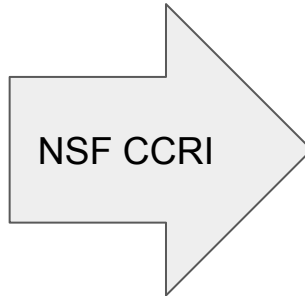


PIVOT: Platform for Innovative Use of Vehicle Open Telematics

Presentation to COVESA Fall All-Member Meeting
Christos Papadopoulos, U. Memphis
October 20, 2022

Goal of this Talk (BLUF)



PIVOT

Community-based platform to catalyze the production and consumption of automotive and heavy duty datasets and tools to support research in vehicle system cybersecurity, intelligent transportation, and smart and connected communities

Provide overview of PIVOT project and talk about the use of VSS as the naming format for the signal data that PIVOT will collect and distribute

Outline/Topics

- NSF CCRI program and the PIVOT award
- PIVOT Goals and Objectives
- Five Pillars
 - Platform
 - Datasets
 - Tools
 - Services
 - Community Outreach & Engagement
- VSS and PIVOT

NSF CCRI Program



Promotes the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense; and for other purposes.

Computer and Information Science and Engineering (CISE) Directorate

Supports research and education, fosters broad interdisciplinary collaboration, helps develop and maintain cutting-edge national cyberinfrastructure, and contributes to workforce development

CISE Community Research Infrastructure (CCRI) Program

Drives discovery and learning through the creation and enhancement of research infrastructure to support diverse communities of CISE researchers pursuing research agendas in computer and information science and engineering

Need for High Quality Automotive Datasets

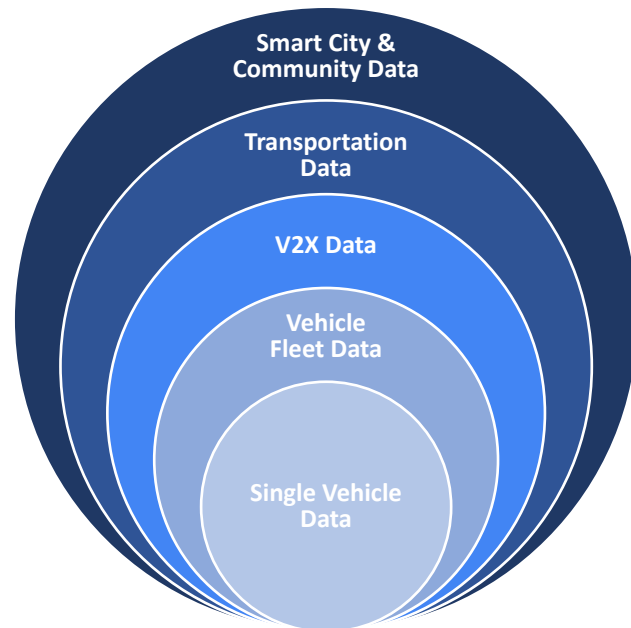
- High quality, real-life vehicle network datasets are needed by researchers who are advancing the state of the art in automotive and related systems
- When it comes to passenger cars and heavy vehicles, such datasets are ad hoc, hard to obtain, and have limited utility, which prevents (or slows) the research community from growing the discipline

Need for PIVOT Infrastructure

- The PIVOT infrastructure is needed to transform the ad-hoc, small-group endeavors for vehicle data curation into a scientific body of work done by a larger synergistic community

Examples of Automotive Research Datasets

- Oak Ridge ROAD and potential future datasets
- U. South Korea HCRL Datasets
- Bosch SynCAN (for CANet)
- TU Eindhoven Lab Automotive CAN Bus Intrusion
- CrySiS Lab CAN-Log Infector and Ambient CAN Traces
- Cephas Baretto Dataset
- Heavy Truck Datasets from Jeremy Daily @ CSU
- Geotab Ignition
- U. Michigan Mcity
- US Department of Transportation Public Data Portal
- SmartColumbus Datasets Curated for Visualization
- Wyoming DOT CV Pilot



Potential Applications of Automotive Datasets

- **Vehicle:** System monitoring and optimization, in-vehicle infotainment, predictive maintenance, route and trip planning, etc.; ADAS, CAVs, EVs, heavy trucks, etc.
- **Transportation and fleet management:** passenger safety, traffic management, ride sharing, multi-modal mobility, data-driven insurance
- **Smart cities:** infrastructure monitoring and mgmt, weather sensing and mapping, asset mgmt, etc.
- **Safety and cybersecurity:** CAN bus anomaly detection, sensor security, AI and MSF, etc.
- **NSF research communities:** SaTC, S&CC, CPS, CIVIC, etc.

