Android Infotainment quality analysis

By end-user behavior modeling and vehicle data

AMM Gothenburg April 2024

COVESA

Accelerating the future of connected vehicles

Introduction

Development of an infotainment system - **large task**

- Powerful platforms running many applications
- Dependencies on many other ECUs
- The main user interface to people in the vehicle

-> quite a lot that can go wrong

- laggy user interface
- random crashes
- …

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Speakers

Emil Dautovic

remotiveLabs

Tero Aaltonen

Profilence

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“Yesterday”

Image source : Wikimedia Commons

Mobile phones 20 years ago

-> a lot of experience gained

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Today

Problems with Infotainment Systems Most Prevalent

"Among the nine major vehicle categories measured in the *2024 VDS (Vehicle Dependability Study)*, owners experience the most problems with their infotainment systems" - JD Powers

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Problem

“I have a 2 week old [redacted]. Numerous issues with the infotainment system.

Still waiting for [redacted] to provide an update to resolve stability.”

“I'm in market for a new car and I really like the [redacted], but the issues I see about Android Automotive on this and other forums are really troubling."

“Had [redacted] for 3 months. Had 3x infotainment issues, one of which required a trip to the dealership.

Android in a car - terrible idea.”

“The [redacted] now has just under 10,000 miles. The Google system is terrible.”

“Curious if other folks are seeing issues with the infotainment system rebooting.

The car drives fine, but definitely a PITA. I read a lot of posts forums of similar experiences.”

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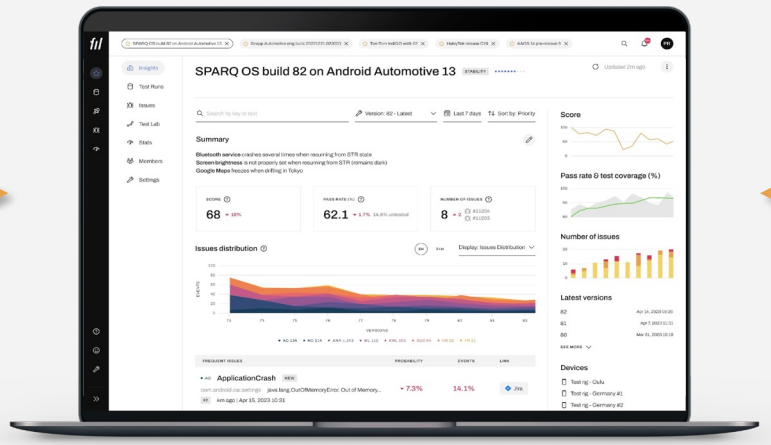
Profilence

Discover hard-to-find defects before your end-users do.

Our technologies and services provide a prioritized summary of software stability, performance, power consumption, and functionality levels at one sight.

Automotive Infotainment

Profilence Quality Analytics



Smart and Medical Devices

Some typical findings in automotive infotainment systems

Memory leaks

A SW component leaking memory will lead to system instability and crashes in the long run.

Such defects often go unnoticed in OEM QA processes but are the most common defect type we discover during the analysis.

Suspend-to-RAM and resuming

Resuming system state is complex and its implementation lays low in the SW stack, often provided by the chipset vendor.

STR issues may lead e.g. to Bluetooth connectivity problems which are extremely difficult to debug.

UI performance

Stability problems don’t always manifest as crashes.

Sometimes, they lead to an ever-slowing-down system that is still functionally ok but unpleasant to use.

