Automotive and OTA Testbed

PLUS - *Go Kart Testbed Demonstrator*

aicas realtime

AASA 01LightComm

Overview

Testbed Summary

The Testbed demonstrates how software can be managed on a fleet of vehicles remotely. Software can be deployed, updated, and replaced. A microservices architecture is used to provide the maximum functional improvement with a minimal of software change. This testbed covers standard topics such as vehicle control and data handling: collection, filtering, and analysis. The solution also addresses the specific automotive safety risks in a cybersecurity realm and introduces Li-Fi as a complementary wireless communication option for such updates as well as general V2X communication.

Why is the Testbed Important to IIC?

- Incorporates several technologies and initiatives that are at the core of IIC's mission
- AIOTA is one of the task groups with IIC and this testbed is being presented under this task group
- The concept and technologies fall within IIC Distribution Delivery Network and IIC Intelligent Transport Systems (ITS)
- Relates to multiple IIC initiatives and technologies
- The solution incorporates Cyber Security elements related to OTA, ITS and connected vehicles
- Provides real world validation for crucial elements in the automotive industry
- Positions IIC as a thought leader in the OTA and connected vehicle aspects of the automotive industry
- Fosters collaboration amongst IIC members as well non-members in the automotive, cyber security and other industries that rely on OTA updates.

Overview- Market Segment

Market Segment

The basic challenges addressed are common among most IoT domains including whether it be medical devices, industrial machines, or vehicles.

- Automotive (OTA, connected vehicles, V2X)

- Healthcare (Medical Devices)

- Manufacturing (Industrial Machines)

Overview- Description of prior deployment

The concept for the testbed was originally in Austin Texas in 2018. The demonstration went through several upgrades and was subsequently demonstrated at the IIC quarterly meetings in 2018 and 2019 and at the IoT Solutions World Congress in Barcelona in February 2019 where it was one of the nominated concepts for testbed of the year.

Overview: Participants

Current Participants

- aicas
- AASA
- Linaro
- Bosch
- IIC Automotive and Industrial OTA Task Group

Contacts:

Dr. James Hunt (Aicas): jjh@aicas.de

Dirar Hakeem (AASA): dhakeem@aasainc.com

Potential Participants

- Car Manufacturers
- Automotive OEM's
- Companies working on:
    - Cyber Security
    - Verification & Validation
    - Telecommunication
    - TSN
    - Edge Computing

Use Cases

Current Use Cases

- OTA Dependency Management: Standardized, technology-independent "manifest" for ECUs to provide release configuration information

- OTA for Heterogeneous Operations Management: Management of different bus systems and specialist deployment platforms (e.g. FPGAs)

- OTA Silicon to Cloud: Holistic Use Case for future OTA architectures

- OTA and Lifecycle Management: Security, Safety and validation

Future Use Cases

- Fleet management
- OTA for Autonomous Driving: Dealing with distribution of AI models
- OTA and Supply Chain: Creating tamper-proof trace of the vehicle`s change history
- OTA for distribution of personalized user profiles for car sharing.
- V2X Communication/Connected Vehicles

Solution Overview

- Li-Fi
- Wi-Fi and other Radios
- Commercial Wireless (4G, 5G, LORA, NB-IoT, SIGFox, and beyond)

