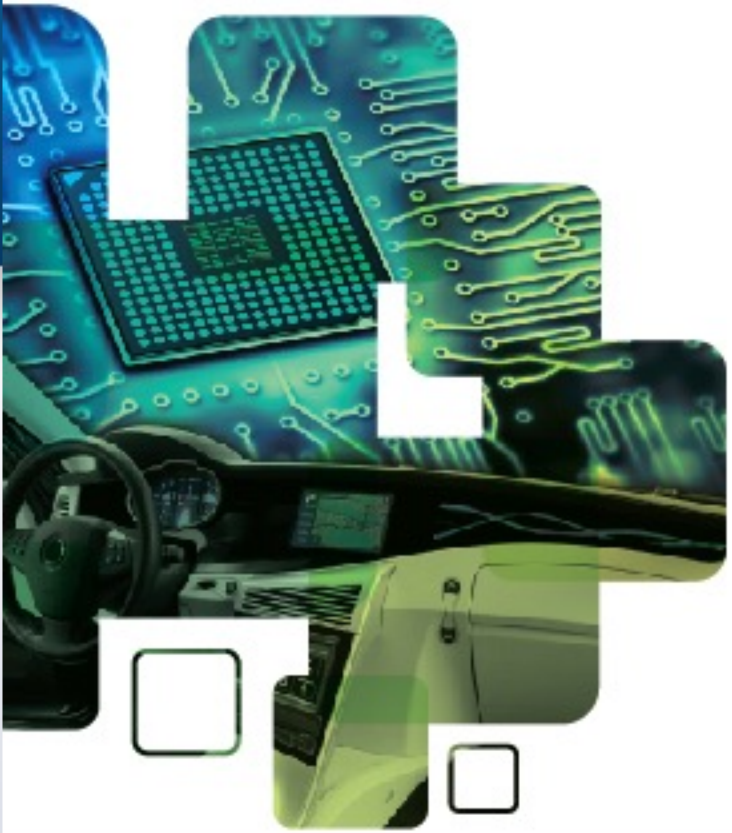

GENIVI®

Erlang, Open Source and The Connected Car

2016-03-11

Ulf Wiger
GENIVI

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GENIVI Alliance

Developing an open standard for aligning automotive and consumer infotainment cycles

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GENIVI Alliance

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Original car manufacturers

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DAIMLER · NISSAN · PSA PEUGEOT CITROËN · RENAULT · SAIC 上汽集团 SAIC MOTOR · VOLVO Volvo Cars

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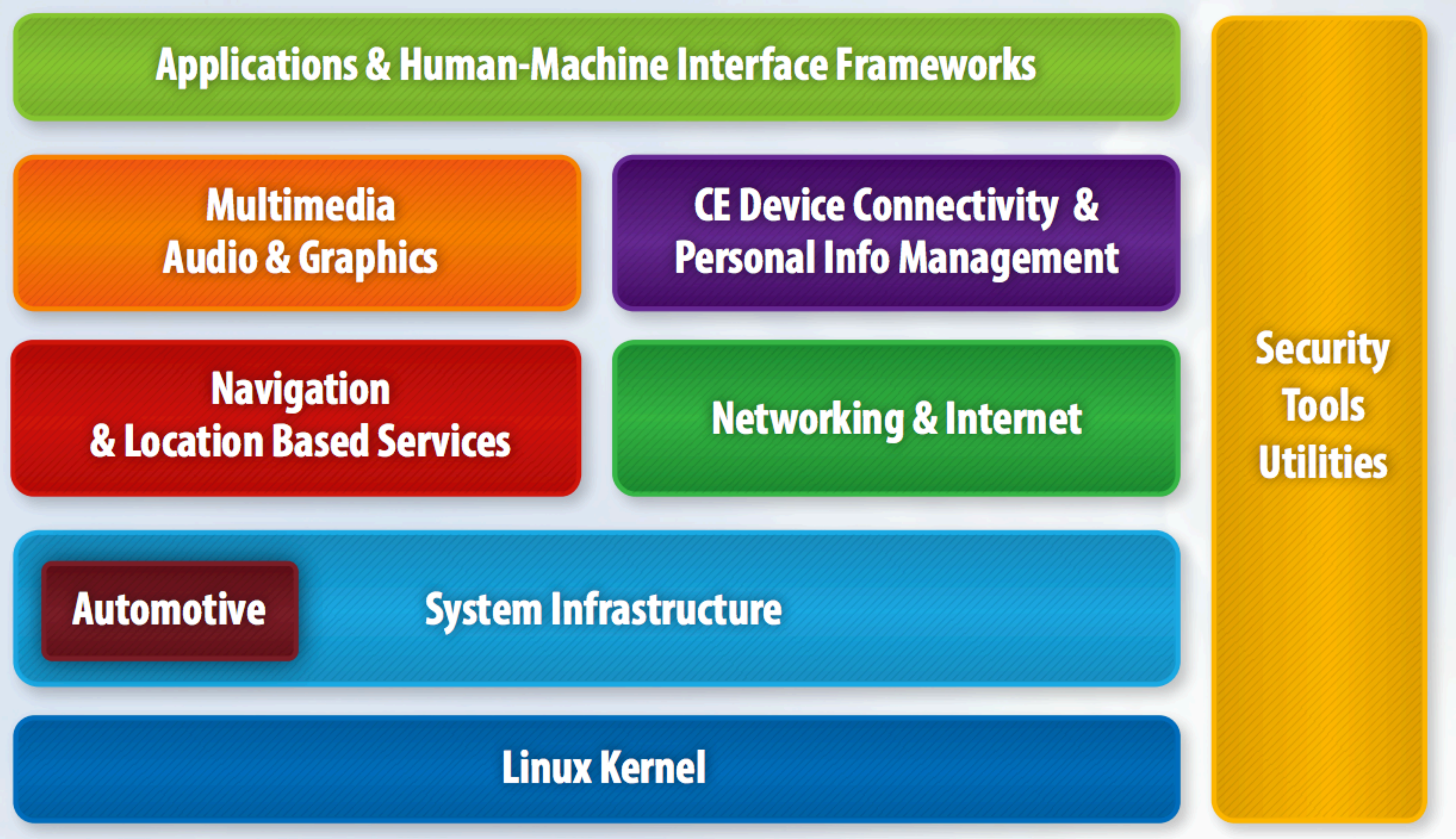
GENIVI Projects


Applications & Human-Machine Interface Frameworks
Multimedia Audio & Graphics
CE Device Connectivity & Personal Info Management
Navigation & Location Based Services
Networking & Internet
Automotive
System Infrastructure
Linux Kernel
Security Tools Utilities

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Current dissatisfaction

- At least 20 percent of new-vehicle owners have never used 16 of the 33 technology features measured (J D Power DrIVE Report 2015)
  - in-vehicle concierge (43%)
  - mobile routers (38%)
  - automatic parking systems (35%)
  - head-up display (33%)
  - built-in apps (32%)
- Hard-to-use in-vehicle tech can be a safety risk
  - Insurance claim costs can increase

http://www.jdpower.com/press-releases/2015-driver-interactive-vehicle-experience-drive-report

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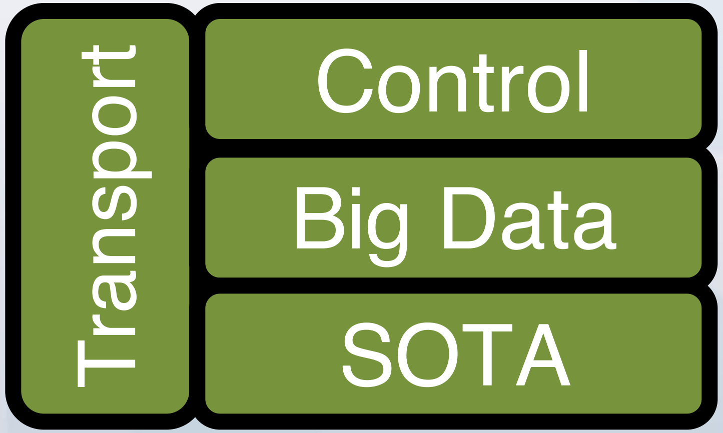
RVI – Remote Vehicle Interaction



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RVI Transport

Provide P2P based provisioning, authentication, authorization, discovery and invocation between services running inside and outside a vehicle.

- **P2P**
  Internet connection not required for two peers to exchange services.

- **Provisioning**
  Add, delete, and modify services and network nodes.

- **Authentication and Authorization**
  Proves that a service is who it claims to be, and has the right to invoke another service.

- **Discovery and Invocation**
  Allow two peers to exchange services that the other party is authorized to use, and invoke those services over any data link.