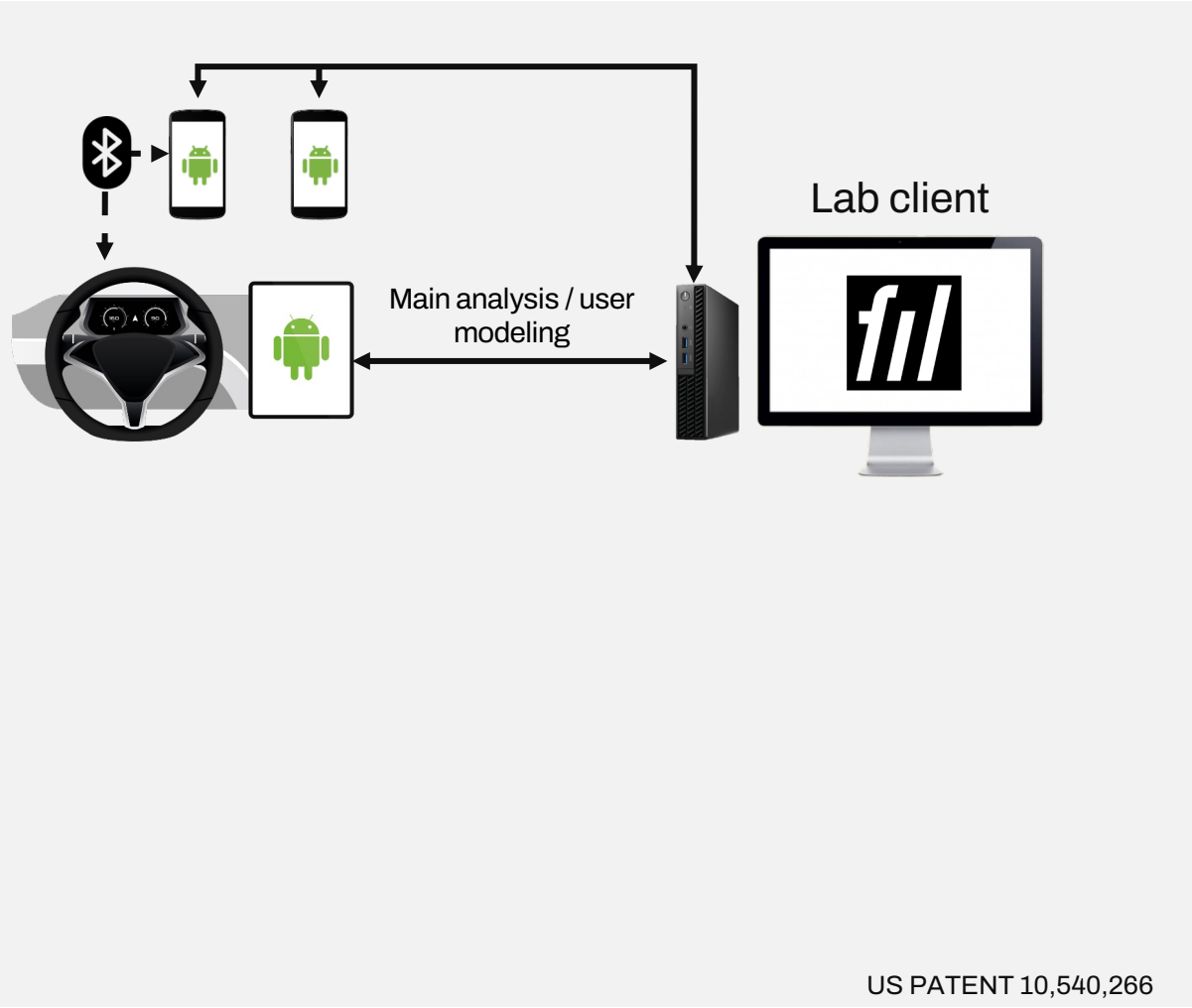
Random crashes outside the infotainment domain

Some defects occur only under specific, sometimes rare circumstances.

Root cause might not be in infotainment, but e.g. at a hypervisor level, or in some of the interconnected entities.

