OAK RIDGE National Laboratory

Transportation Cybersecurity

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U.S. DEPARTMENT OF ENERGY

TSUSG Annual Meeting 2023

Transportation Cybersecurity Research Team

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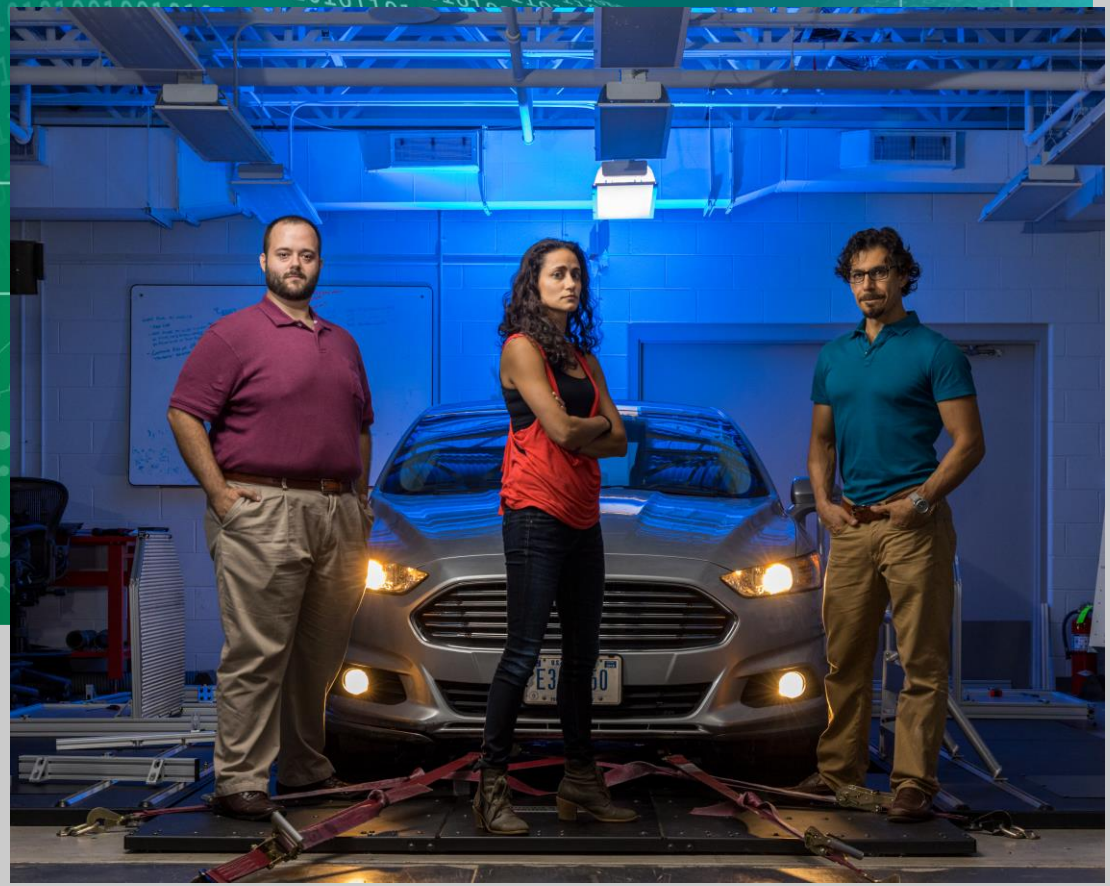


National Nuclear Security Administration

Cyber Attacks on Vehicles

Jeep Hack (2015)

Hackers Miller & Valasek remotely kill Chrysler vehicle on highway.

www.cnbc.com/video/2015/07/22/hackers-hijack-moving-jeep-shocking-video.html

Keyfob Replay Attacks (2022)

Although more known—keyfob attacks continue to thwart implemented security (2022)

https://www.blackhat.com/us-22/briefings/schedule/#rollback---a-new-time-agnostic-replay-attack-against-the-automotive-remote-keyless-entry-systems-27185

Gone in 60 Seconds (2022)