Access
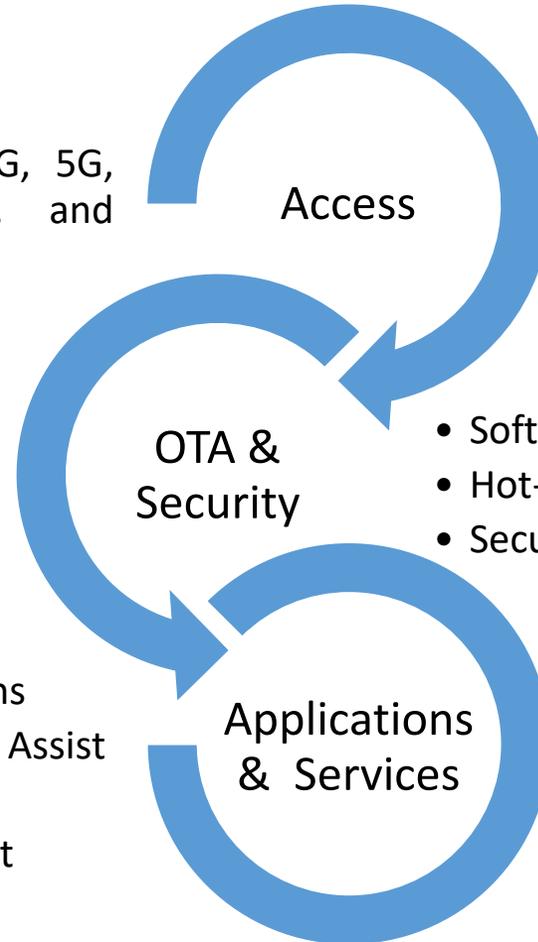
OTA & Security

- Software Update
- Hot-Swap (SW/HW)
- Security Update

- Optical Car Communications
- ITS – V2V, V2x, V2P Driving Assist
- Infotainment
- Device (Fleet) Management

Applications & Services
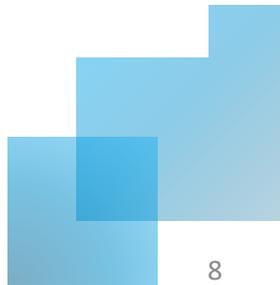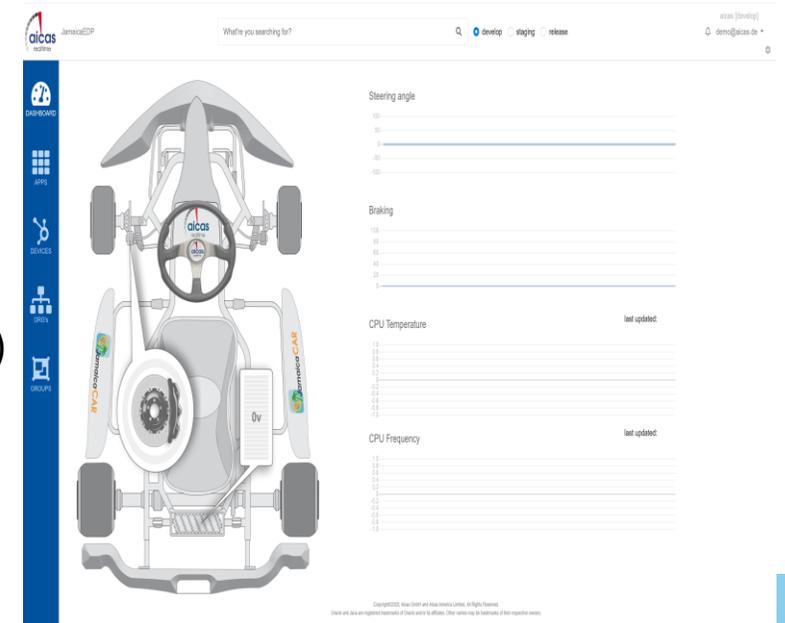
Solution Details: Validation Features

Testbed for validating:

OTA Implementation

OBD Software Update

Security Updates

Car Communications (Connected Cars)

After-Market Add-ons

New Services
•Smart Garage/Smart Shops, Platooning with Light (OCC)

Solution Details: Current System Capabilities

## Kart System (Multiple Computers)

- Steering without bus signal encryption
- Breaking with bus signal encryption
- Power not yet connected
- HMI unit with (Wi-Fi) Ethernet connectivity
- Li-Fi-based (Li-Fi) near field (V2X) communication
- Li-Fi based augmented reality UI

Cloud Portal System

- Data connection
- Remote control
- Software/Device management (Aicas -JamaicaEDP) (no-code quick prototyping to a full code implementation)
- AWS based (but could be used on other systems)