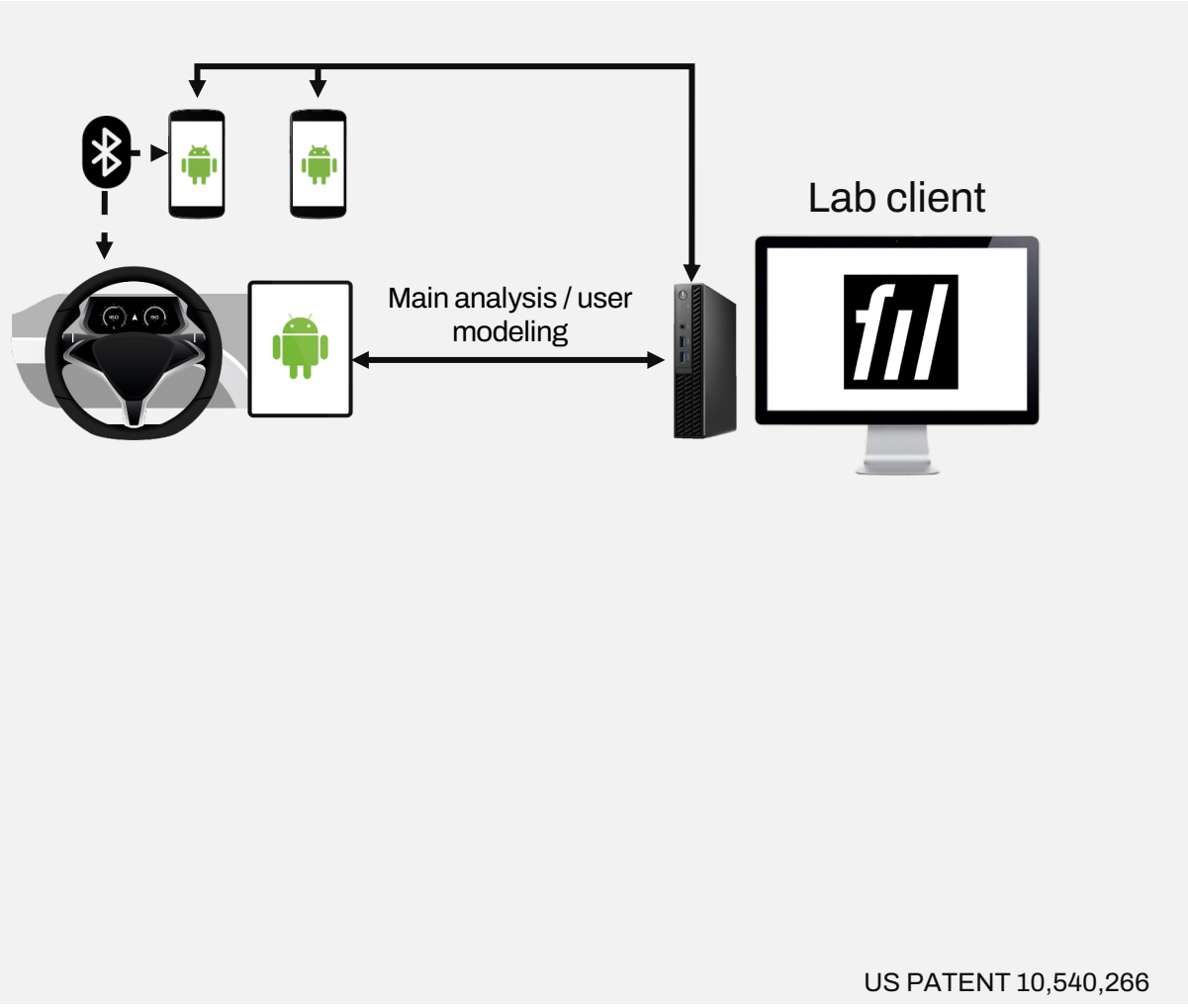
Automotive

Stability Analysis System Architecture



US PATENT 10,540,266

Stability Analysis System Architecture



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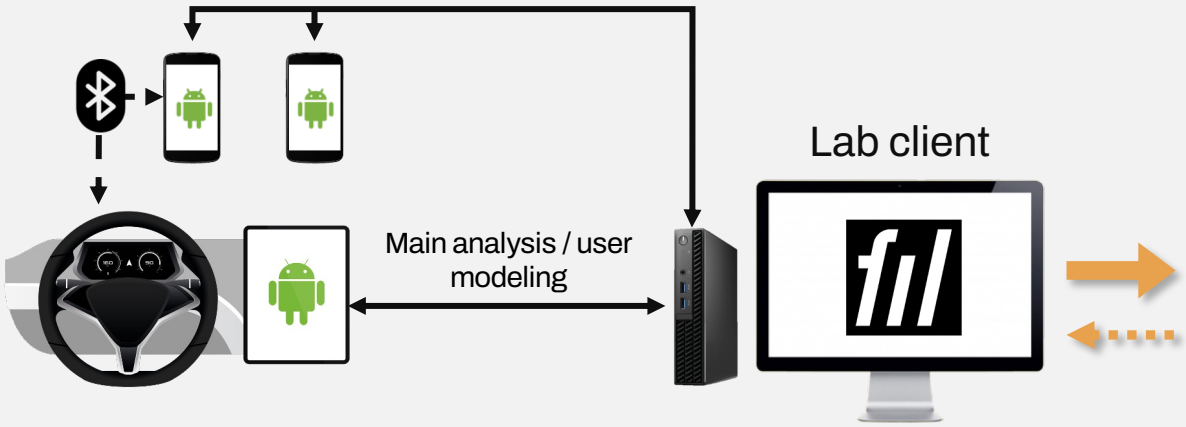
User behaviour models

- Navigation
  - Set destination, navigate there, ...
- Multimedia
  - Music player
  - Radio
- Phone calls
  - Originating (from various parts of the UI)
  - Receiving
- Bluetooth
  - Connecting / disconneting phones
  - Receiving an audio stream over BT
- Voice control / assistant
- In-cabin settings
  - HVAC, ...

Stability Analysis System Architecture



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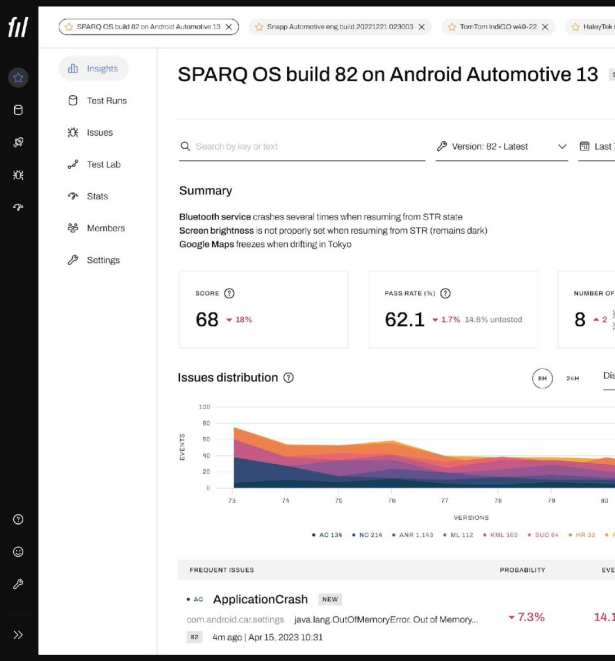
Quality Analytics Backend

Data synchronization, issue detection, and root cause analysis

Dashboard for product management, QA, and engineering teams:

- Quality trends: are things getting better or worse?
- What are the most critical issues?
- How likely are they to happen, and when?
- What's their impact on end-users?
- What are their root causes?