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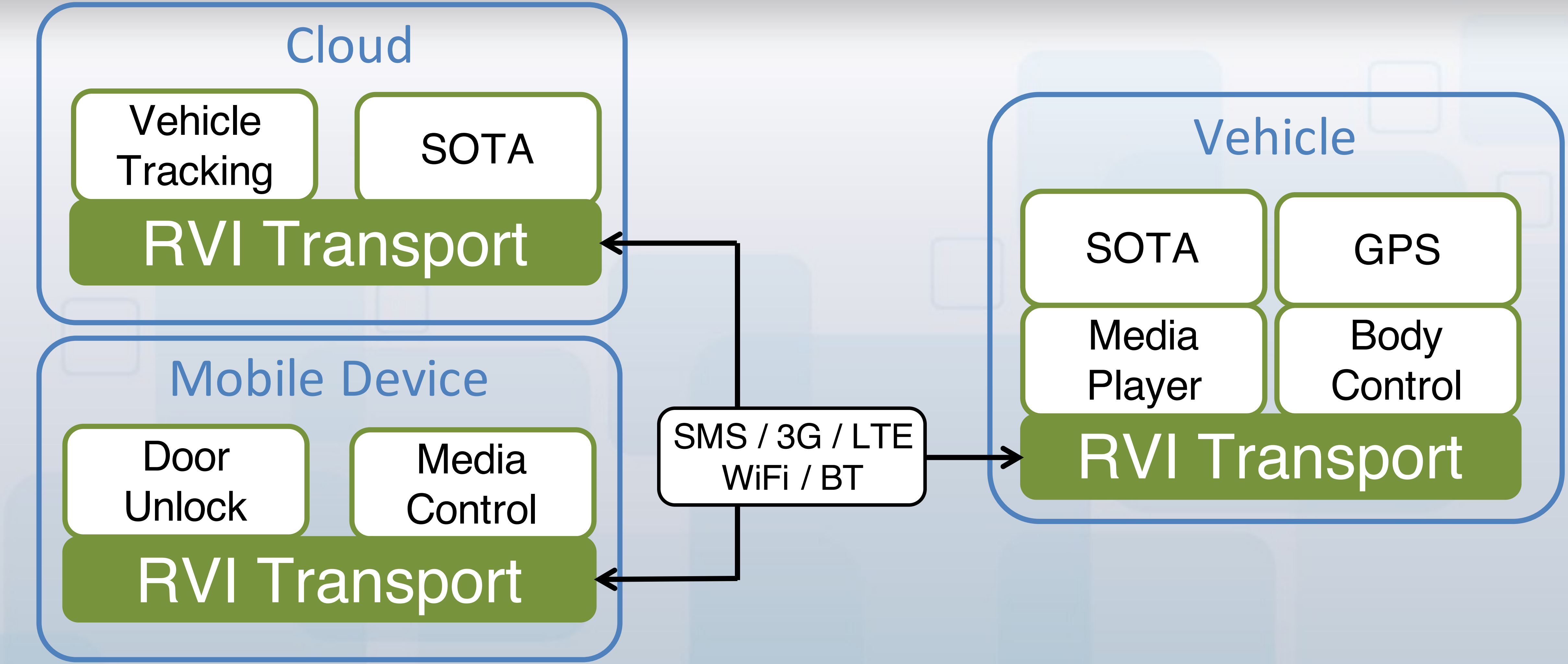
Schematics



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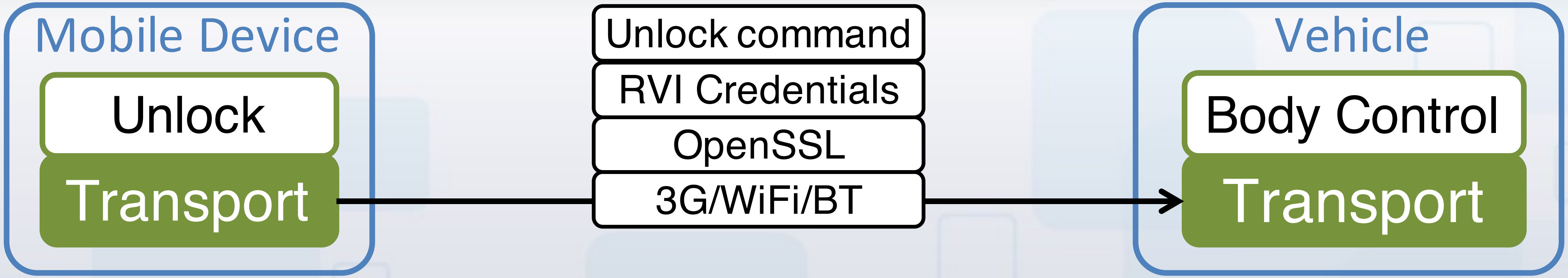
Security



- **OpenSSL**
  TLS provides core eavesdropping and MITM attack protection

- **RVI Credentials**
  Signed by root server to prove device authenticity and its right to invoke unlock on the given vehicle

- **Unlock**
  Will only be accepted by vehicle if validated certificate specifies device's right to invoke unlock command

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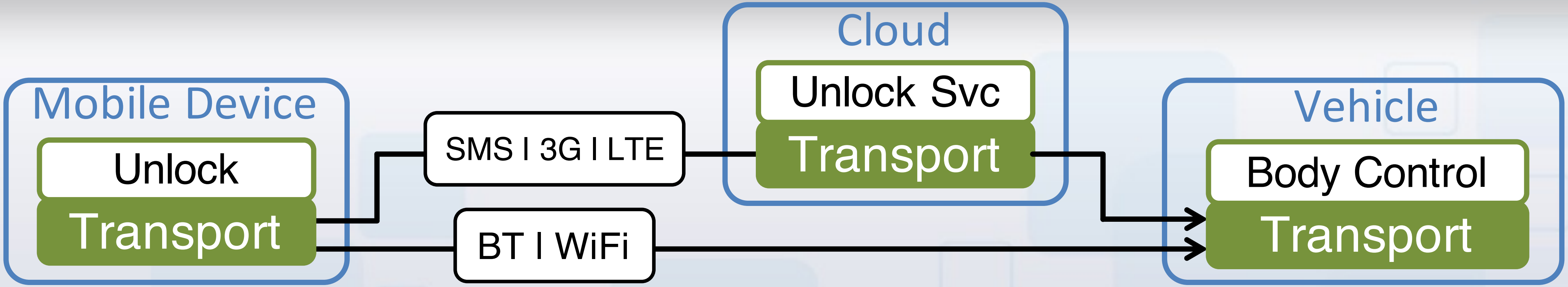
Robustness



- **Multi-pathed commands**
  Commands can be tried over multiple data links, both as peer-to-peer and via backend server.

- **Traffic prioritization**
  Forces high-bandwidth services to use WiFi while allowing mission-critical svcs to use 3G and SMS.

- **Multi-protocol**
  A single service (such as unlock) can employ different protocols and data links depending on the targeted vehicle type.

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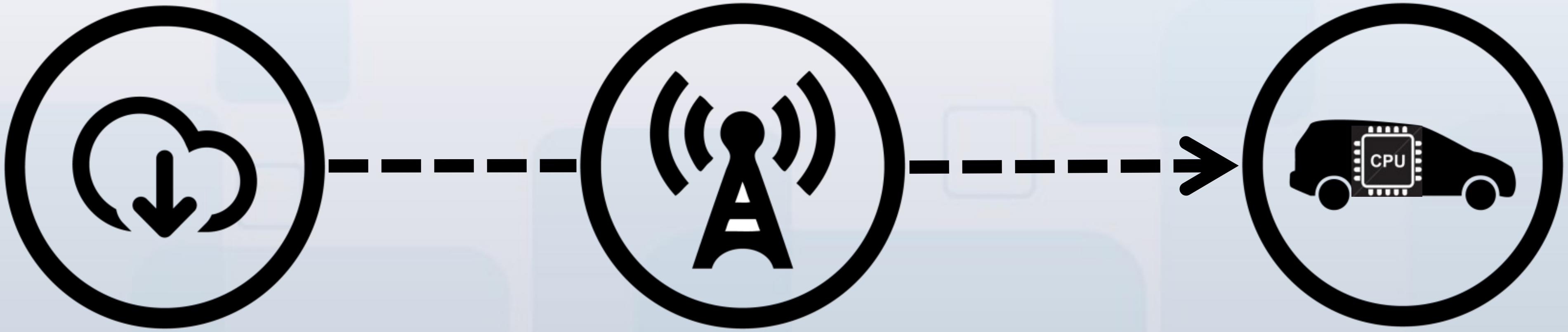
SOTA Software Over The Air