Solution Details: System Components

Vehicle communications through commercial and other communication accesses

Intra-vehicle communications network security testing on encrypted CAN Bus

Automotive Services for Early Design, Prototyping, and R&D Phases

Automotive Safety and Cybersecurity

Augmented Reality Visualization using Li-Fi

ECM

ECU

ECU

- Cloud-enabled validation and certification capabilities for OTA
- Infotainment and Add-on Services
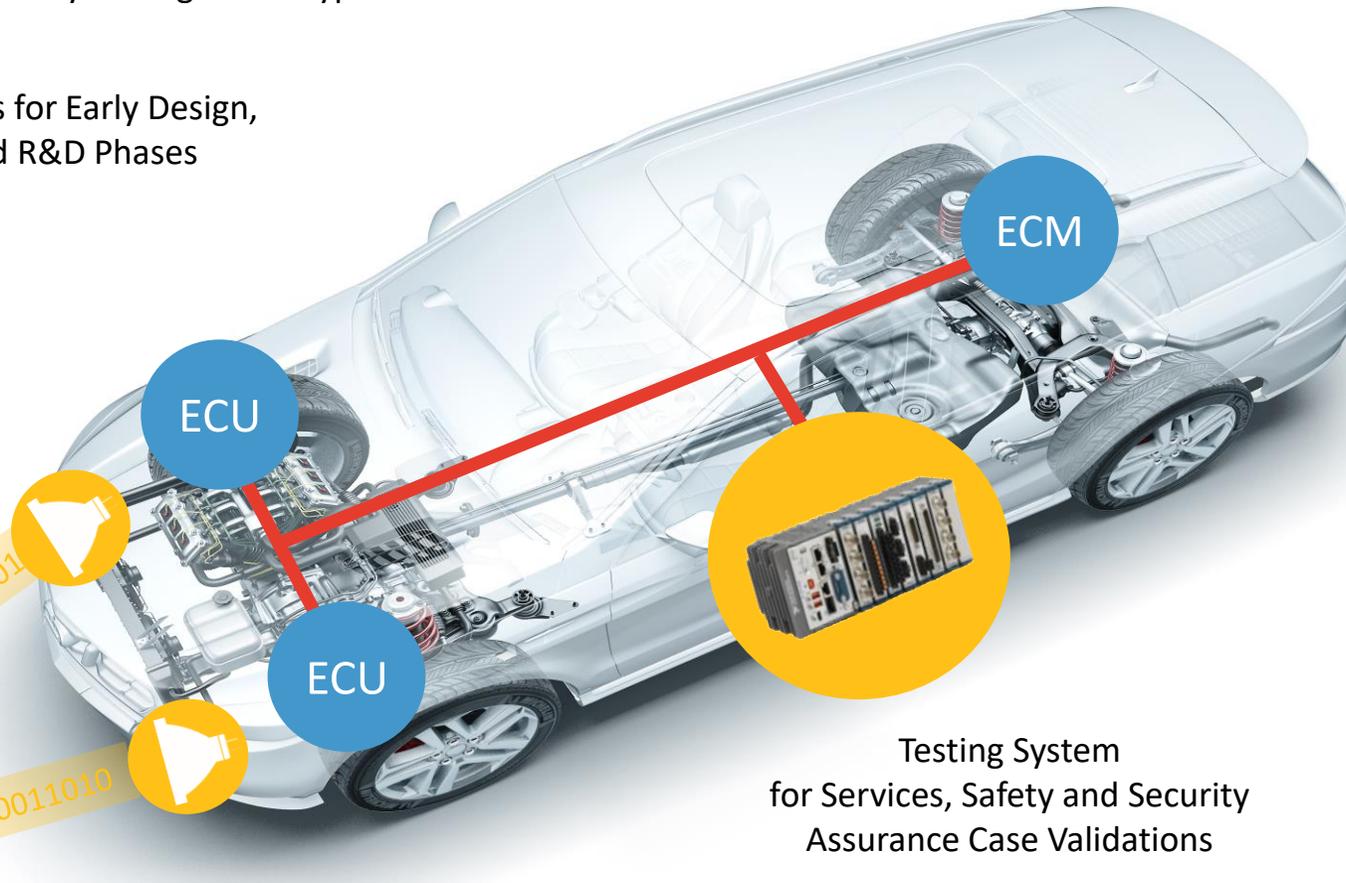
Testing System for Services, Safety and Security Assurance Case Validations
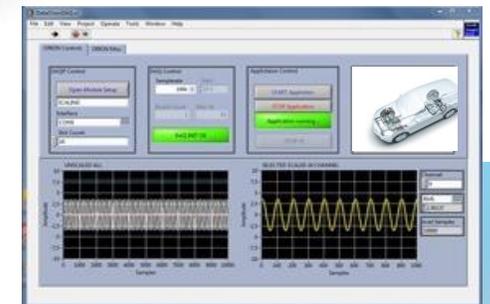
Dashboard for design, control, configuration, and measurement