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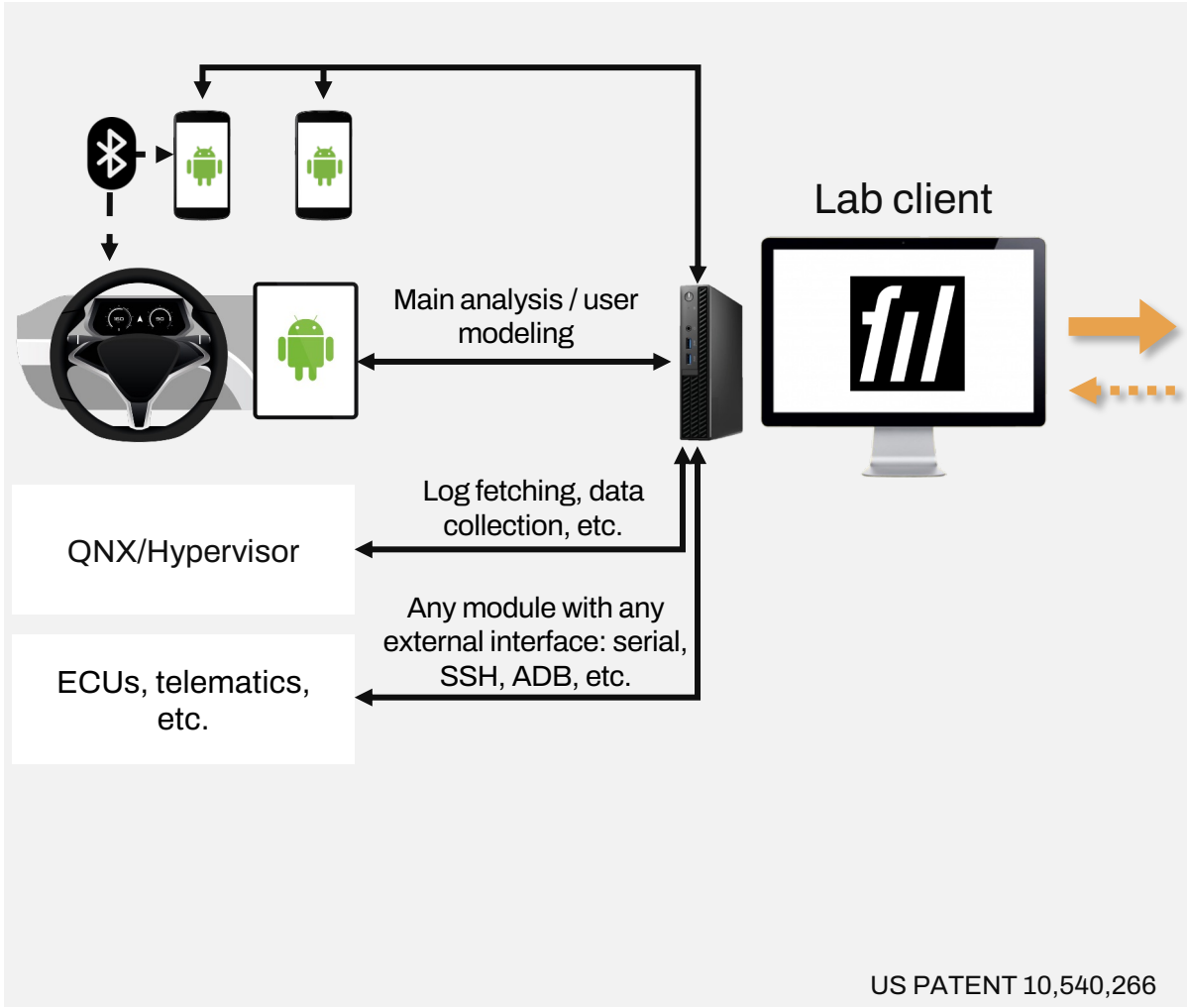

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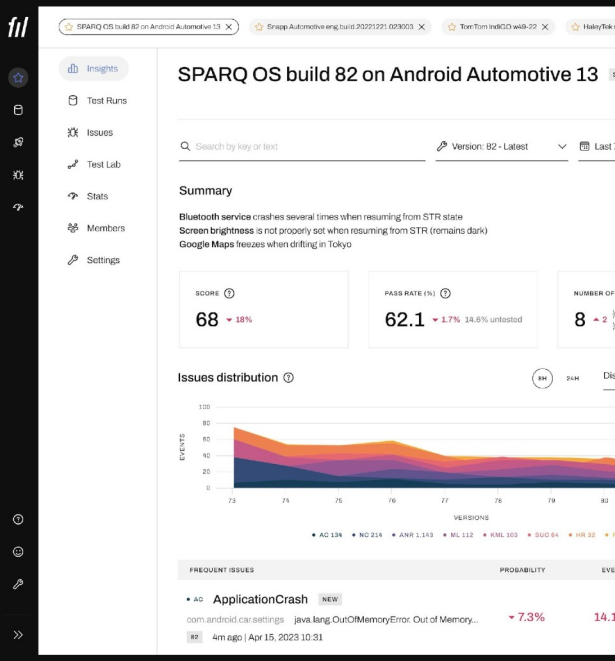