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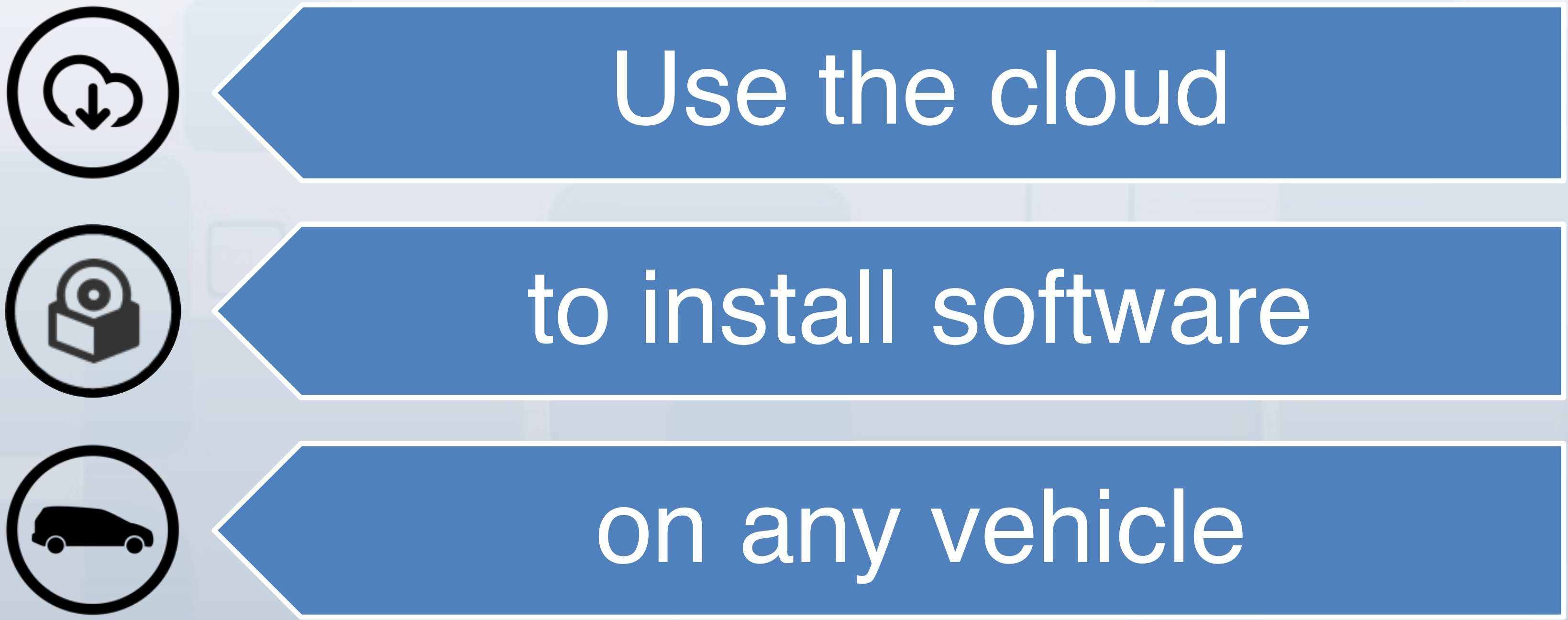
Purpose



Use the cloud

to install software

on any vehicle

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The user's story

When owner starts the car in the morning, an update icon is displayed on the head unit.

After learning that the update allows the car to analyse its daily commute to optimize drivetrain management, saving 6% fuel, the owner installs it.

When the owner drives home after work, the new app is available showing how the vehicle is adapting to the commute to minimize fuel consumption.

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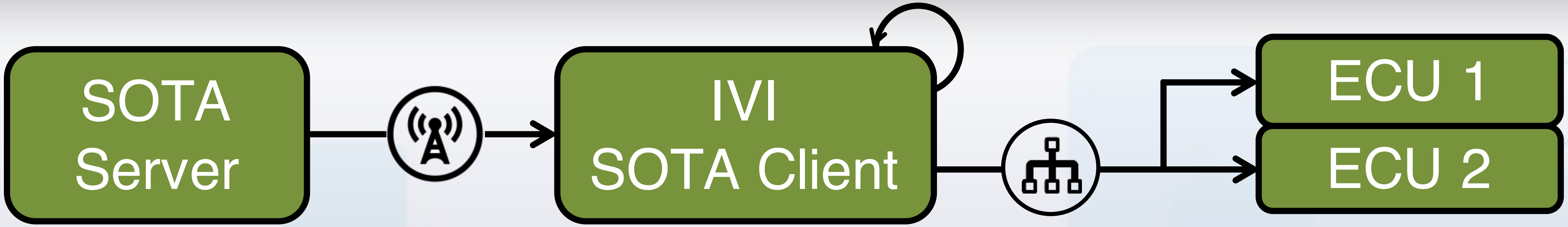
Overview



SOTA Server [Cloud]
Manages software images and vehicle database

SOTA Client [Head Unit]
Validates and installs software received from SOTA Server

Electronic Control Units
Installs firmware forwarded from SOTA Client

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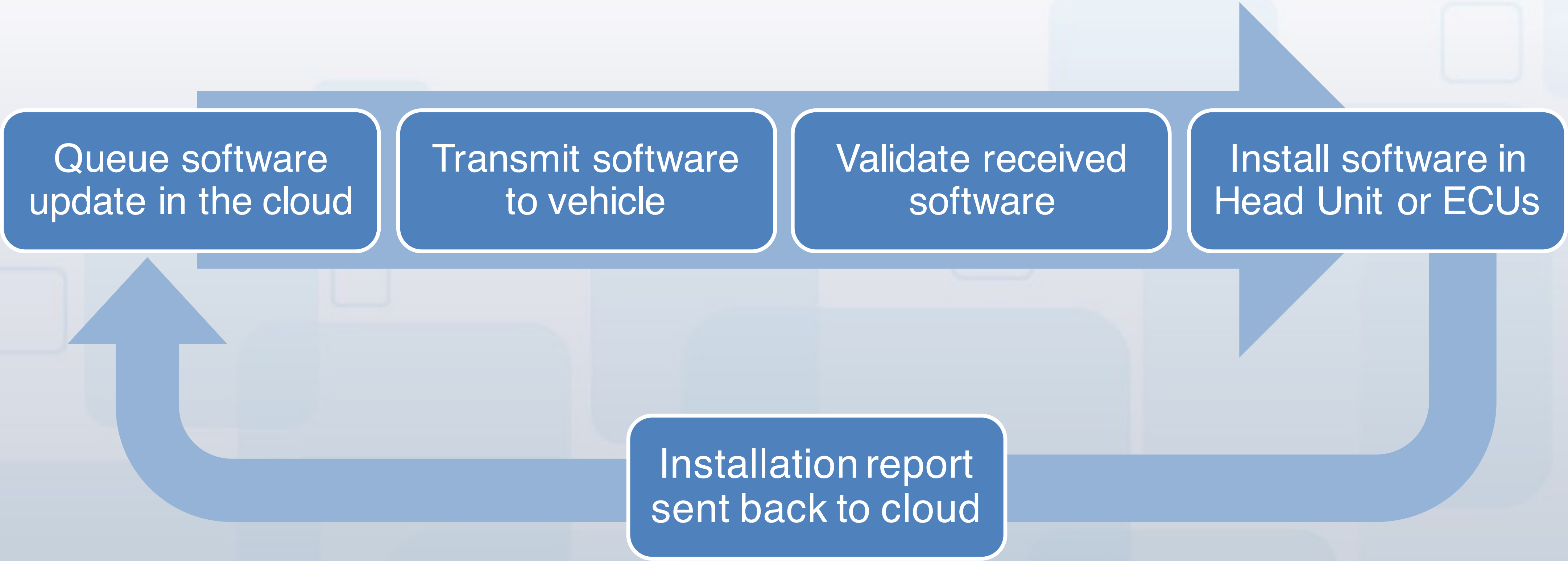
Use Case


Queue software update in the cloud
Transmit software to vehicle
Validate received software
Install software in Head Unit or ECUs
Installation report sent back to cloud

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Feature - Benefit

Open Source	• Free to use. Free to modify. Free to integrate.
Reference end-to-end implementation	• Ready to deploy for evaluation and prototypes
Billing cycle aware	• Avoids data plan overrun costs
Mixed asset management	• One system to handle legacy and new fleets
Genivi reference system	• Vetted architecture with broad industry support
Logistic system separated from transport	• Allows for integration with existing production system
Vehicle configuration-based targeting	• Installs updates only on vehicles with given specification

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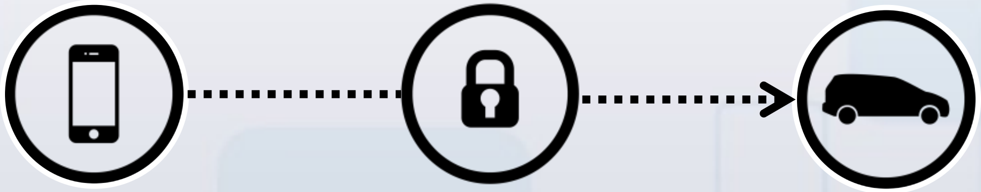
Control Demo: Mobile Unlock



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Purpose

Use any smartphone

to unlock

any vehicle

11 March 2016

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The user's story

An owner is travelling when a friend emails her to ask if he can borrow her car.

The owner brings up her guest driver app and sends a virtual car key, valid over the weekend, to her friend.

After the friend receives the key, he can walk up to the car to have his phone automatically unlock and start it.