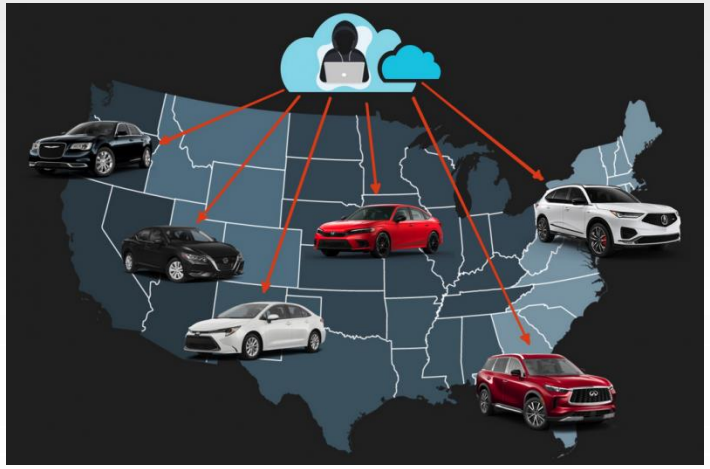
New thieving tool uses headlight plugs to reprogram car keys. Thefts are fast and easy (120s)

https://kentindell.github.io/2023/04/03/can-injection/

Cyber Attacks on Vehicles

Sirius-XM API Leak (2022)

Sirius-XM leak allows hackers to remotely unlock and start vehicles



https://www.securityweek.com/several-car-brands-exposed-hacking-flaw-sirius-xm-connected-vehicle-service/

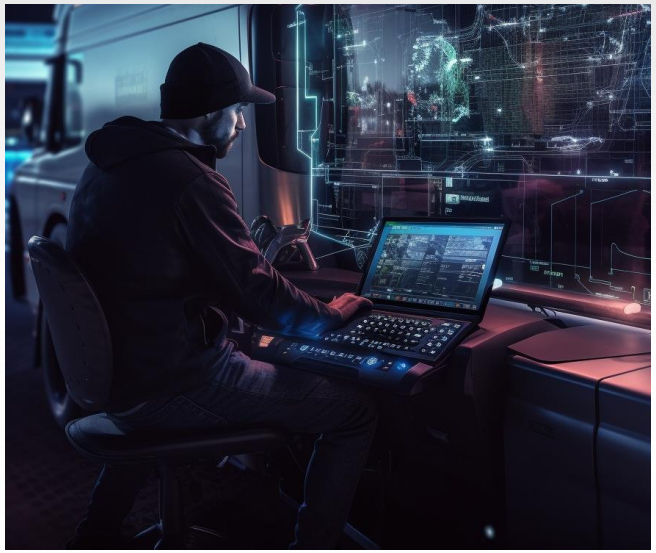
Toyota Location Leak (2023)

Vulnerability in Toyota Cloud Services allows hackers to eavesdrop on vehicle location.

https://www.bleepingcomputer.com/news/security/toyota-car-location-data-of-2-million-customers-exposed-for-ten-years/

Continued API Leaks (2023)

Sam Curry continues research into leaked APIs. Finds vulnerabilities in **16!!!** OEMs



https://samcurry.net/web-hackers-vs-the-auto-industry/

A Simple Attack

Example of what you can do with

- $75 hardware
- Nearly no knowledge
- A modern vehicle

We simply send randomized messages at a high rate

Denial of Service Random Injection Attack Video
Video credit: Frank Combs at ORNL

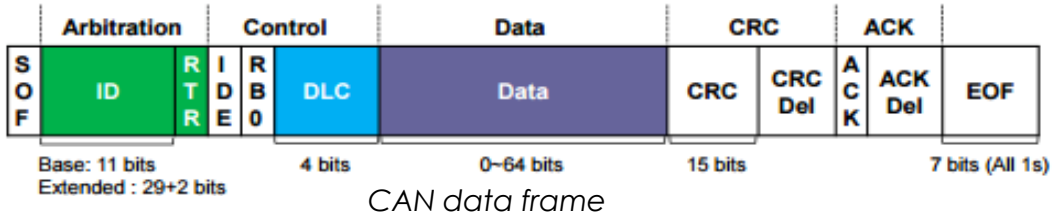
CAN basics

Shared serial communication bus designed to be robust and inexpensive

Implemented as a two-wire differential signal (CAN High and CAN Low)

