CONNECTED VEHICLE DATA STUDY

pennsylvania
DEPARTMENT OF TRANSPORTATION

AGENDA

- Study Purpose
- Discovery
- Findings
- Vehicle Data Viability
- Recommendations/Opportunities
- Transportation Pooled Fund Study Framework

STUDY PURPOSE

Determine feasibility and potential for CV data

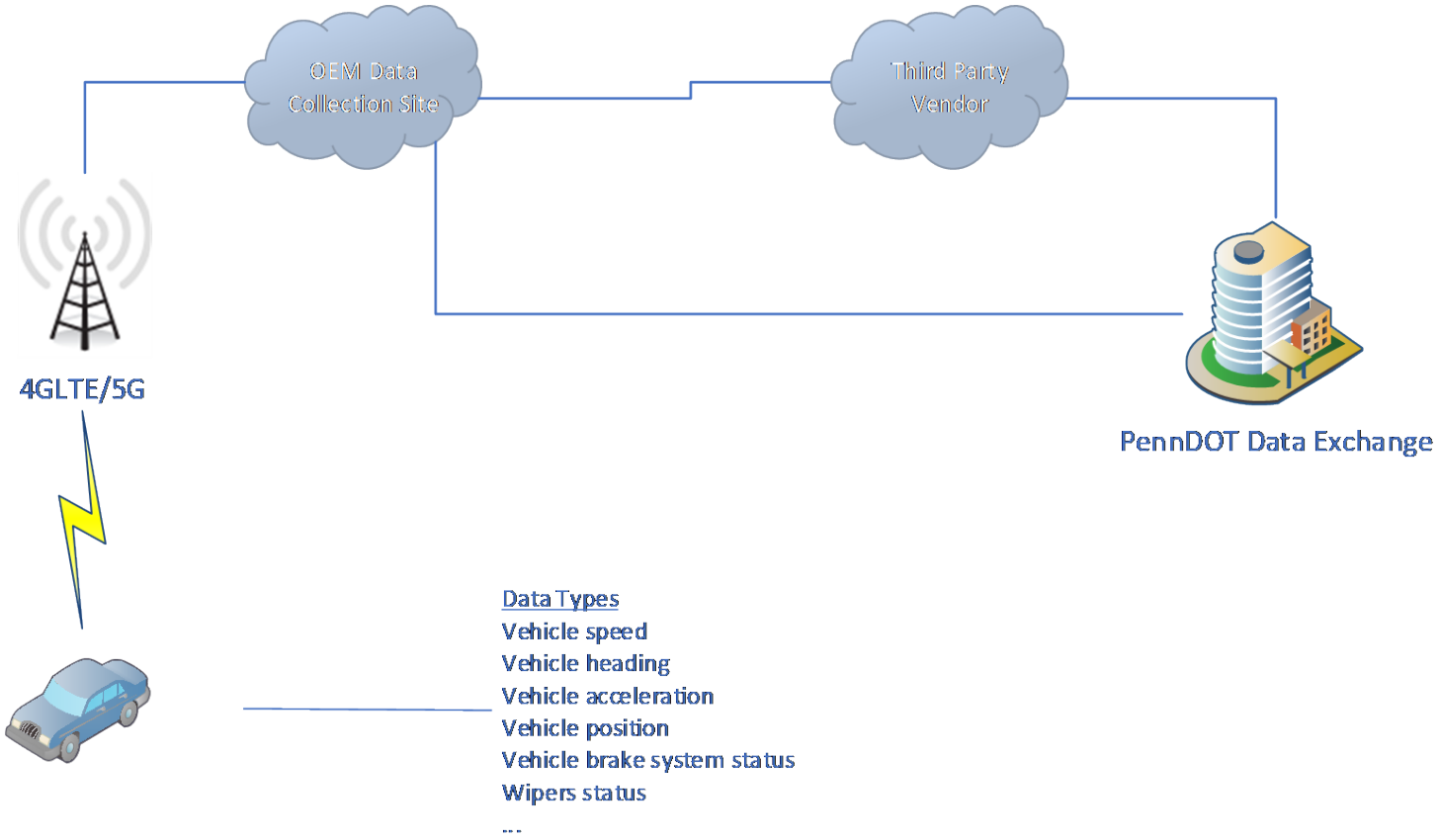
- Identify and analyze different sources of vehicle data
- Assess potential of data for TSMO use cases
- Evaluate viability of obtaining data from OEMs and 3rd Party data providers