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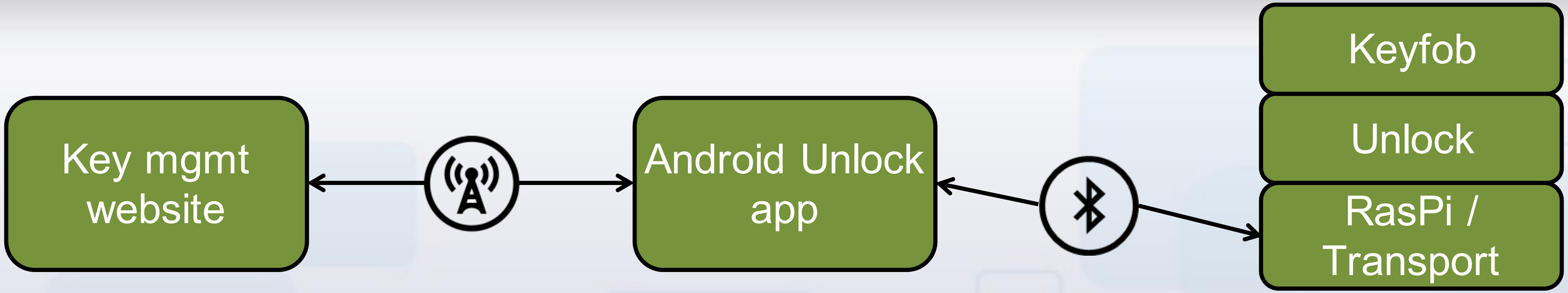
Overview – Demo system



Key management website [Cloud]
Allow vehicle owners to provision and transmit keys to any android app

Android unlock app [Mobile Device]
Runs a background service using keys to lock/unlock select vehicles

Unlock / Keyfob [Raspberry Pi]
Receives, validates, and executes received lock/unlock command using a keyfob

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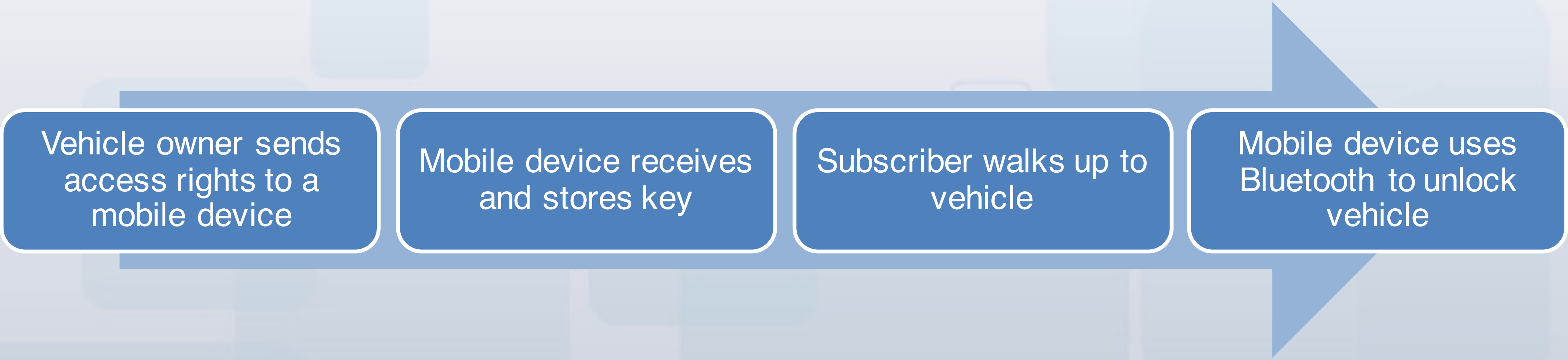
Use Case



Vehicle owner sends access rights to a mobile device

Mobile device receives and stores key

Subscriber walks up to vehicle

Mobile device uses Bluetooth to unlock vehicle

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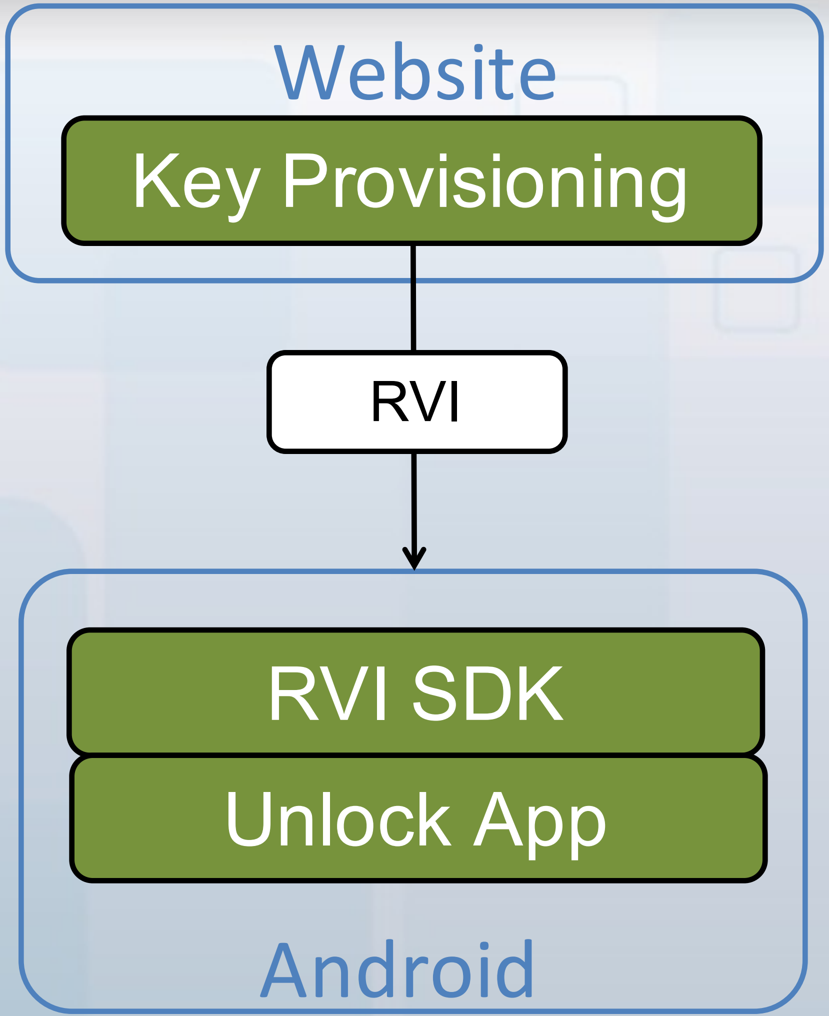
Key provisioning

A guest driver is provisioned with vehicle id and target Android device

An RVI credential containing target service (genivi.org/[VIN]/unlock) is created and signed by the root certificate

RVI credential is transmitted from website to target Android device using RVI

Unlock app on Android device receives credential and stores it as an RVI certificate



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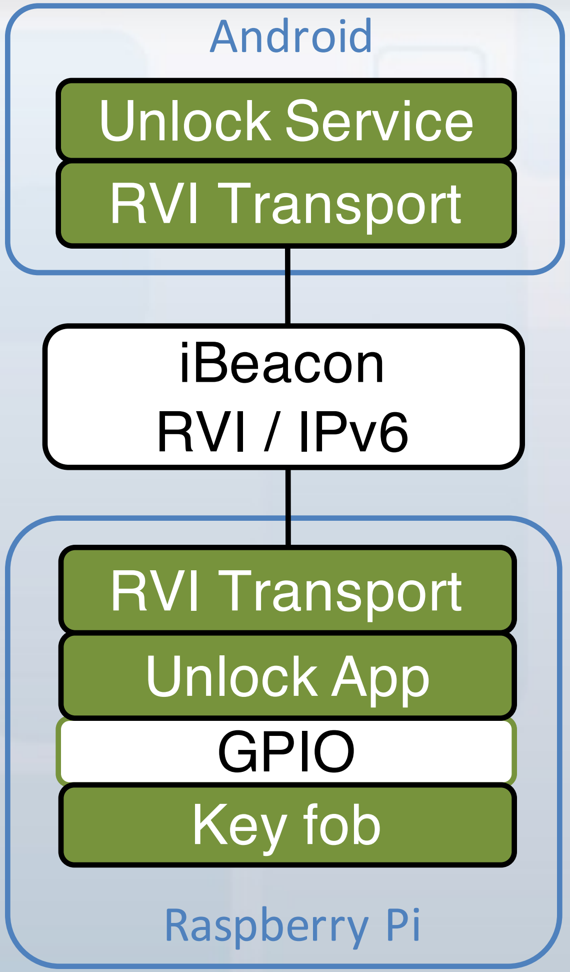
Vehicle

- Unlock service detects vehicle presence
- Unlock service sends unlock command to Android RVI
- RVI forwards command, with provisioned credentials, to Raspberry RVI using Bluetooth
- Raspberry RVI validates command and forwards it to Unlock app
- Unlock app manipulates GPIO pins to press the unlock button on key fob