The PIVOT Project

- Joint effort among:
 - University of Memphis (Christos Papadopoulos),
 - Colorado State University (Jeremy Daily),
 - USC Information Sciences Institute (David Balenson and Wes Hardaker), and
 - commercial telematics provider Geotab (Glenn Atkinson and Ted Guild)
- Three-year project
- \$1.81M grant
- Supporting the CISE automotive and heavy duty vehicle research community



PIVOT Goals and Objectives

PIVOT is a community-based platform intended to catalyze the production and consumption of automotive and heavy duty datasets and associated tools to support the NSF CISE community pursuing research in vehicle system cybersecurity, intelligent transportation, and smart and connected communities

- The platform component of PIVOT is the hardware and software infrastructure needed to host the datasets, tools, and services
- PIVOT will provide the CISE community with in-vehicle datasets, telematics data, an open source data repository, and new open source tools to help collect, process, and analyze data
- The user services will employ existing privacy controls as well as enable researchers to further advance privacy approaches using PIVOT datasets

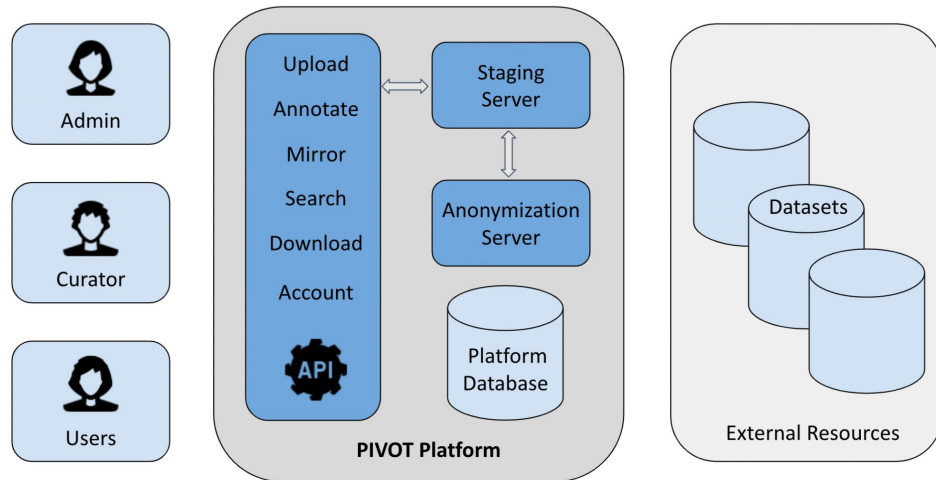
PIVOT Five Pillars

- (1) Robust and reliable hardware/software platform upon which the system runs
- (2) Curation and sharing of the data and contextual information
- (3) Researcher centric services for sharing, securing, and evaluating datasets
- (4) Common software-based tools to collect, transform, combine, filter, and visualize the data
- (5) Extensive community outreach and engagement to improve the data utility using design feedback mechanisms



PIVOT Platform

- Scalable, interactive platform to provide user services and access to data and tools
- The platform will host a web server, database, and microservices
- Robust security including firewall
- Hosted at Memphis
- Mirrored at partner institutions (e.g., Colorado State) for backup, redundancy, and seamless recovery



Datasets - Three Broad Categories

(1) Community datasets

- Bosch and other CAN datasets
- HCRL CAN and other datasets
- Etc.

(2) Geotab telematics devices and fleet data

- Altitude (Ignition) aggregated for PIVOT researchers (and Geotab customers)
- PIVOT Spindle (raw) data for PIVOT researchers

(3) PIVOT CAN loggers

- Passenger cars – Christos Papadopoulos (Memphis) CAN Logger
- Heavy trucks – Jeremy Daily (CSU) CAN Logger 3

(1) Community Datasets

- Produced by other researchers and/or laboratories
- Supports prior / ongoing research
- Available for use by others, but may not be widely known
- PIVOT acts as a portal to increase awareness, make connections
- Examples
 - Oak Ridge ROAD and potential future datasets
 - U. South Korea HCRL datasets
 - Bosch SynCAN (for CANet)
 - TU Eindhoven Lab Automotive CAN Bus Intrusion
 - CrySiS Lab CAN-Log Infector and Ambient CAN Traces
 - Cephias Baretto Dataset
 - Heavy Truck Datasets from Jeremy Daily @ CSU