USE CASES

Traffic Operations	Safety	Maintenance/Work Zones	Planning
Real-Time Traffic Management Systems	Accident Prediction and Prevention	Work Zone Traffic Flow Monitoring	Traffic Pattern Analysis
Traveler Information	Wrong Way Driving Prevention	Dynamic Work Zone Signage	
Traffic Incident Detection and Response	Work Zone Warning/Notification	Predictive Queue Warning	
Road Weather Information/Weather Impact Analysis	Queue Warnings		
Active Traffic Management	Driver Behavior Analysis		
Traffic Signal Timing Optimization			

TYPES OF DATA ASSESSED

- Traditional V2I (5.9 GHz) Communication
- Fleet Data – OEM Directly
- Fleet Data – Third Party



Example of Vehicle Data Through OEM Directly or Through Third Party Vendor

DATA SETS

SAE J2735 Basic Safety Message (Comparative Data Set)

Part I

- Vehicle Size
- Vehicle Position
  - Latitude
  - Longitude
  - Elevation
- Speed
- Heading
- Acceleration/Deceleration (negative acceleration)
- Brake System/Traction Control Status

Part II

- Vehicle path history and prediction
- Vehicle exterior light status
- Emergency Vehicle Status
- Trailer hauling descriptions
- Vehicle Classification Data
- Weather Probe Data

Challenges and Opportunities

- Requires ubiquitous RSU deployment
- Currently very small vehicle penetration
- Can support safety-of-life (low latency) applications

DATA SETS

Basic Vehicle Telematics

- **ECU** - Central Control Device that manages vehicle systems and functions
- **Inertial Measurement Unit** (IMU) - Measures the vehicle's movement by using accelerometers and gyroscopes to detect changes in acceleration and angular velocity

Typical Data Available	Other Functional Data
• Vehicle Position • Latitude • Longitude • Elevation • Speed • Heading • Acceleration/Deceleration Brake System/Traction Control Status	• Wiper Status • Headlight Status • Seat Belt Status • Air Bag Deployment Status