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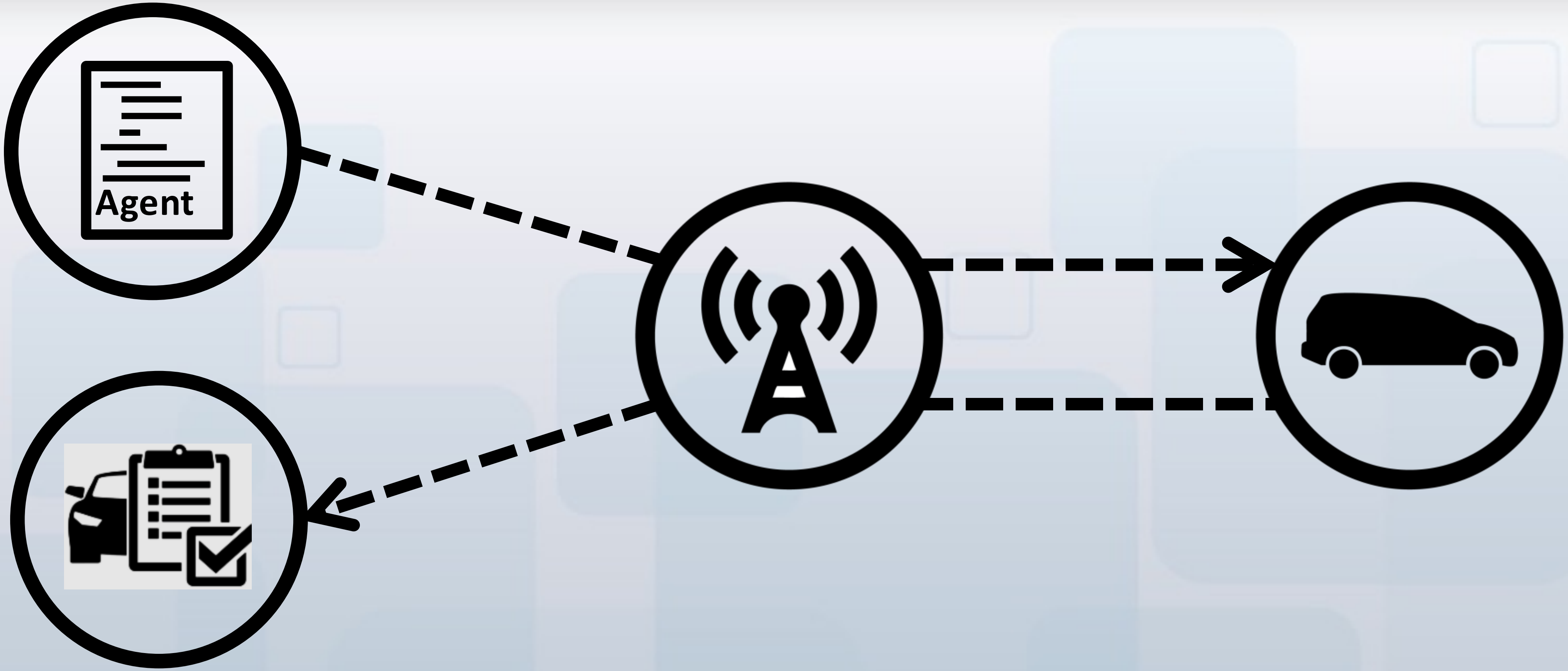
RVI Big Data – Dynamic Agents



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Purpose

Deploy remote probes

to monitor vehicles

and report results

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The user's story

A young entrepreneur comes up with an idea of letting people monitor their shared cars to make sure they are not abused.

By purchasing the V2XBoard and downloading the RVI – Dynamic Agent starter pack, she can develop her app using her own car as a test platform.

The entrepreneur demonstrates the finished application to an TaaS-oriented OEM who can bring it to production quickly since they both use the same connectivity stack.

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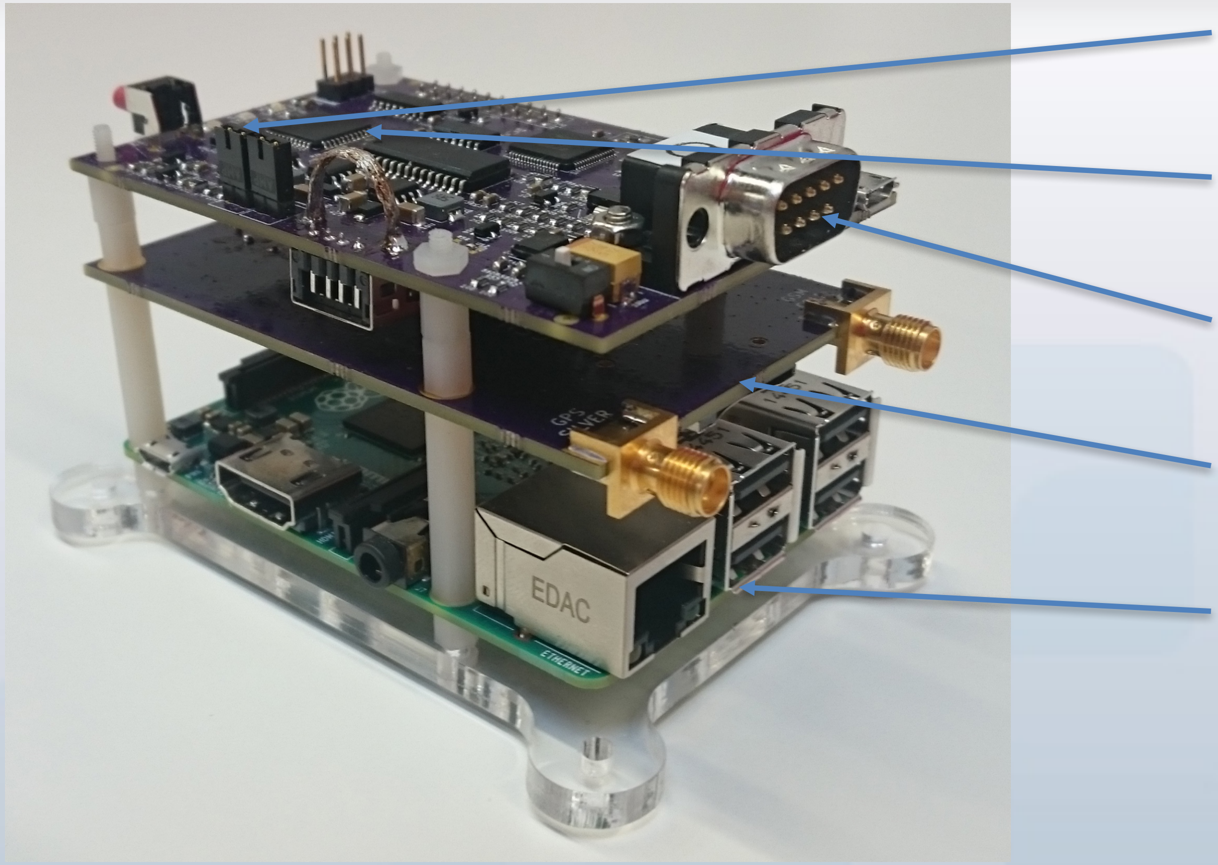
V2X Board



Accelerometer

Power Management

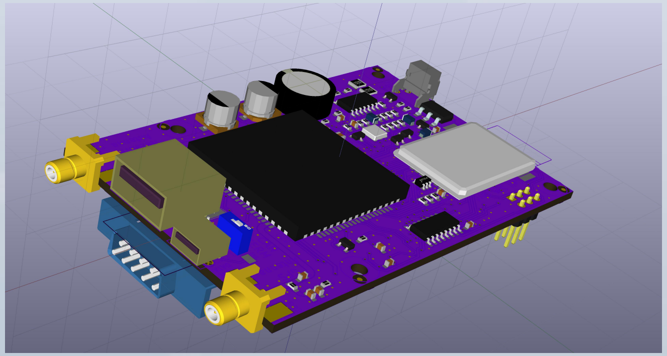
CAN Interface

Modem/GPS

Raspberry Pi

https://github.com/PDXostc/rvi_v2x_hardware

V2X version 2.0



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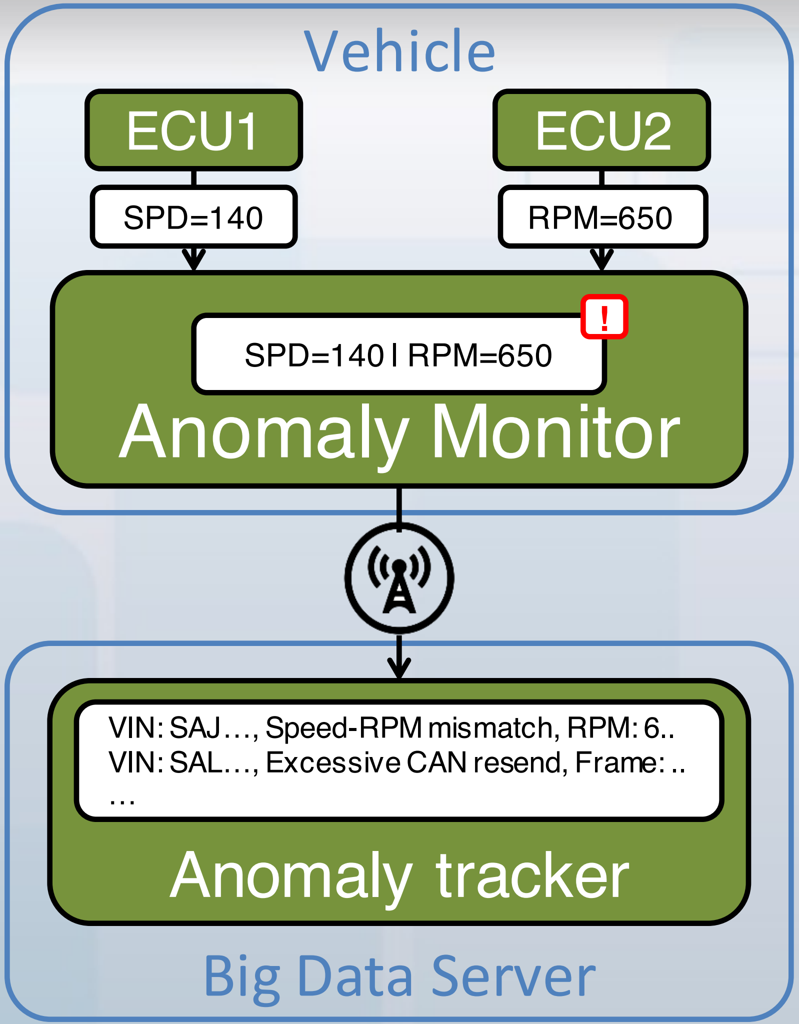
Use case: Health Monitor

