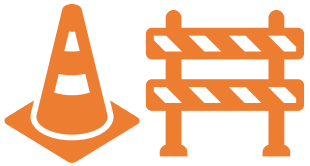
- V2X Roadmap
  - US DOT Draft V2X Plan
  - Engaging OEMs – CV Data Study
  - IoT Network – Working with IT
  - Develop the ‘ecosystem’
- SMART Grant award
  - V2XDx and Curve Speed Warning over Cellular
  - Plan for Phase 2
- Operations and Maintenance Questions



WORK ZONE CHALLENGES

Unfamiliar/ Varying Conditions

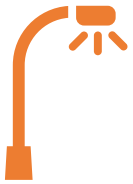
Conflicting Pavement Markings



Displaced WZ Objects

Safety of Workers

Presence of VRUs

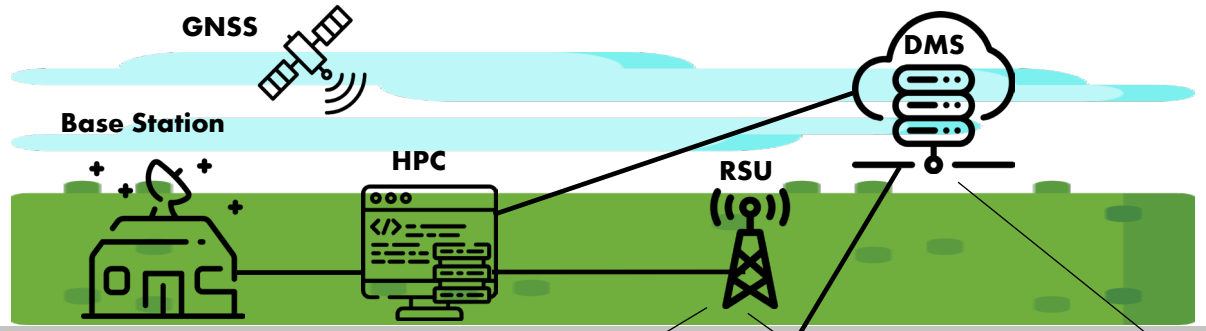


Varying Lighting Conditions

"Google and Delphi cite construction as a common reason their human engineers take control of the wheel while testing" – Wired article