CAN is a message-based protocol

Messages contain an ID field, a data field, and a few others



CAN data frame
Photo credit: Cho & Shin, *CCS 2016*

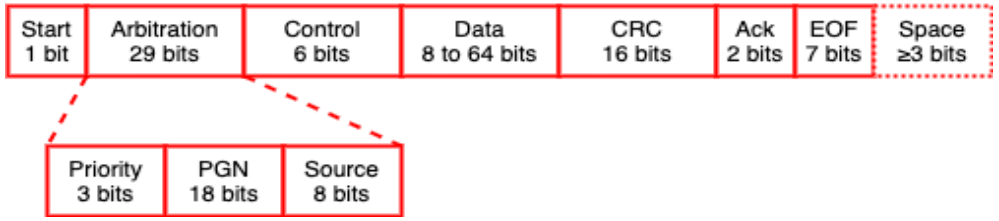


Diagram of CAN frames
Image credit: Mike Iannacone at ORNL

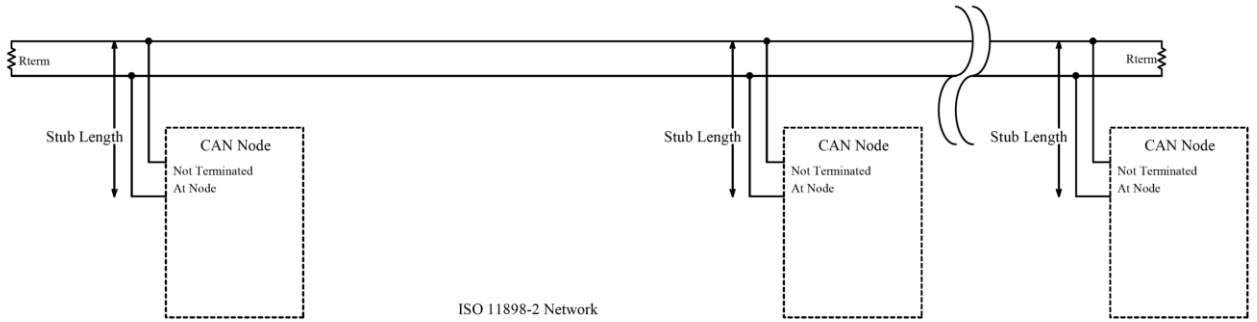


Diagram of CAN network topology
Image credit: EE JRW at Wikimedia Commons

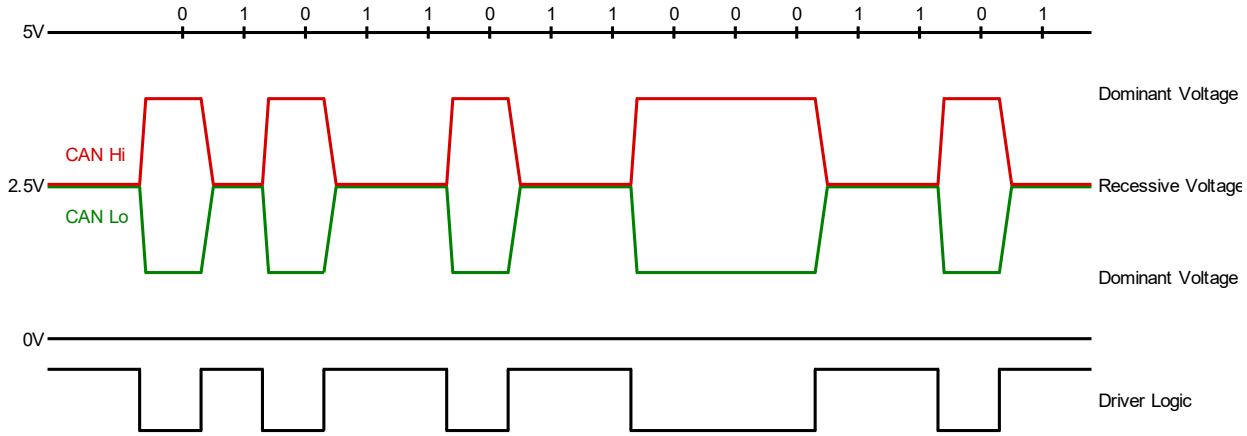


Diagram of CAN network signaling
Image credit: EE JRW at Wikimedia Commons

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Defending against Cyber Attacks