Anomaly monitor agent reads data from vehicle buses

Any anomalous data detected by the agent is reported to the big data server

Big data server profiles all incoming data to generate failure trends and analysis



VIN: SAJ…, Speed-RPM mismatch, RPM: 6..
VIN: SAL…, Excessive CAN resend, Frame: ..
…

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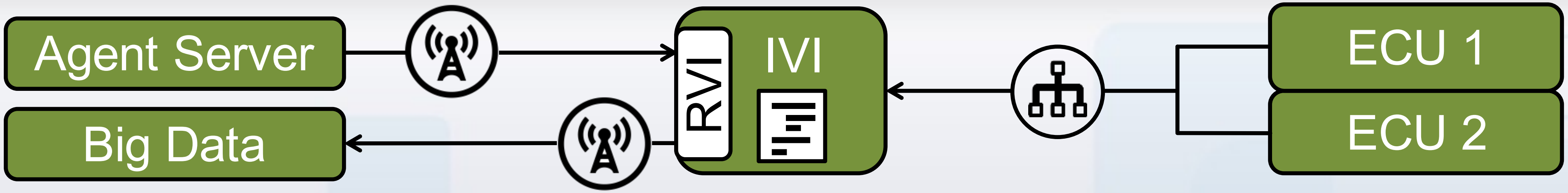
Overview – OEM solution



Agent Server [Cloud]
Distributes dynamic agents over the air, using RVI, to vehicle TCUs

IVI [Head Unit]
Executes dynamic agents in background to monitor ECU data streams

Big Data [Cloud]
Receives and analyses reports transmitted from dynamic agents through RVI

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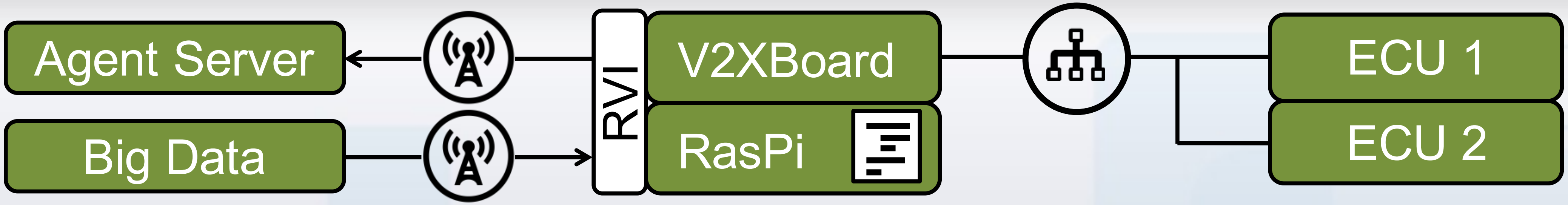
Overview – Entrepreneur solution



Agent Server [Cloud]
Distributes dynamic agents over the air, using RVI, to vehicle TCUs

Raspberry Pi / V2XBoard
Runs RVI and agent. V2XBoard for OBD2/CAN integration and M2M communication

Big Data [Cloud]
Receives and analyses reports transmitted from dynamic agents through RVI

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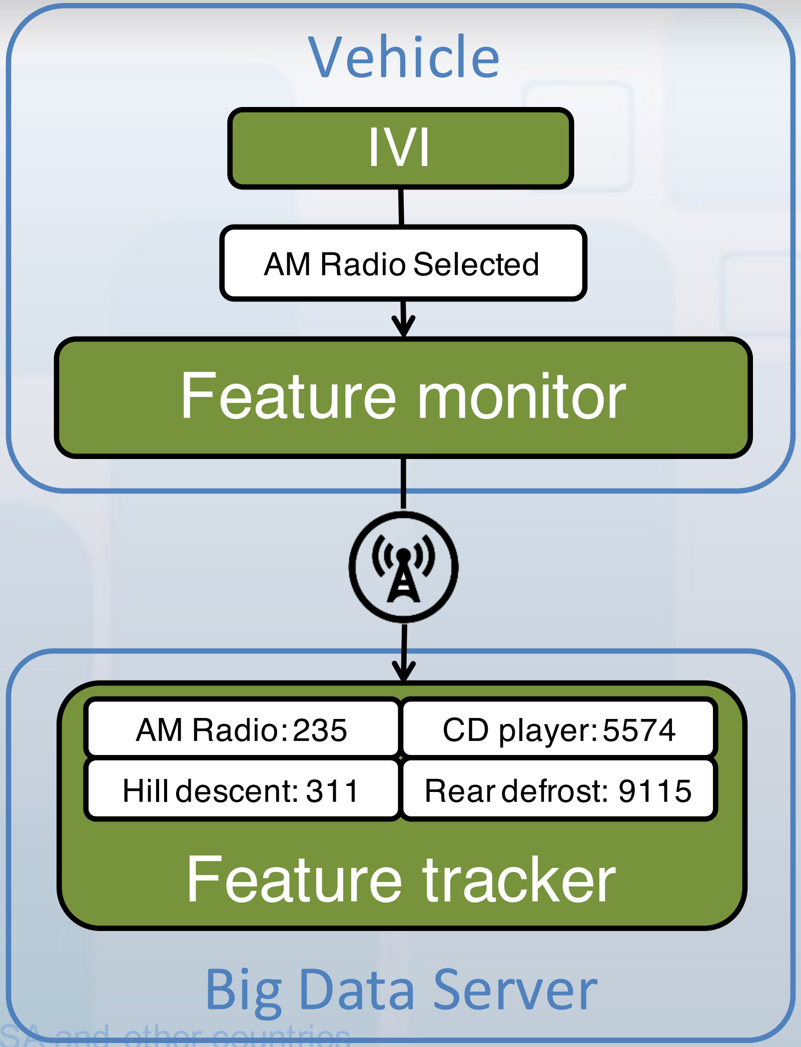
Use case: Feature usage

Feature monitor records all in-cabin feature usage

Periodic reports are sent by the feature monitor to the big data server

Feature tracker compiles report of fleet-wide feature usage



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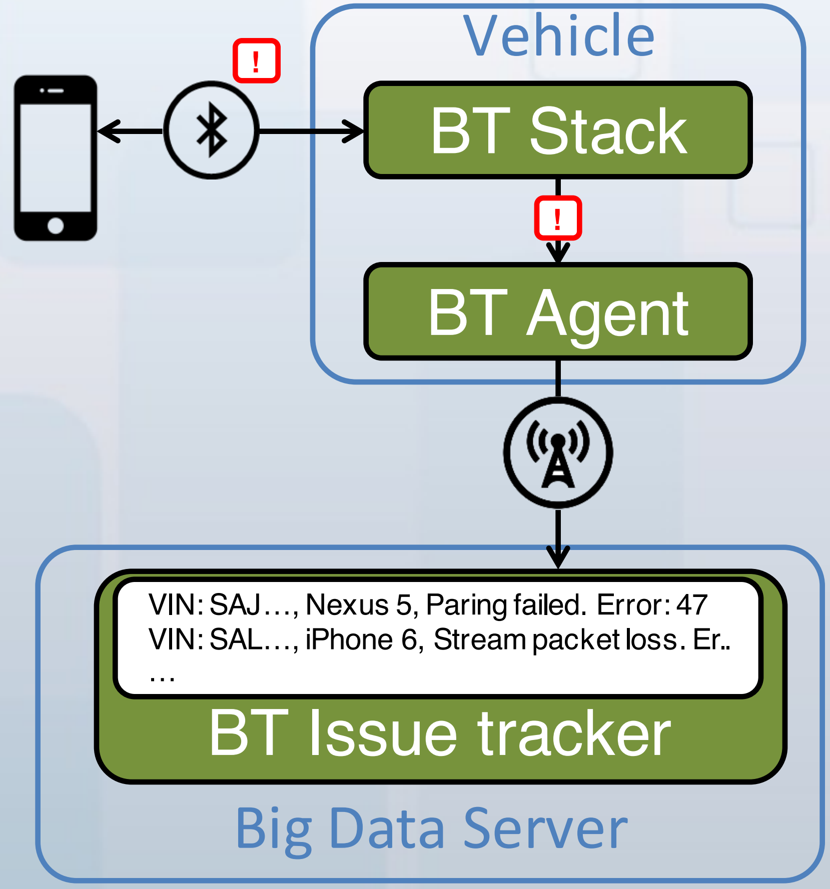
Use case: BT issue tracker

Bluetooth issue agent monitors pairings, streaming, and other possible failure points in the IVI BT stack