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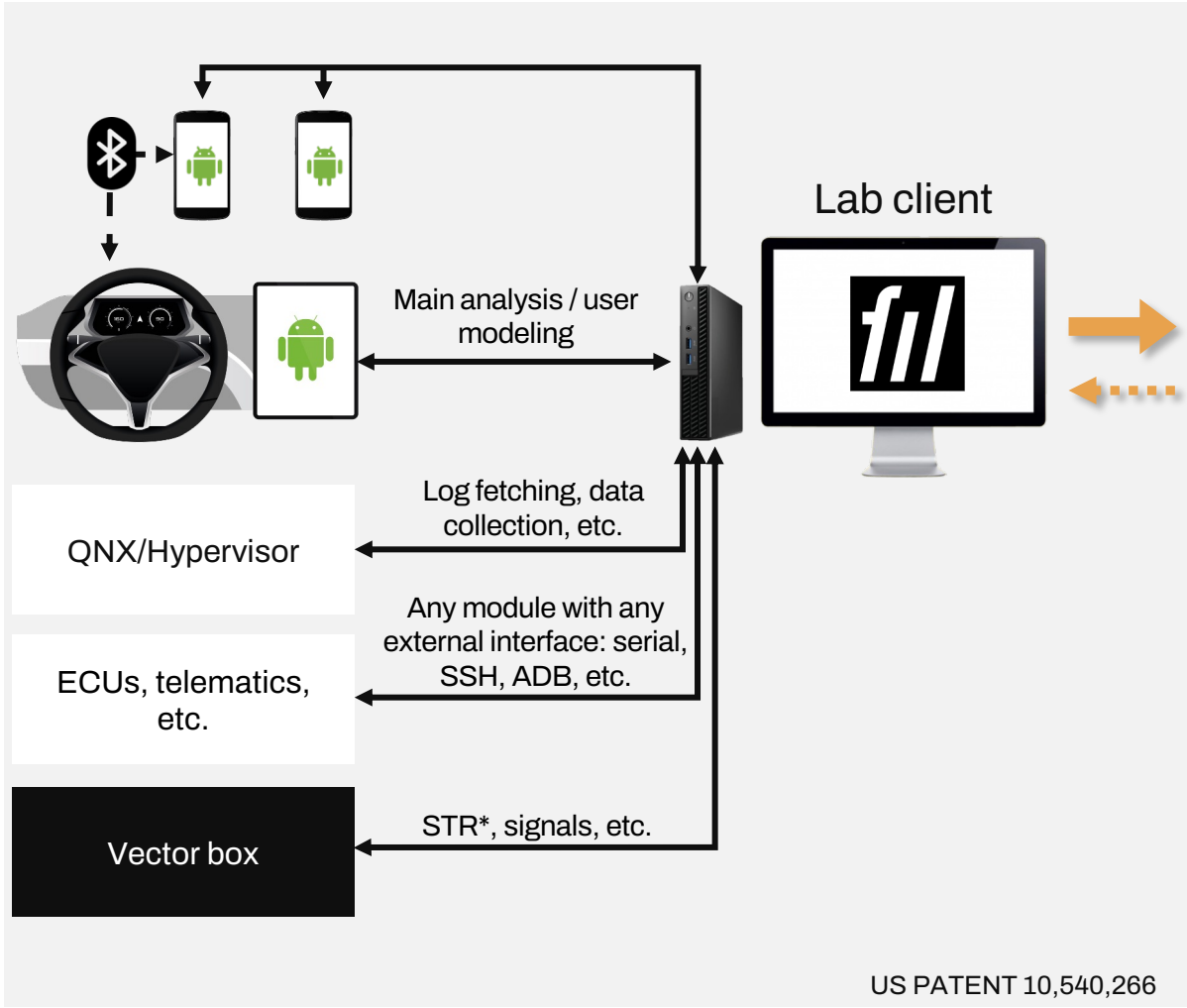

