



# Remote Vehicle Interaction Architecture

An open source solution for the automotive industry

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# Background



- **80% of connected vehicle functionality shared across platforms**
  Core IVI and Server functionality are similar, regardless of vendor. The final 20% are the services that defines the user experience.

- **A shared, open source platform will benefit OEMs**
  A joint architecture and reference implementation allows OEM to minimize cost, vendor dependencies, and security risks, letting them focus on applications and services that make a difference.

- **A shared, open source platform will benefit service providers**
  A common architecture allows service providers to easily port their products to additional OEMs, thus giving them a wider revenue stream from multiple vendors.


# What we are doing



## The Problem

*How do we allow an in-vehicle application to exchange data with other devices and servers in a simple, robust and secure manner, regardless of connectivity?*

## The Solution

*Build open source technology to handle authentication, authorization, discovery, and data exchange between services in a sparsely connected P2P network.*

## The Goal

*RVI is accepted by the automotive industry as a secure, reliable, and proven technology choice for connected vehicle projects.*


# Benefits



**•Enable new breed of 3rd party service providers**
Open source implementation enables start-ups to develop in-vehicle apps and their corresponding backend services, and showcase the finished product to OEMs.

**•Alleviate vendor dependency**
OEM can replace components at will, using either external or internal resources. All IP of the replaced components belongs to the OEM.

**•Wider talent pool**
Large competence base provided through open source community, OEMs, app developers, and professional service vendors.


# Feature Set



- **Peer-to-peer based**
  Two nodes can exchange services without an internet connection.

- **Provisioning**
  Services and nodes can be added and deleted from the system.

- **Authentication & authorization**
  All executed services are authenticated and authorized against certified credentials.

- **Service discovery**
  Services and applications can discover and invoke other services.

- **Invocation**
  Services can be remotely invoked over a sparsely connected network.


# Status



- **AGL Expert Group Formed**
  AGL's RVI Expert Group is up and running

- **Wiki and code repos setup**
  http://wiki2.automotivelinux.org/eg-rvi
  http://github.com/PDXostc/rvi

- **Design completed and validated**
  Rich High Level Description document available at Wiki.

- **Version 0.2 released**
  Handles core service discovery and transactional routing.

- **Remote HVAC demo + video released**
  Real-time mirrored HVAC UI between Tizen in Jaguar F-type and mobile device.


# Upcoming Demos



- **Software Over The Air (SOTA) - Telematics Update San Diego Oct 30-31**
  Transfer, install, and validate a software package from a backend server to an IVI unit.

- **Remote CAN bus monitoring**
  Remotely subscribe to specific CAN frames, and have them delivered to a backend server.

- **Remote control of IVI nav system**
  Use remote mobile device to setup POI in vehicle's navigation system.

- **More**
  Demo suggestions and cooperative projects are welcome.



# Architecture

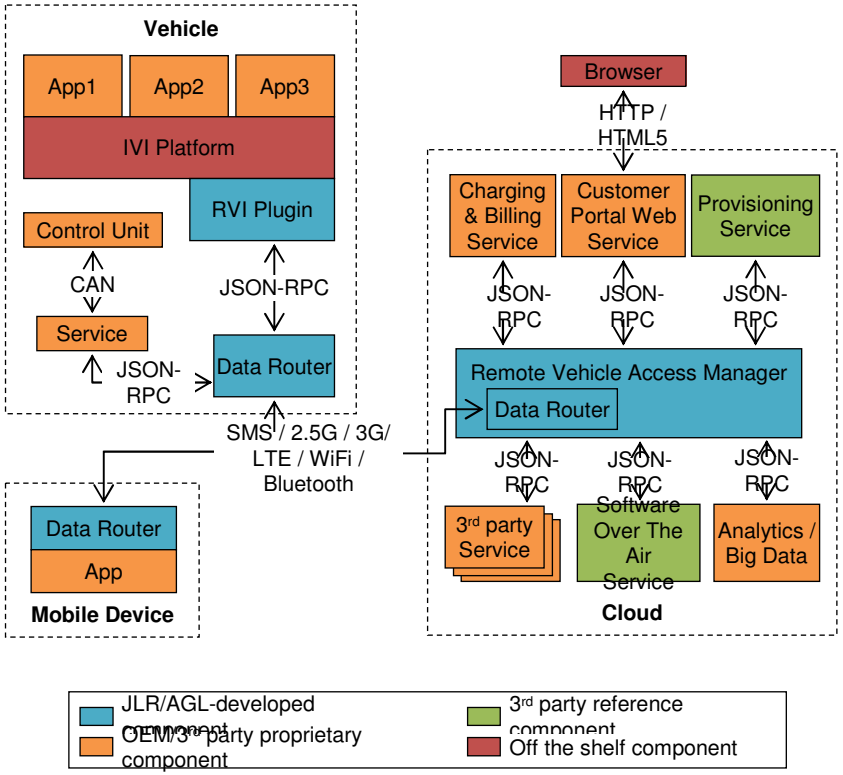
# Architecture - Overview

- **API based**
  The API is the driving technology.
  Implementation is secondary.