Any BT error is logged with circumstances and equipment ID

Error reports are transmitted to backend server for further analysis and bug fixes



```
VIN: SAJ…, Nexus 5, Paring failed. Error: 47
VIN: SAL…, iPhone 6, Stream packet loss. Er..
…
```

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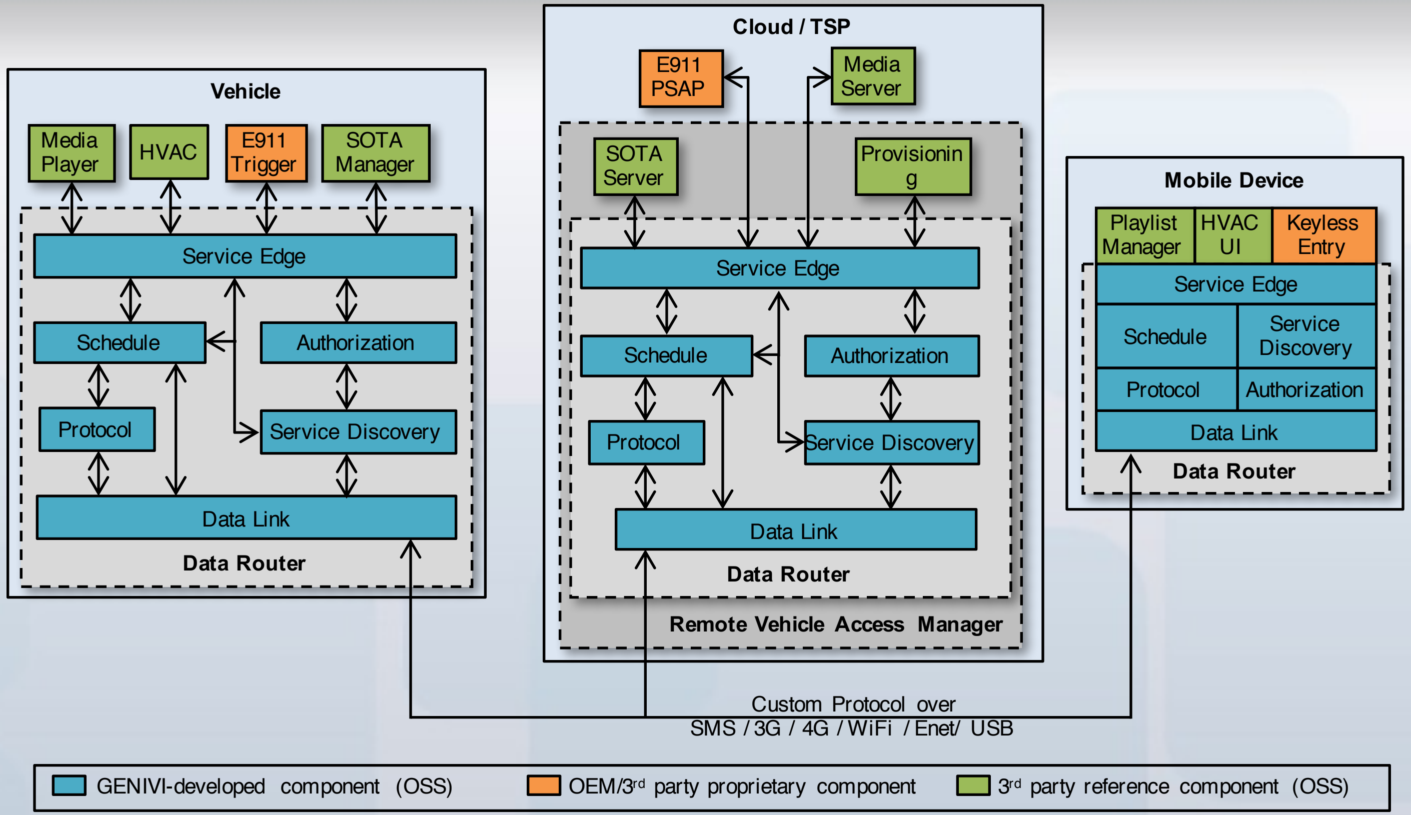
RVI Transport – A Closer Look



🟦 GENIVI-developed component (OSS) 🟧 OEM/3rd party proprietary component 🟩 3rd party reference component (OSS)

https://github.com/PDXostc/rvi_core

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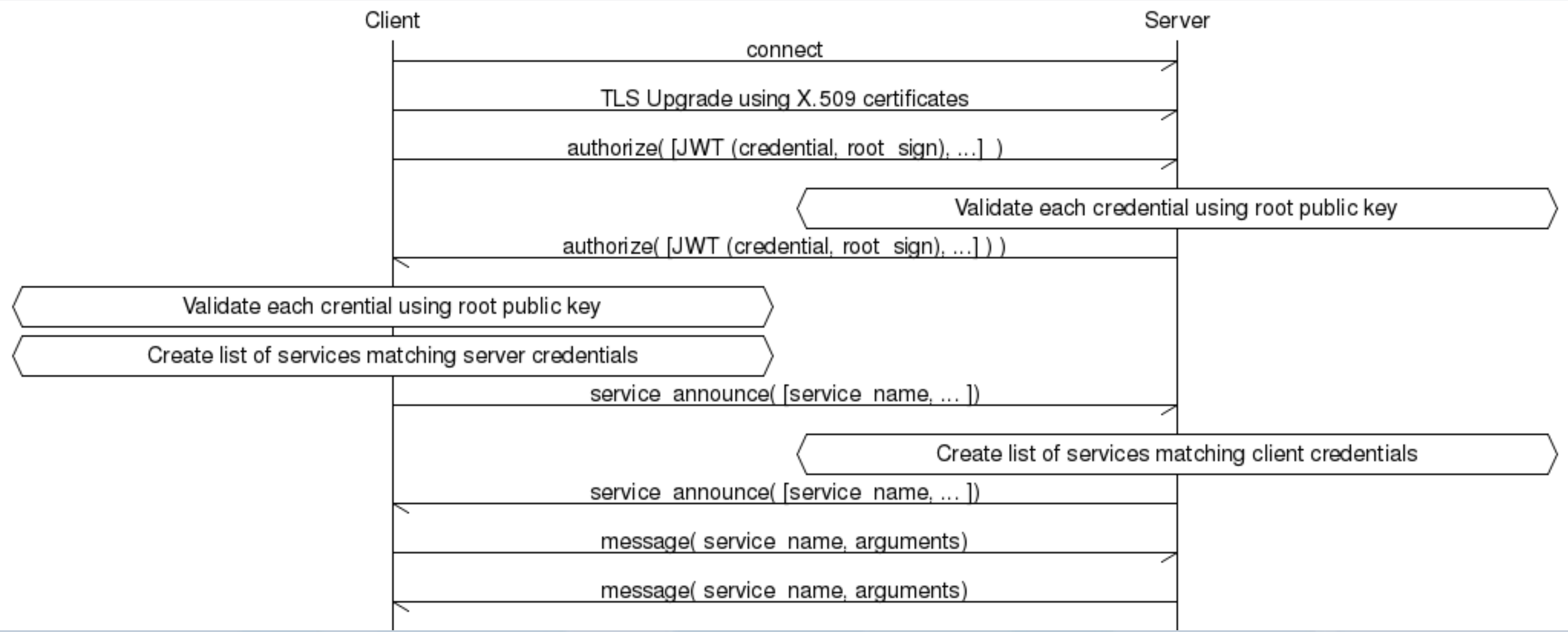
RVI Protocol



Client

Server

connect

TLS Upgrade using X.509 certificates

authorize([JWT (credential, root sign), ...])

Validate each credential using root public key

authorize([JWT (credential, root sign), ...]))

Validate each crential using root public key

Create list of services matching server credentials

service announce([service name, ...])

Create list of services matching client credentials

service announce([service name, ...])

message(service name, arguments)

message(service name, arguments)

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RVI Credentials

- Encoded as JSON Web Tokens (JWT) by provisioning service
- Validated using root cert public key
- Inform service announcements
- Service invocations authorized through pattern-matching (wildcards optional)

```
{
    "create_timestamp": 1439925416,
    "right_to_invoke": [
        "genivi.org/vin/"
    ],
    "right_to_receive": [
        "genivi.org/backend/sota"
    ],
    "id": "insecure_cert",
    "iss": "genivi.org",
    "device_cert": "",
    "validity": {
        "start": 1420099200,
        "stop": 1925020799
    }
}
```