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Solution Details: Communication Layers

Access

Radio (4-5-6G/LoRA/Others)

Visible Light Communication (Li-Fi)

Optical (OCC, Camera/Li-FI)

OTA & Security

OTA Software Update (HOTSWAP)

Validate automotive platforms against Safety and Cybersecurity issues

Automotive Safety (Li-Fi V2x, V2P, V2V)

Applications & Services

Prototyping & Testing (Apps & Products)

AI-Assisted Application development

AR for Shops - Li-Fi based Augmented Reality for fast and accurate identification of service points

Solution Details: Features

Kart Systems (KS)

- Improved Container based Deployment
- Add 5G connectivity
- Add Li-FI connectivity
- Flashing on-board devices

Cloud System (CS)

- Improved Asset and Software Management
- Further cloud data connections such as
  - Azure
  - Salesforce
  - Private Cloud
  - R&D CAD

All Java Data Dashboard (vDD)

- Based on OSGi and JavaFX standards Ref. Motorcycle Demo as is, Generic MQTT Server here.
- Competing JavaScript / Web Dashboards (https://colorlib.com/wp/free-html5-admin-dashboard-templates/)

# Trustworthiness

- Security

- Safety

- Reliability

- Resilience

- Privacy

- Testbed Components Threat Analysis and Threat Ranking
    - App Codes
    - Hardware
    - Communication
    - Network & Cloud

Relationship to IIC Technologies:
IIC Distribution Content Delivery Network
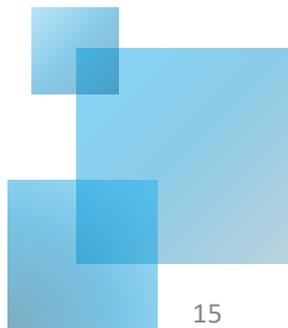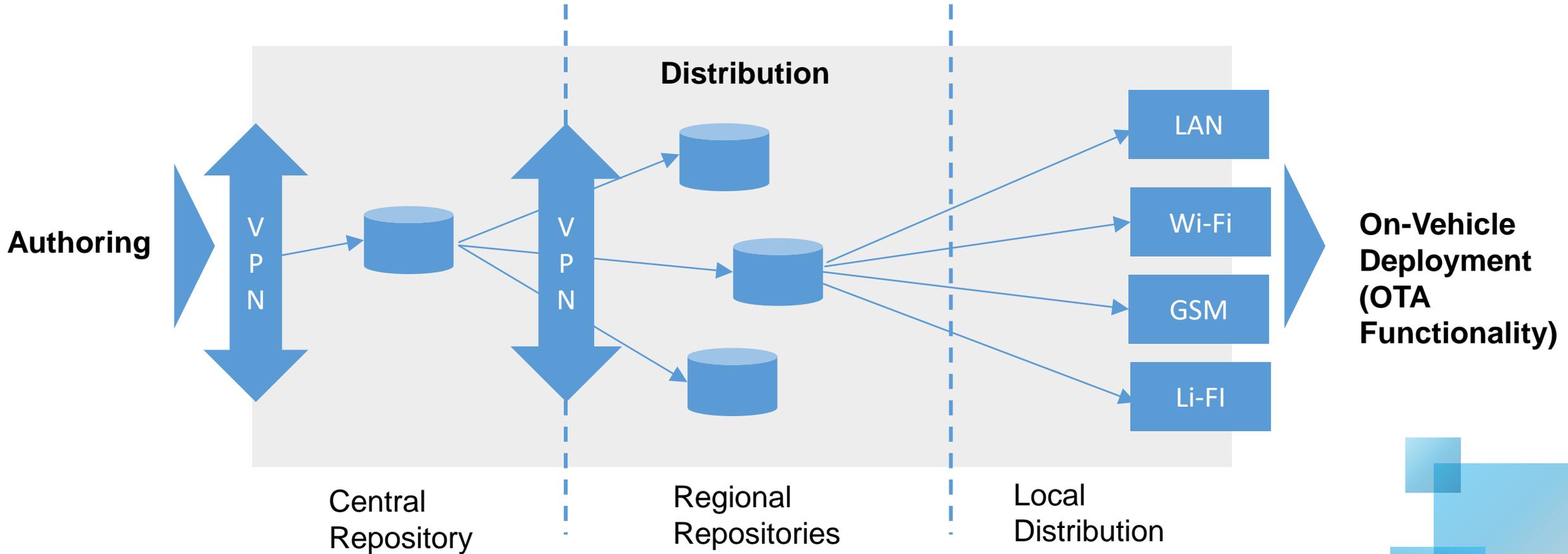
Relationship to IIC Technologies: IIC ITS