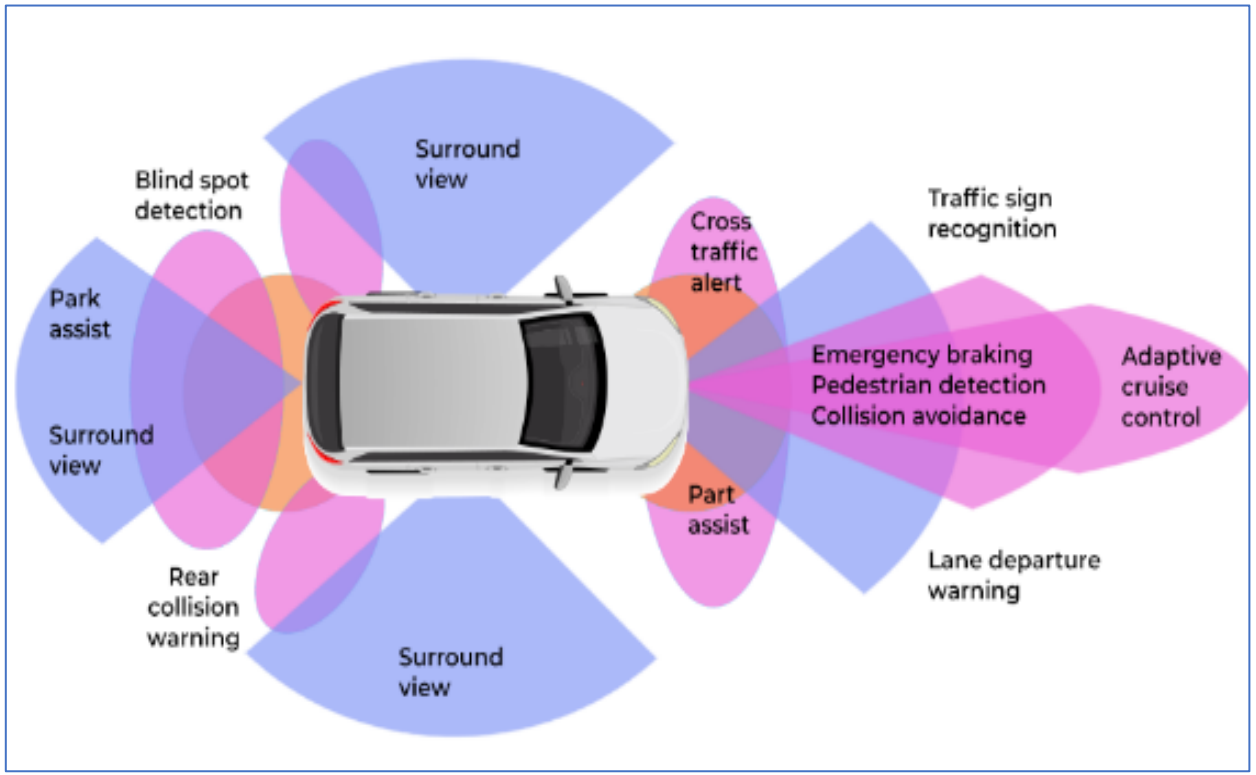
<u>Challenges and Opportunties</u>

- All new vehicles provide this data feed, but richness of data is manufacturer dependent
- Data transmission is dependent on supporting cellular connectivity
- Data frequency vary by manufacture and use case
- Near real-time data – data collection cost increases as latency decreases

DATA SETS

ADAS Sensor Suite

- Additional sensors provide data rich output
  - Emergency Braking
  - Traffic Sign Recognition
  - Lane Departure Warning