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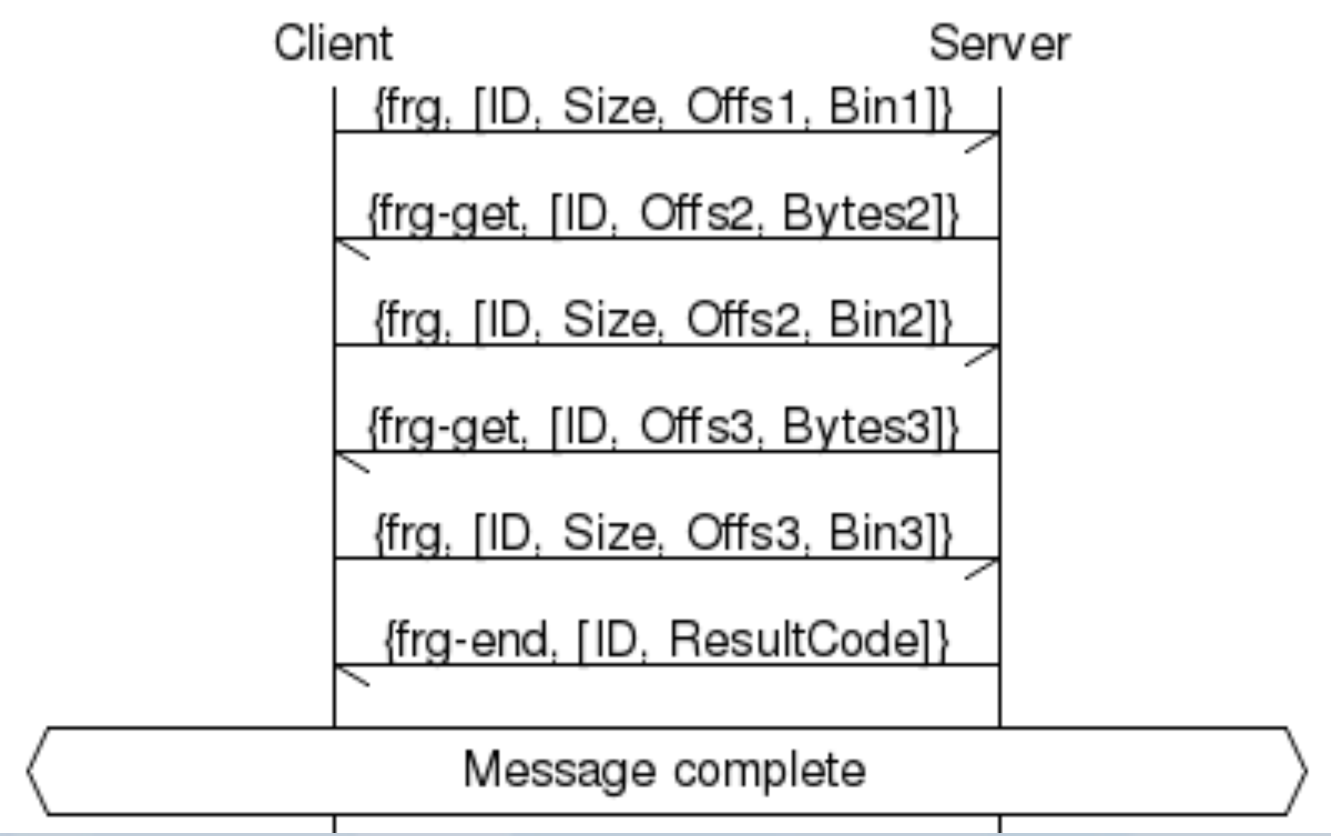
Message Chunking



Client

Server

{frg, [ID, Size, Offs1, Bin1]}

{frg-get, [ID, Offs2, Bytes2]}

{frg, [ID, Size, Offs2, Bin2]}

{frg-get, [ID, Offs3, Bytes3]}

{frg, [ID, Size, Offs3, Bin3]}

{frg-end, [ID, ResultCode]}

Message complete

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Service Edge API

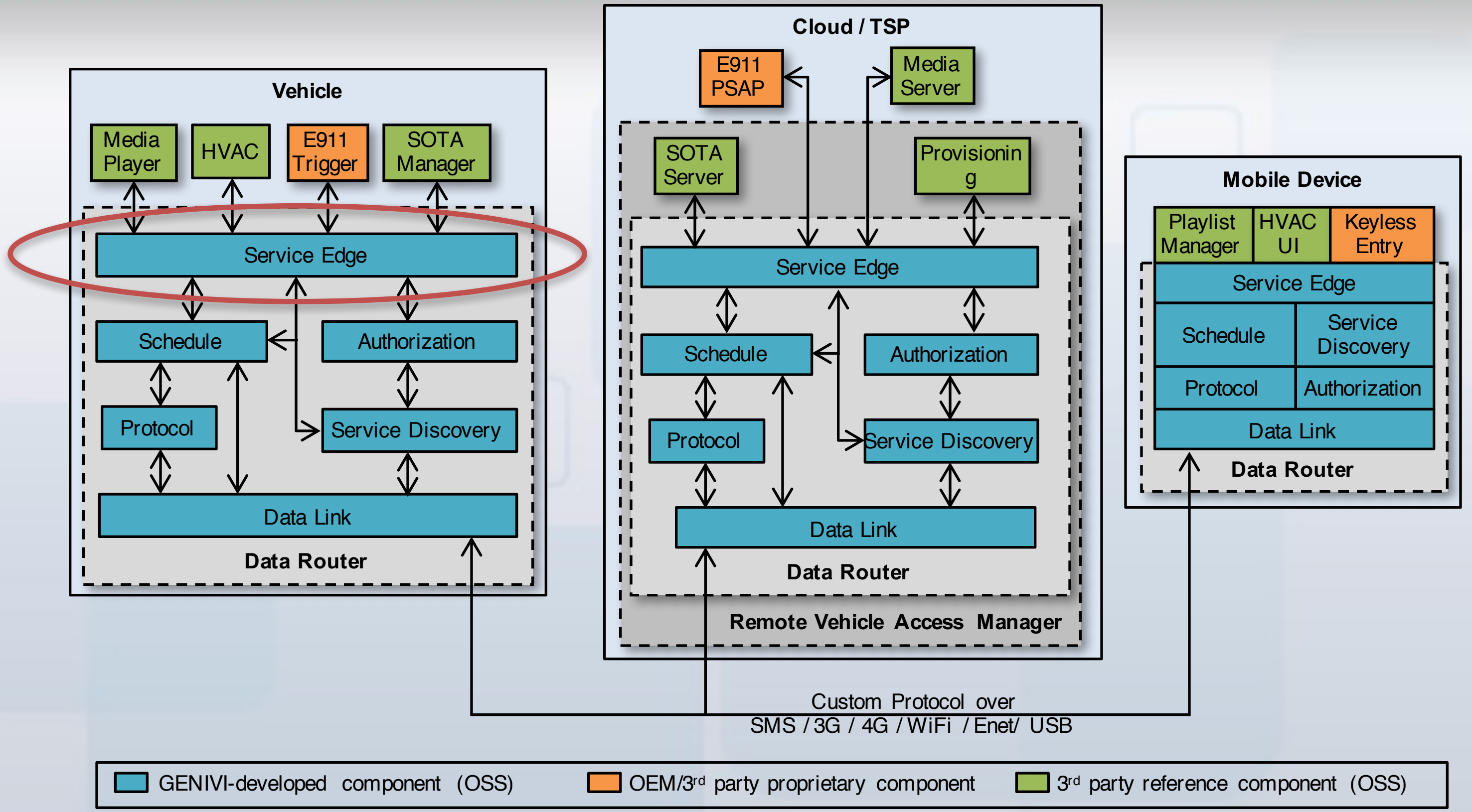
RPCs:

```
register_service(Svc, Addr)
unregister_service(Svc)
get_available_services()
message(Svc, Timeout, Params)
```

Notifications:

```
service_available(Svc)
service_unavailable(Svc)
handle_remote_message(
  IP, Port, Svc, Timeout, Params)
handle_local_timeout(Svc, TID)
```

- JSON-RPC
- Websocket
- (msgpack-RPC soon)



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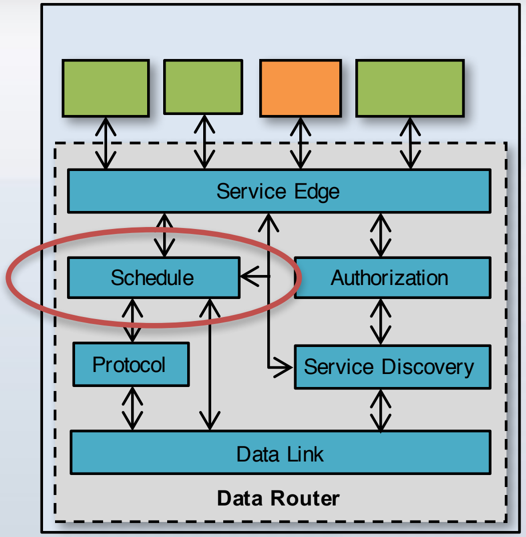
Schedule Logic (sketch)

```
{routing_rules,
   [{"jlr.com/backend/",
      [{proto_json_rpc, {dlink_tcp_rpc,
                         [{target, "38.129.64.31:8807" }]
        }}
      ]},
    {"jlr.com/vin/",
      [{proto_json_rpc, {dlink_tcp_rpc, [broadcast,
                                         {interface, "wlan0"}]}},
       {proto_json_rpc, {dlink_3g_rpc,  [initiate_outbound]}},
       {proto_sms_rpc,  {dlink_sms_rpc, [{max_msg_size, 140}]}}
      ]},
    {"",  % catch-all
     [{proto_json_rpc, dlink_tcp_rpc}]}
   ]}
```



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RVI Status

- Version 0.5.0 recently released (License: MPL 2.0)
- rvi_core (RVI Transport) usable for pilots
  - Debian and Raspian packages built
  - Automated test suite (Common Test)
- Android SDK
- iOS SDK
- Python support libs
- Dynamic agent demos

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