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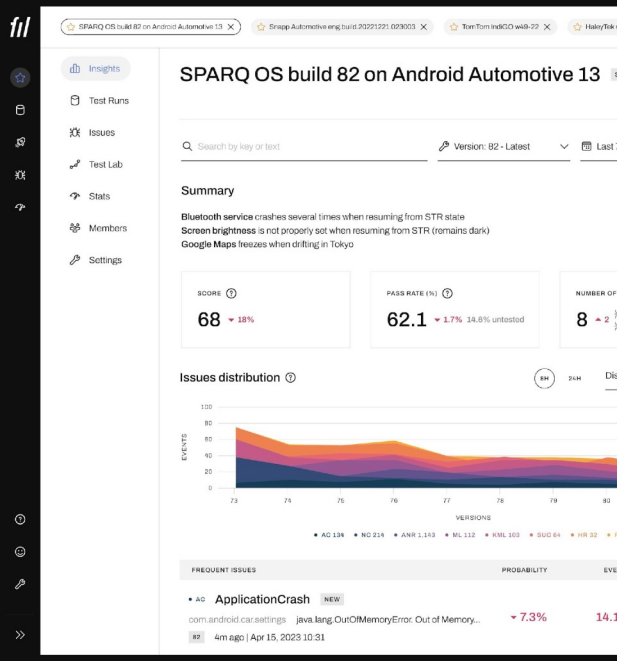
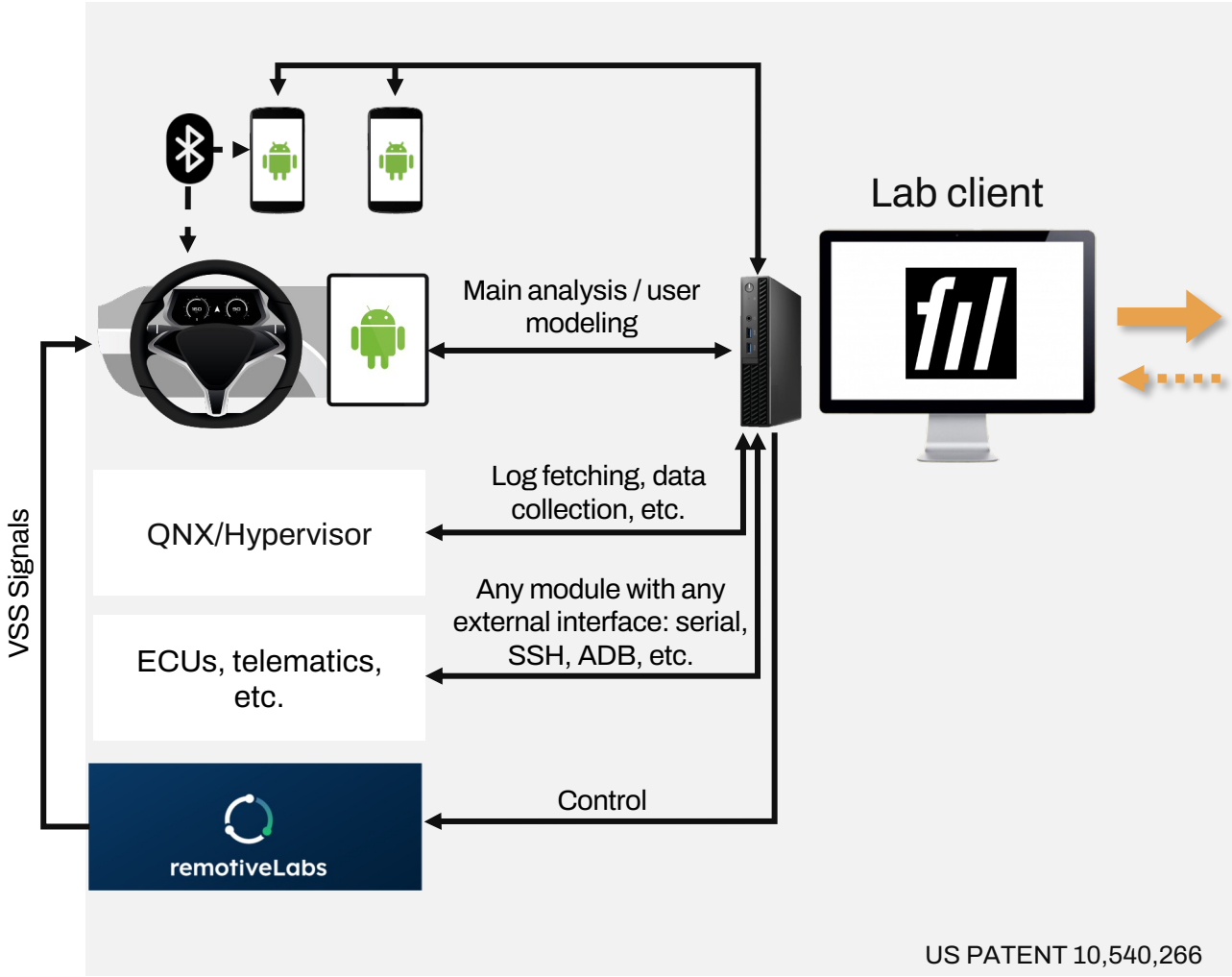


STR* (Suspend-To-RAM)

Stability Analysis System Architecture



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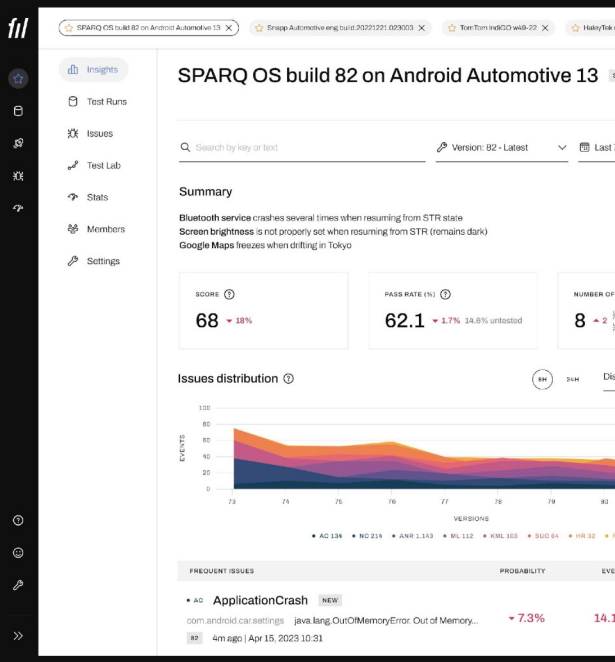


TomTom Digital Cockpit - long-term stability analysis

version: standalone_ttdc-1.0.7136

Testrun Explorer

- Test Run Report
- Tests
- Events
- Execution Log
- AAOS Log
- Phone Logs
- Trace Log
- Performance
- Processes
- Profiler
- Dumpsys Log
- Resets
- Kernel Memory Leaks
- Use Case Performance
- Video
- Java Heap Dumps
- Files
- Screen Contents History
- Battery Historian
- Telematics Logs
- Hypervisor Logs
- Voice Assistant Logs
- Instrument Cluster Logs
- Vehicle Signals

Events × Performance × Vehicle Signals ×

Vehicle Signals

- Vehicle
  - IsMoving
  - Speed
  - TraveledDistance
  - ADAS
  - Body
    - Hood
    - Horn
    - Lights
      - Beam
        - Low
        - High
      - Backup
      - Brake
      - DirectionIndicator
      - Fog
      - Hazard
      - Mirrors
      - Raindetection
      - Windshield
  - Cabin
    - Door
    - DriverPosition
    - HVAC
    - Infotainment
    - Light
    - RearviewMirror
    - Sunroof
  - Chassis
    - Accelerator
      - PedalPosition
    - Brake
      - PedalPosition
    - ParkingBrake
    - SteeringWheel
      - Angle
      - Extension
      - HeatingCooling
      - Tilt
  - Connectivity

Vehicle.Speed

Vehicle speed.