(2) Geotab Telematics Device and Fleet Data

- Geotab Altitude (or Ignition) data
 - High-level, aggregated telematics data
 - From over 2.5M cars and trucks around the globe
 - Uses Geotab's GO9 telematics device and cloud services
- PIVOT Spindle Program
 - Small “fleet” of PIVOT researchers w/ GO9 device installed in their vehicles
 - Agreed to contribute their data and make it available to other PIVOT Spindle researchers
 - Raw data accessible via Geotab SDK in .NET



GEOTAB
management by measurement

(3) PIVOT CAN Loggers

Currently in progress for passenger cars and heavy trucks

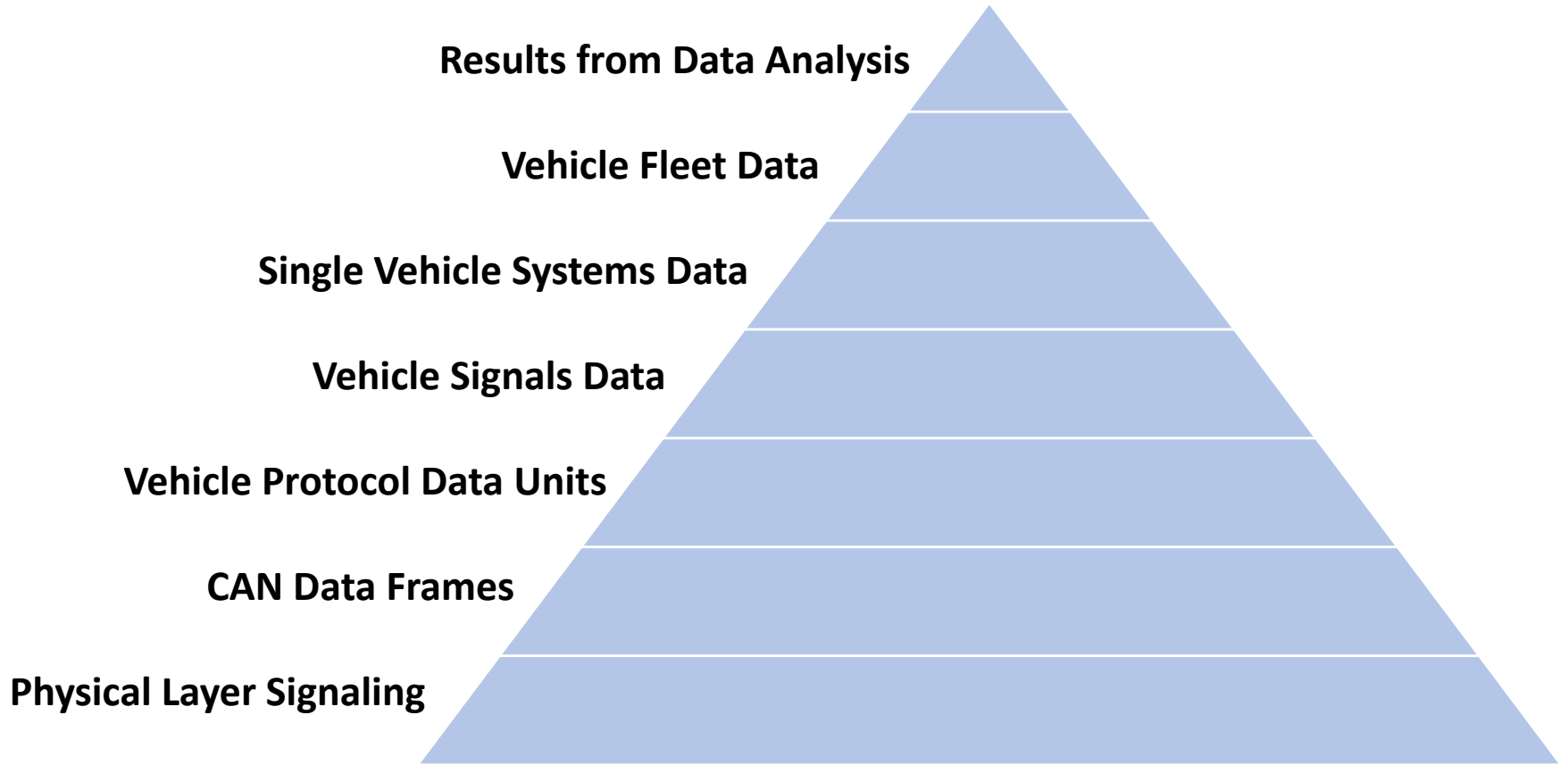
Current Plan:

- Raspberry Pi or Arduino-based devices
- Open source software
- Distributed to volunteers
- Collect data, return to PIVOT
- Privacy controls
- 50-100 devices
- Deployment cycles and strategies (geography, make/model of vehicle, etc.)