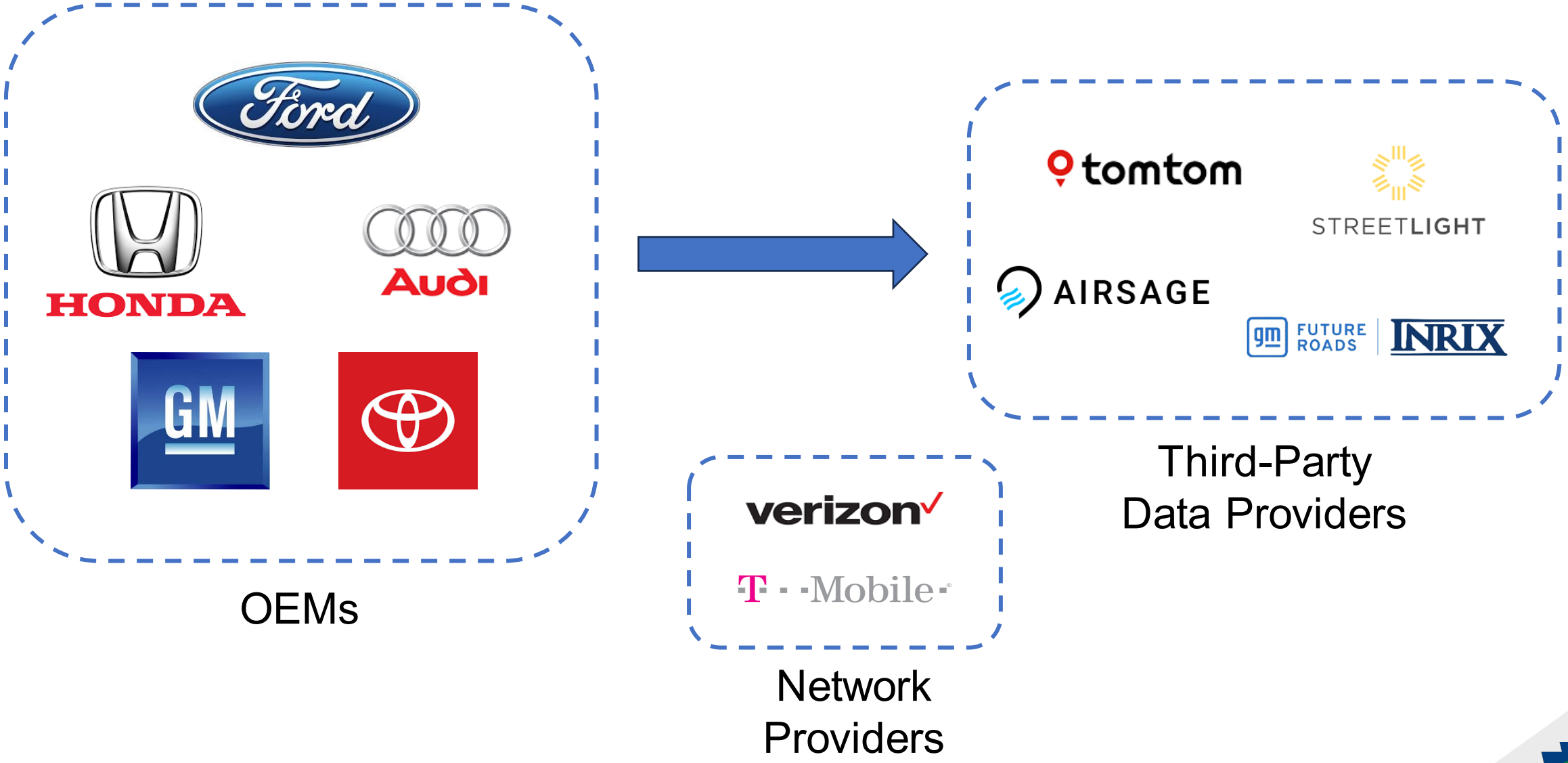
Challenges and Opportunties

- Data standardization and interoperability not there yet
- No known use cases for IOO traffic operations or safety applications
- Some promise for maintenance use cases

DATA CHARACTERISTICS

Characteristic	Description
Data Density	Essential for predicting traffic patterns or travel conditions. Requires significant vehicle data in the target area. Large data volumes needed for algorithm improvement.
Data Consistency	Must be normalized across different vehicle sources. Ensures reliable application use.
Data Latency	Low latency needed for real-time traffic management. Historical data can be older and still useful.
Data Frequency	High frequency increases costs but improves data resolution. Lower frequency sufficient for general mobility or historical analysis.
Data Richness	Detailed datasets valuable for real-time traffic and short-term delays. High-level datasets useful for origin and destination studies.
Data Integration	Significant effort required for integrating traffic datasets. Important to specify needed data based on use cases.
Data Cleaning	Ensures data validity and proper range. Corrects GPS signal drift and correlates position to the roadway.
Geofencing	Filters data to show areas of interest. Creates virtual boundaries for relevant data analysis. Triggers alerts for specific events within geofenced zones.