Problem: Cybersecurity Resilience Varies Wildly by Manufacturer

Best Practice	OEM A	OEM B	OEM C	OEM D
CAN Gateway	✓		✓	
CAN Message Authentication			✓	
Segmented Networks	✓	✓	✓	
Transparent Vulnerability Handing	✓			
Frequent Security Patching			✓	
Whole-Vehicle Security Assessments				

Intrusion Detection & Prevention

- Fabrication Attacks: Simple injected malicious messages
- Suspension Attacks: Preventing ECUs from speaking (e.g., targeted bus-off)
- Masquerade Attack: Very sophisticated. Suspends transmission of real messages, replaces expected data with malicious payload

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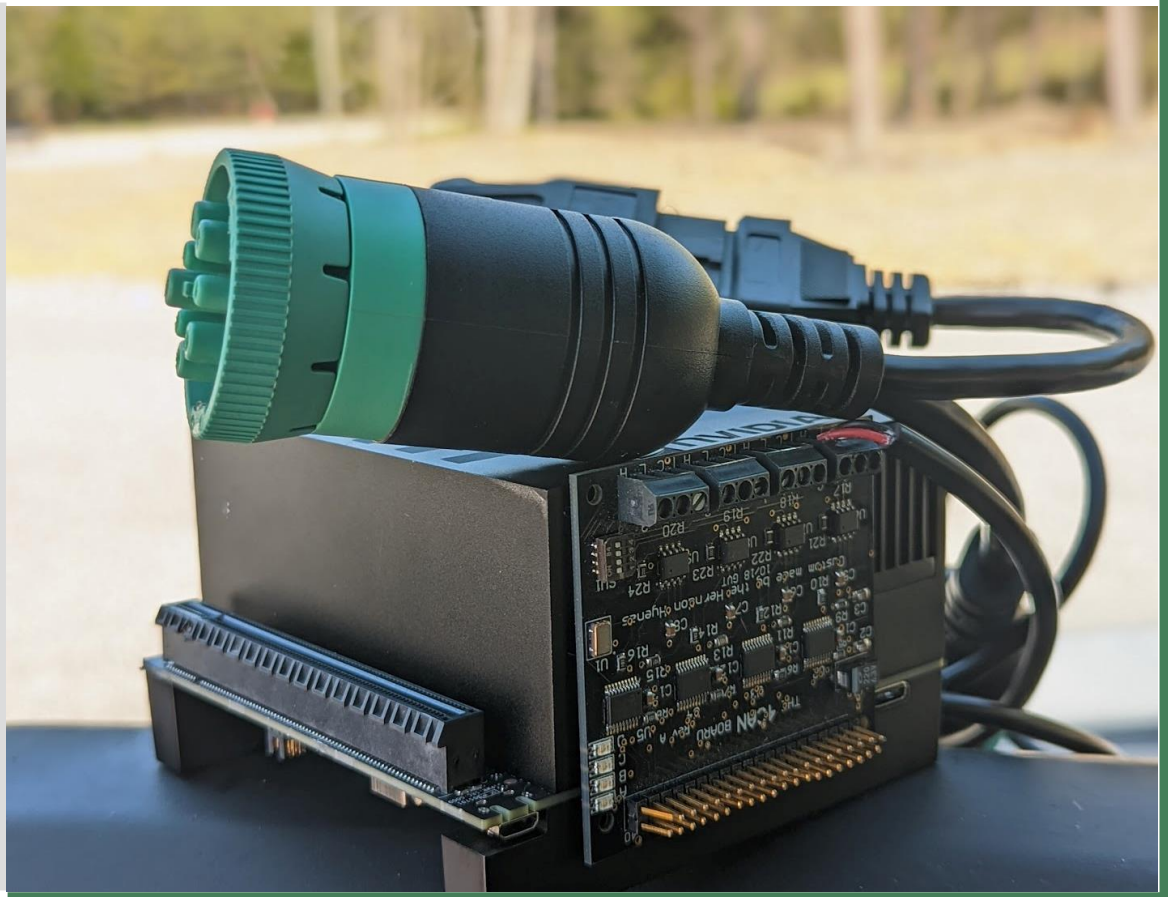
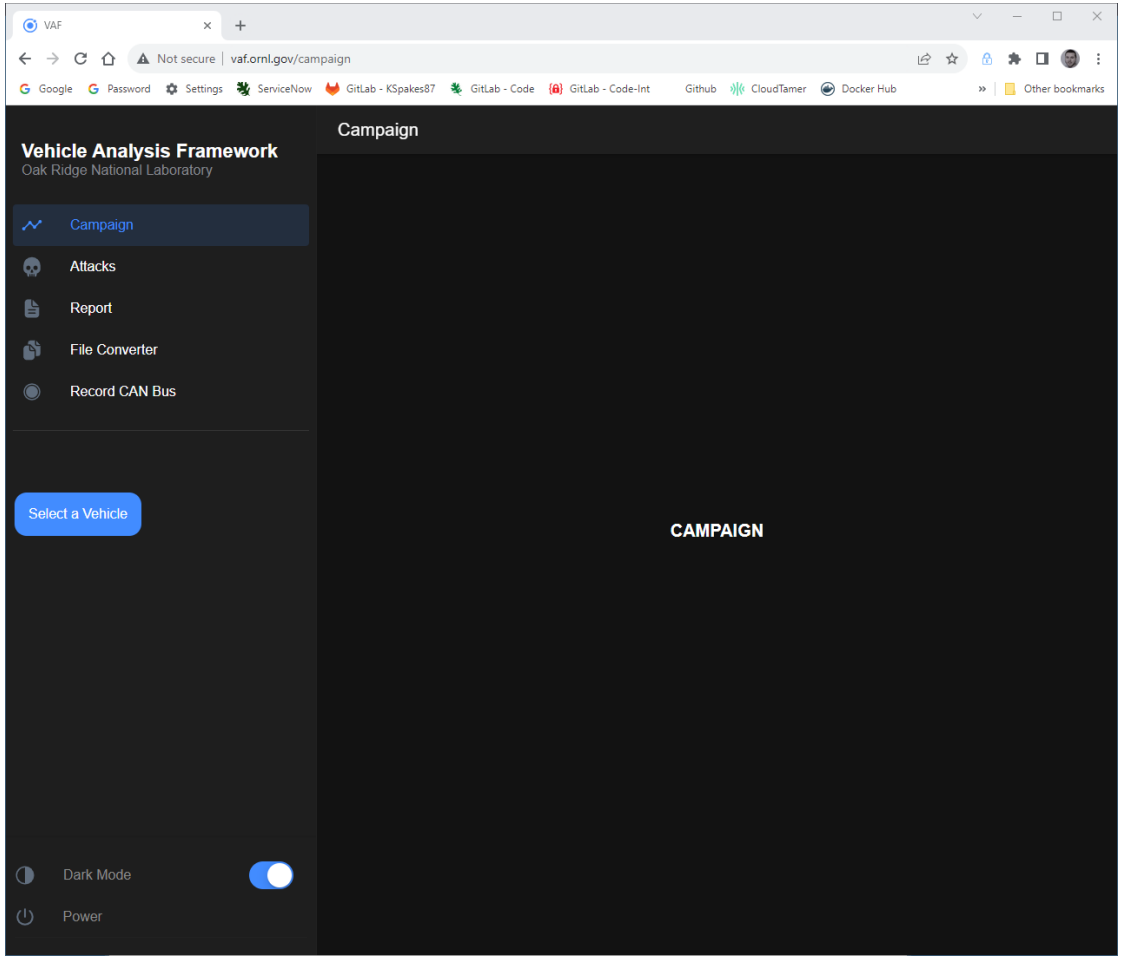
SHIELD: Secure Hijack, Intrusion, and Exploit Layered Detector