ADS DEMONSTRATION GRANT

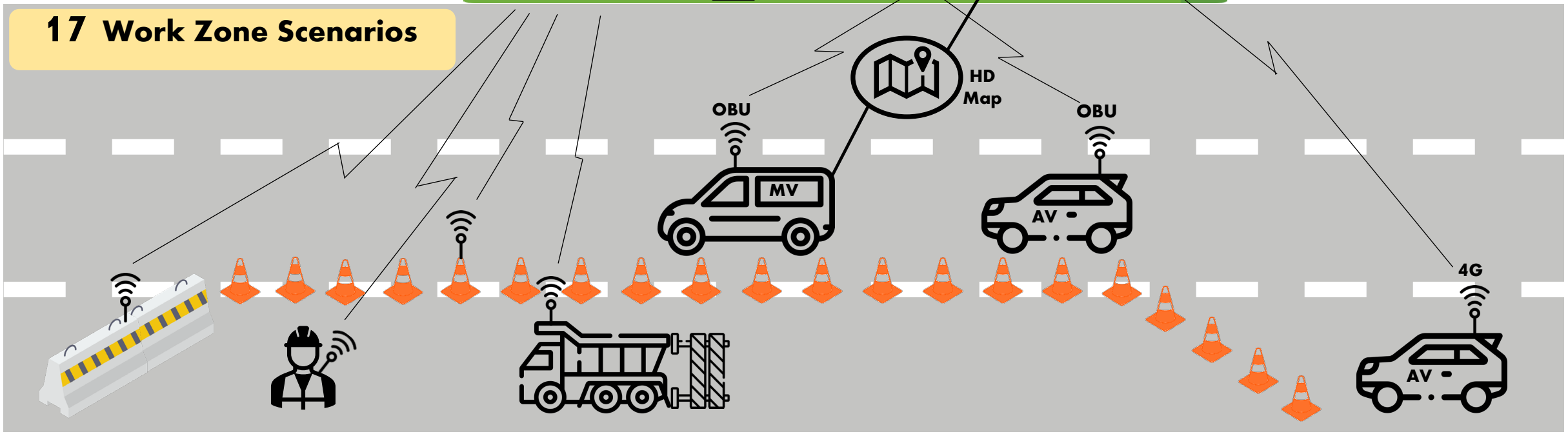
3 Test Environments



3 Safety Modes

- Connectivity
- Machine Visioning
- High-Definition Mapping

17 Work Zone Scenarios



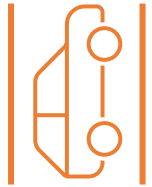
DMS = Data Management System
HPC = High-Performance Computer

Project Team

PENNA TURN-PIKE · CMU · HNTB · Michael Baker INTERNATIONAL · D. DRIVE ENGINEERING

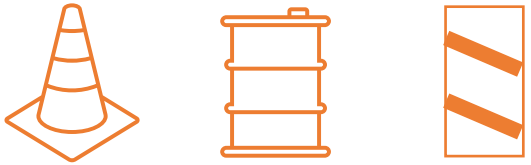
CLOSED-TRACK TESTING – INITIAL RESULTS

WZ speed matters

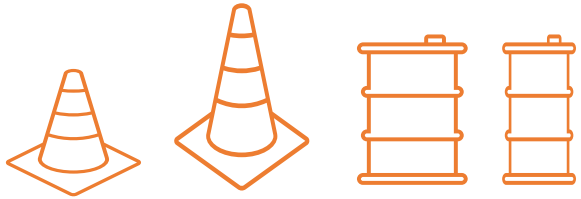


WZ lane width matters to a degree

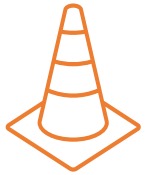
Testing similar scenario – not needed



Types of WZ artifacts don't matter

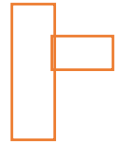


Different size/shape of WZ artifacts matters



Reflectivity matters at night (old vs new WZ artifacts)

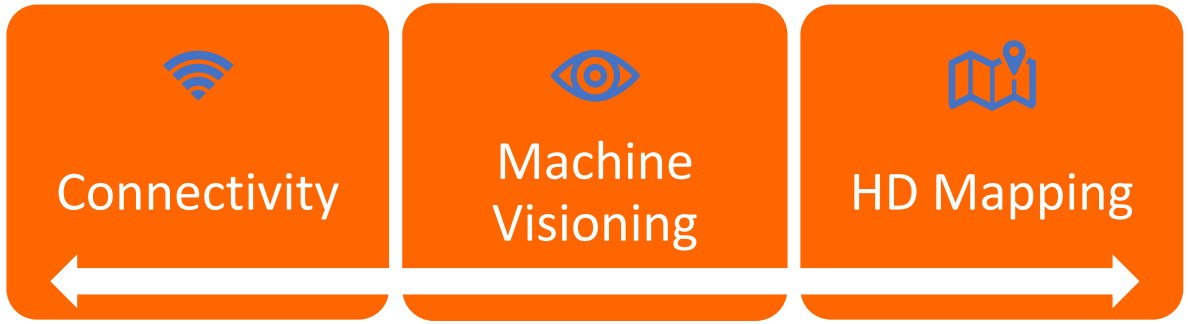
Mapping is critical



CV2X helps a lot (particularly at night)