OUTREACH

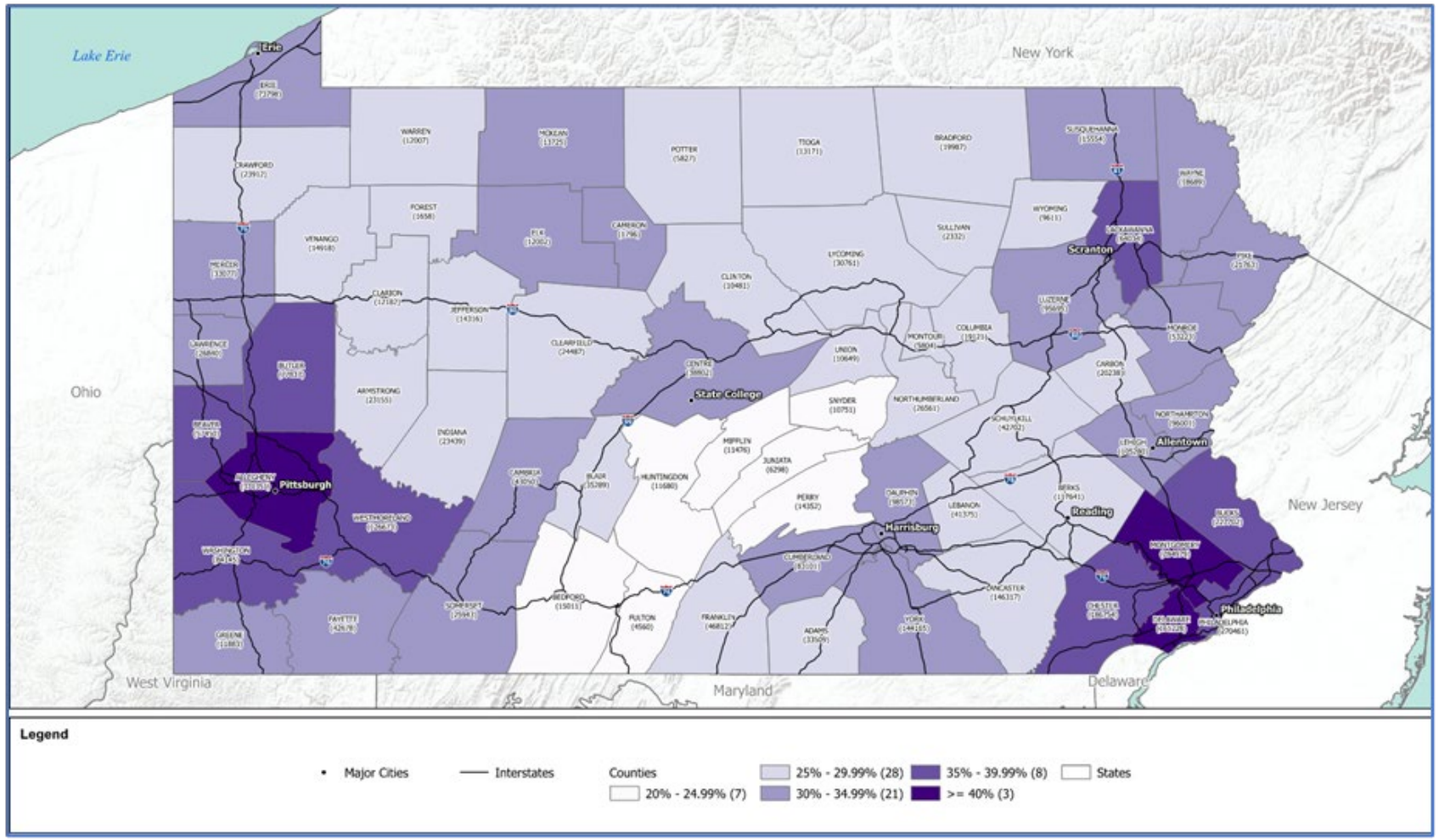

Ford
HONDA
Audi
GM
OEMs
tomtom
STREETLIGHT
AIRSAGE
FUTURE ROADS
INRIX
Third-Party Data Providers
verizon
T-Mobile
Network Providers

VEHICLE DATA VIABILITY

Pennsylvania Vehicle Makeup

- As a % of total registered vehicles

1. Ford – 6%
2. Toyota – 4%
3. Honda – 3%
4. Chevrolet – 3%
5. Jeep – 3%



STUDY FINDINGS

- Wealth of data is collected from vehicles and can apply to various use cases both near real-time and historical
- Most OEMs are reluctant to share data directly with DOTs, preferring instead to work through third-party providers
- The market is dominated by third-party data resellers who aggregate, clean, and analyze data from various sources
- Data privacy and security is a concern, including sharing data to insurance companies
- Litigation concerns with data that might be discoverable in a court case
- Data management and processing costs