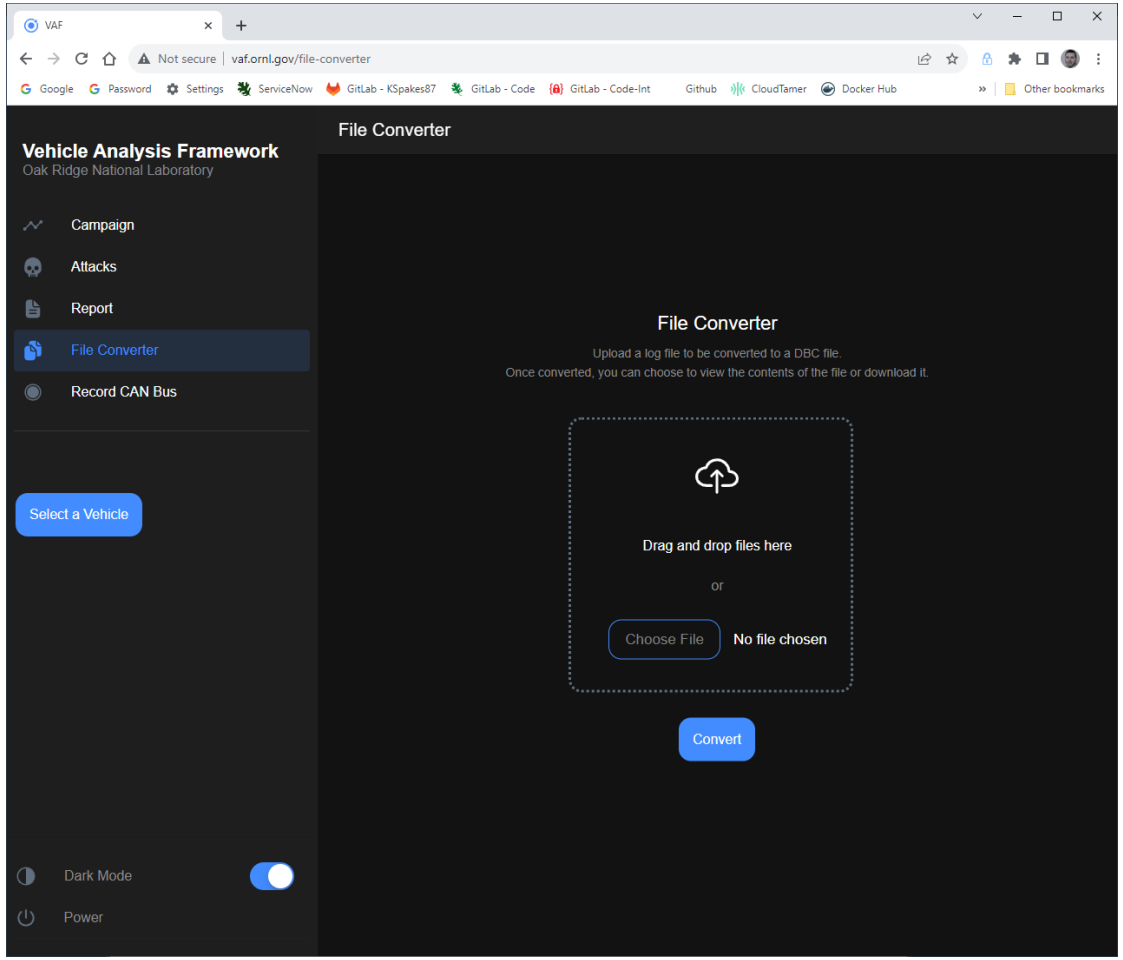
- Ensemble intrusion detection system for in-vehicle Controller Area Networks



ORNL Entire Vehicle Analysis of Cybersecurity (EVAC) Framework



Goal: Automate the analysis of a vehicle's cyber resilience



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Bridges, CAN-D

Acknowledgements

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Questions?

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