Use Cases

Driver Assistance | Autonomous Vehicles | Platooning | Robo-Taxi| Sharing Economy | Passenger Services | Efficiency | ...

Software-defined-Vehicle

Edge Computing | Cloud | IoT | Big Data | AI | ...

Networking

TSN | V2V | V2X | 5G | Li-Fi | ...

Lifecycle Management
(Secure, Safe, Reliable)

DevOps — Agile Product Development (HW+SW)

Over the Air Updates (OTA)

Security — Secure Development Lifecycle

Verification & Validation

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Proposed Testbed Plan

24 months

Test Bed Feature	Action Items	Phases	Deliverables	Target Dates	Actors/Notes
KS1	Improved Container based Deployment	I	Package Installed on the Go Kart	T+3 Months	
KS2	Add 5G connectivity	II		T+9 Months	AASA
KS3	Add Li-FI connectivity	I	Li-Fi modules installed on the Go-Kart	T+3 Months	AASA
KS4	Flashing on-board devices	I			
vDD1	Based on OSGi and JavaFX standards	I		T+4 Months	AICAS and Linaro
vDD2	Ref. Motorcycle Demo as is	II			
vDD3	Generic MQTT Server here	III			
vDD4	Competing JavaScript / Web Dashboards	I			
CS1	Improved Asset and Software Management	II	Demo the final work on Go Kart		
CS2	Further cloud data connections such as Azure, Salesforce, Private Cloud, R&D CAD	II	Connectivity demonstrated and validated		

Outcomes/Deliverables

Outcomes	Deliverables	Documentation
Improved Container based Deployment	Completed	
5G connectivity		
Li-FI connectivity	Currently used for sending info from Kart. Next goal is to use for receiving updates	
Flashing on-board devices		• Testbed Progress Report
Based on OSGi and JavaFX standards		• Use Cases Technical Report
Ref. Motorcycle Demo as is		• Security Assessment Report
Generic MQTT Server here		• Industry Guide and Recommendations Report
Competing JavaScript / Web Dashboards		
Improved Asset and Software Management	Demo the final work on Go Kart	
Further cloud data connections such as Azure, Salesforce, Private Cloud, R&D CAD	Connectivity demonstrated and validated	
Lessons Learned	Detailed lessons learned report	