STUDY FINDINGS

European Data Experience

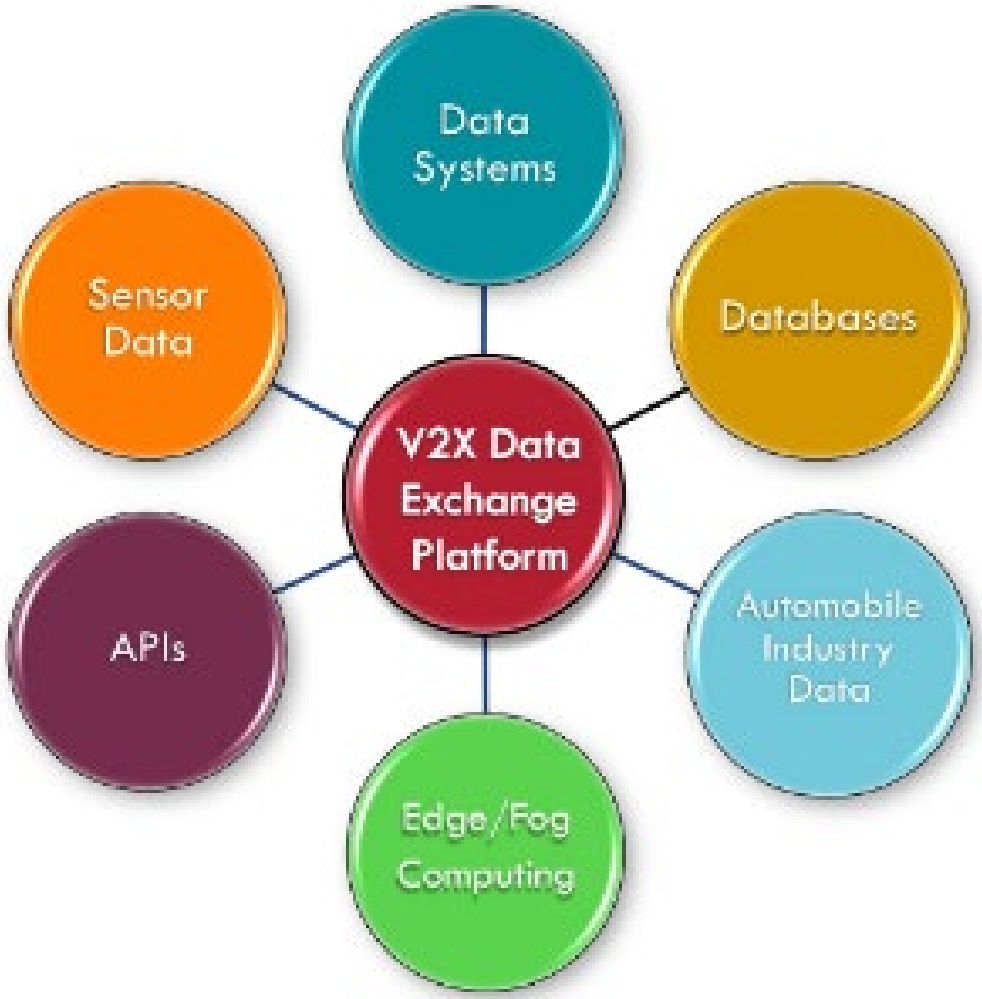
- EU Data Act aims to democratize data access and foster innovation
- Vehicle manufacturers are required to share data
- Safeguards on IP
- Transparency on data use

Takeaways for US

- Balancing Interests
- Interoperability and Standardization
- Legal and Regulatory Alignment
- Transparency and Accountability
- Innovation and Competitiveness

OPPORTUNITIES

- Prioritize relationships with third-party data providers for near-term data acquisition
- Conduct pilot use case through the V2X Data Exchange to evaluate the effectiveness of CV data
- Invest in robust data management infrastructure to handle large-scale CV data effectively
- Engage in collaborative efforts like TPFS to share costs and knowledge with other DOTs
- Explore grant opportunities
- National engagement



QUESTIONS?

Gunnar Rhone, PE
Engineering Specialist – Transformational Technology
Pennsylvania Department of Transportation

717.214.2997
grhone@pa.gov