Vehicle.Chassis.SteeringWheel.Angle

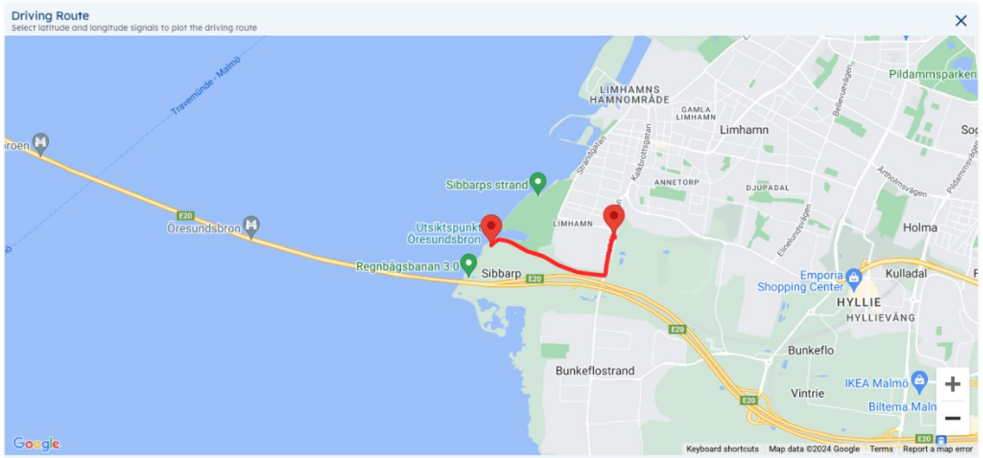
Steering wheel angle. Positive = degrees to the left. Negative = degrees to the right.

Vehicle.Chassis.Accelerator.PedalPosition

Accelerator pedal position as percent. 0 = Not depressed. 100 = Fully depressed.

RemotiveLabs platform

Easy to record, share and use real drive-cycles -> include vehicle behavior into the analysis



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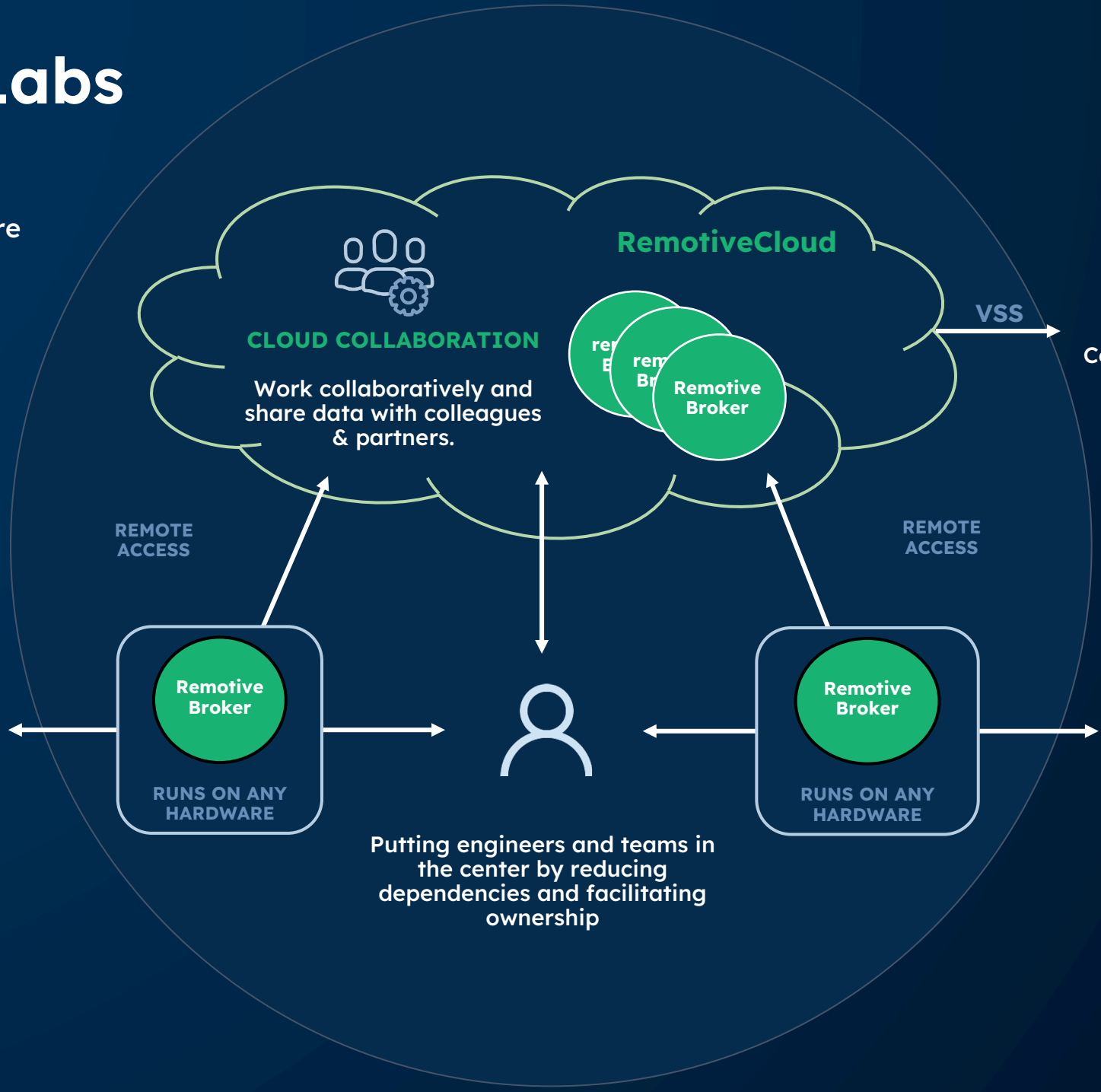
RemotiveLabs Platform