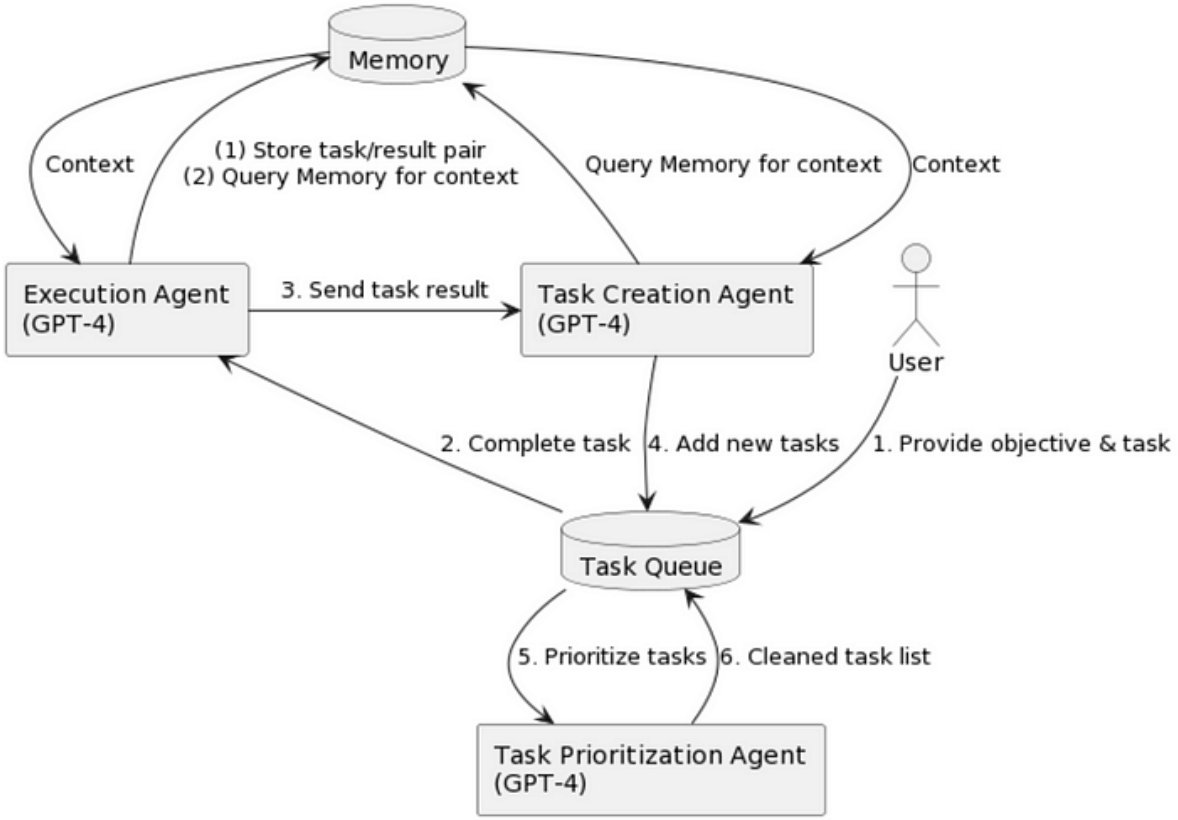
HOW IS AI BEING USED NOW?

- License plate readers
- Automated vehicles
- Real-time traffic management or TMC decision support
- Risk identification/predicting crashes
- Object and behavior detection
- Writing reports/grants



HOW WILL WE BE USING WITHIN 5 YEARS?

- Autonomous agents – supplement active monitoring
- Plan development and review
- Quantity takeoff and estimates
- Reviewing grant applications
- Analyzing vehicle telematics to generate alerts
- Assisting with Asset Management and Long-Range Planning
- UAS and Machine Learning-Digital Twins



RELATED ROADMAP INITIATIVES

- Infrastructure AV Readiness Assessment
- Automated Truck Mounted Attenuator
- V2X Roadmap and SMART Grant
- Cybersecurity in Transportation Assessment
- Freight and Transit Signal Priority

Future consideration:

- Distributed Acoustic Sensing with Fiber Networks

THANK YOU

Follow the Transformational Technology Division

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