CAN Logger 3, rev 3e

By Duy, Secure CAN Logging and Data Analysis,
Colorado State University, Fall 2020.
<https://www.engr.colostate.edu/~idaily/J1939%2FSecureCANLoggingPresentationDuyVan.pdf>



Tools

- CAN log format converters
- Convert raw CAN into protocol data units
- Data decoding
- CAN data log slicing and filtering
- Others TBD (based on community needs)

Services

- Access to datasets and tools
 - Links to community datasets and tools
 - Access to and/or mirroring of Geotab datasets and analytical tools
 - Access to and/or mirroring of PIVOT Spindle datasets
 - Collection, storage, and/or mirroring of PIVOT crowdsourced CAN logger datasets
 - Access to PIVOT tools
- Privacy support services and tools
- Internal Review Board (IRB) support
- Community coordination and interaction

Community Outreach and Engagement

Community engagement and outreach activities to raise awareness, share initial plans, encourage contributions and use, elicit input and requirements from the broader community are a critical element of any NSF CCRI and of PIVOT

- Publications
- Technical Review Articles
- Webinars
- Website
- Social media such as Twitter
- Conferences and workshops
- Hands-on Events
- PIVOT Community Workshops
- CyberAuto & CyberTruck Challenge Events

Engaging a diverse community, including activities targeting faculty, researchers, and students at minority institutions and from underrepresented groups is also important!

Annual Community Workshops

- Bring together the community around development and sharing of robust automotive and heavy-duty datasets to support open research in areas with strong societal impact
- November 2021 workshop brought together close to 70 researchers producing and/or using datasets; commercial vehicle telematics providers willing to share data; and other interested parties

YOU'RE INVITED!

The next workshop will be held VIRTUALLY on November 17-18, 2022.

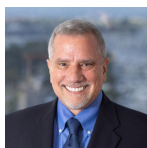
RSVP to info@pivot-auto.org if you are interested in participating!



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Ted
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(Geotab)



Stacy
Prowell
(ORNL)



Sam
Hollifield
(ORNL)

2022 Community Workshop DRAFT AGENDA

DAY ONE

- PIVOT Overview
- Geotab Support for PIVOT
- ORNL Research, Datasets, and Facilities
- COVESA Vehicle Signal Specification
- AGL: Linux Automotive Grade Linux
PASS: Platform for Auto-driving
Safety and Security
- Breakout Discussion: Crowdsourced Data from CAN Loggers

DAY TWO

- NSF CCRI Overview
- MCity 2.0 Overview (invited)
- Lightning Talks on NSF Researcher Efforts
- CyberAuto & CyberTruck Challenges
- Dagstuhl Report Privacy Protection of Automated and Self-Driving Vehicles
Privacy Considerations for Geotab Fleet Data (invited)
- Privacy Enhancing Technologies for Automotive Datasets
- Privacy Panel and Discussion

YOU'RE INVITED: RSVP to info@pivot-auto.org if you are interested in participating!

Benefits of PIVOT

- Help coordinate existing isolated efforts
- Facilitate exchange of knowledge and resources
- Encourage, nurture, and sustain ongoing conversations
- Stimulate research collaborations among users and producers of datasets
- Engage industry, including OEMs, suppliers, and other important partners
- Engage relevant standards bodies and applicable government organizations

Community Impact

- Create robust ecosystem that works to develop, share, and exploit community resources, including automotive research datasets and tools
- Enable research community to address important problems, define high quality research initiatives, and develop new, innovative applications to benefit society

VSS and PIVOT

- We plan to use VSS for appropriate PIVOT data
 - Data containing Signals
- Promote VSS efforts to the PIVOT community
- Encourage coordination and interaction between the two communities for mutual benefit
- Build bridges between academic researchers and industry

Benefits to VSS Community and NSF Researchers

VSS Community

- Encourage the use of VSS in the academic automotive research community
- Gain new collaborators from the NSF CISE community
- Help adoption of VSS and explore new use cases
- Gain new code contributors
- Gain access to PIVOT platform resources and access to the advisory board
- Use PIVOT as an outlet to solicit and distribute new automotive datasets
- Get notifications for workshops, webinars, meetings, and other outreach events

NSF Researchers

- Better understanding and appreciation of the VSS ecosystem
- Educating researchers on the design of VSS
- Improving researcher understanding about needs and requirements that necessitate VSS
- Guidance to researchers in defining real-life problems addressed by VSS
- Code and feature support

Contact Us



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