Empower vehicle software engineers to take ownership over their development environment



EXTERNAL APPLICATIONS

Connect to Profilence QA Suite.

IN-VEHICLE

Supporting prototyping, advanced engineering & logging in early stage project

TEST RIGS

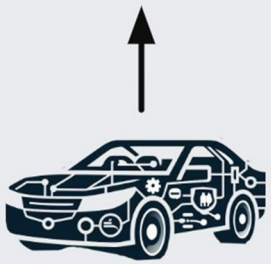
Left-shifting testing activities by enabling engineers to build and own their own SIL & HIL test rigs

Summary

Profilence

Quality analytics & user modeling

Infotainment system under test



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Stream recorded & live vehicle signals

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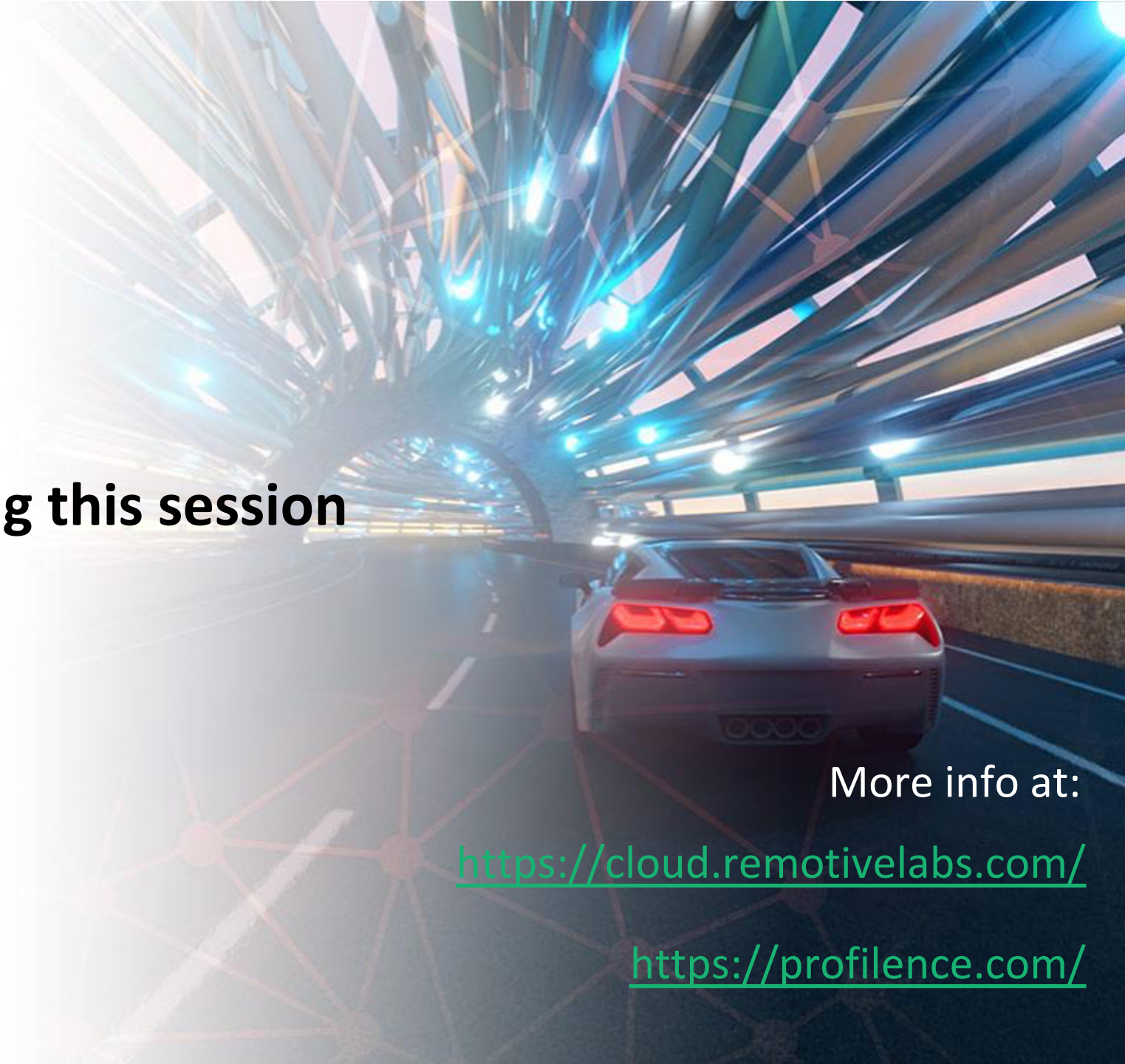
Thank you for joining this session



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