Testbed Benefits
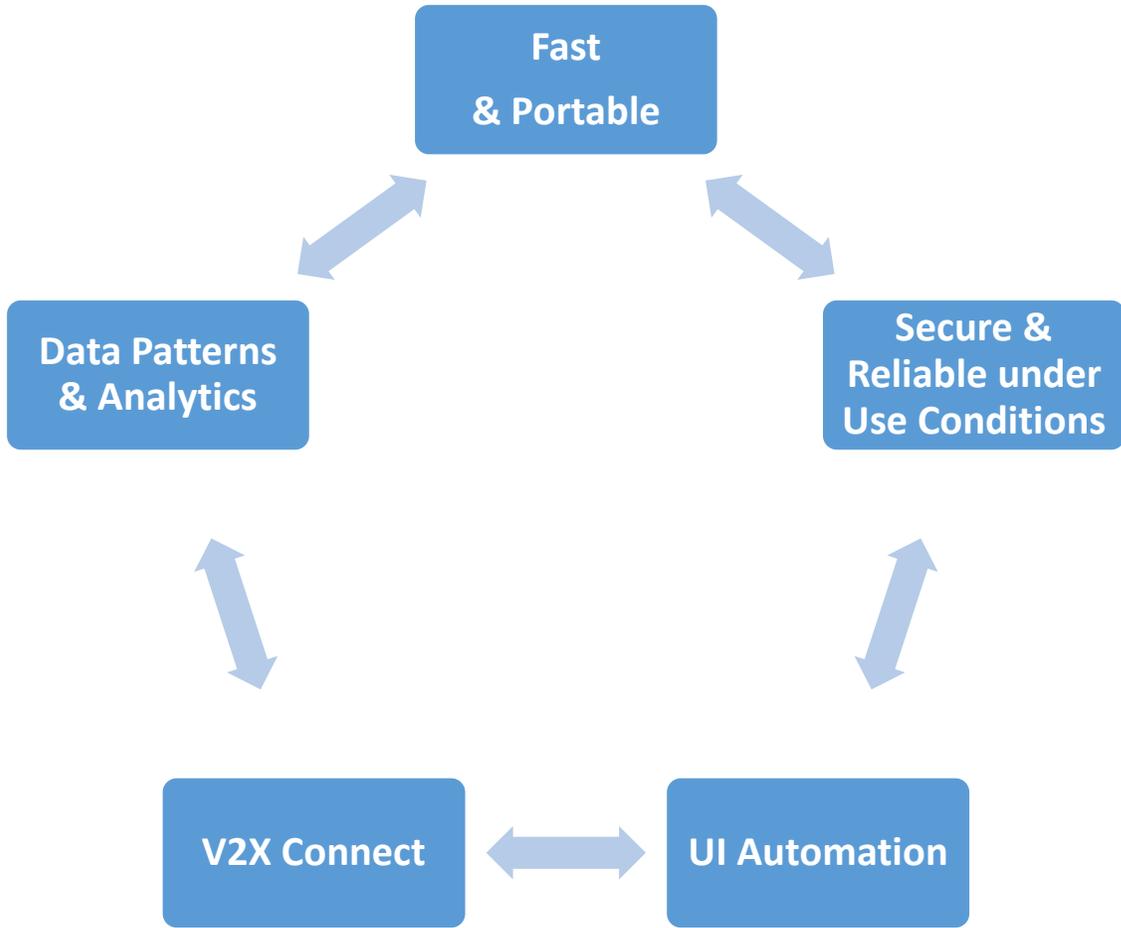
Benefits	To Clients	To Stakeholders
Fast & Portable	Validity of the offered solution	• Solutions or components' testing and validation • Training and Education
Secure & Reliable under use conditions	Proven & Tested Components	• Solution or components' fine-tuning • Scenario's evaluation (what-if)
UI Automation	Flexible Interfaces	• Automation of Manual Tests • Automation and verification of User functionalities • Ability to Know Your Own Customer • Generate and evaluate test results • time and cost-effective
V2X Connect	Introduce another wireless communication method	More robust and reliable communication system
Data Patterns & Analytics	Tailored & cusotmizable Services that meets the users' expectations	Understanding and service-ready for clients

Applicable Standards

- ISO 24089 (Road Vehicles Software Update Engineering)

- OSGi (Open Service Gateway Initiative)

- Eclipse hawbit

- Uptane

- UEFI (Unified Extensible Firmware Interface)

- IETF SUIT (Internet Engineering Task Force, Software Updates for Internet of Things)

- IEEE 802.11bb (Li-Fi)
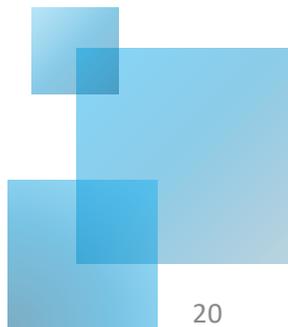
Security

- Primary Security Concerns

- Security and updatability are traditionally IT concerns; his solution addresses specific automotive safety risks in a cybersecurity realm.
- With OTA updates, only authorized entities should be able to monitor devices, and as such, encryption is an important aspect.
- The testbed will use message services, such as MQTT and XMPP, which have the advantage of not needing to have an open port on each device, making the devices harder to detect and attack.
- Implementation language plays a role from a security perspective; using a managed language will reduce security vulnerabilities of the system considerably.

Thank You!

Questions: info@iiconsortium.org