- **Data Router commonality**
  Data Router connects all services on all devices.

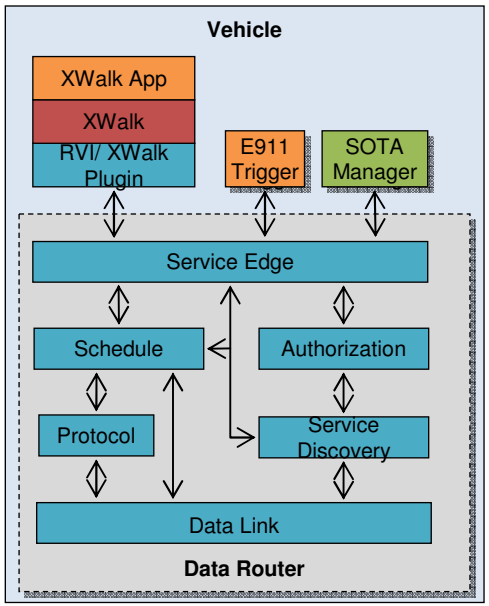
- **Mix of open and closed source**
  Components can be off the shelf, OSS, proprietary, or a combination of the above.

- **Network complexity shielding**
  A clean transaction API alleviates services and applications from connectivity concerns.



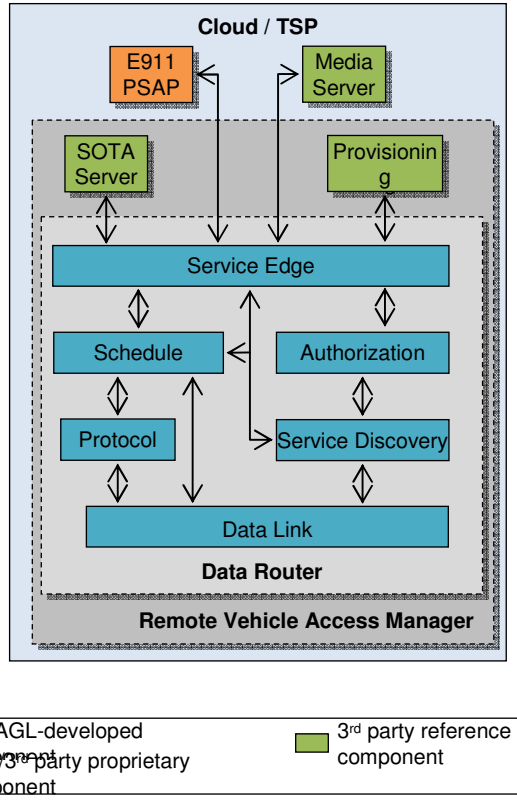
# Architecture – Data Router

- **Service Edge**
  Handles all traffic toward locally connected services.
- **Authorization**
  Handles certificates and authorization for all traffic.
- **Schedule**
  Handles traffic store and forward for unavailable destinations.
- **Data Link**
  Controls communication channels to other node.
- **Service Discovery**
  Identifies and locates local and remote services.
- **Protocol**
  Encodes and transmits traffic to other nodes.




# Architecture – Backend Server

- **Data Router**
  Standard deployment.
- **Provisioning**
  Creates and distributes certificates granting access rights to nodes.
- **SOTA server**
  Manages and distributes software packages to nodes.





# Services


# Services – Requirements



- **Global namespace for all services on all nodes, worldwide**
  All services on all provisioned devices must be addressable through a single schema.
- **Localized service discovery**
  Locally connected nodes must be able to discover each other's services without Internet access.
- **Zero configuration**
  No configuration outside authorization shall be needed for a newly deployed node to join the system.
- **Network agnostic**
  A service shall be accessed the same way, regardless of the communication method used.


# Services – Addressing

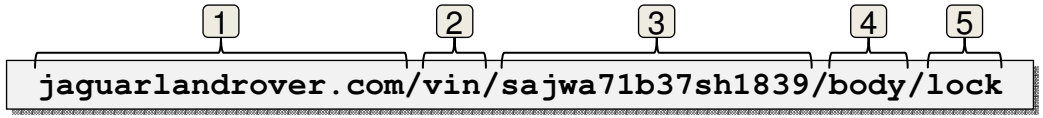


- **Single name space for all services**
  New services can be addressed by creating a unique name for them.

- **Service name identifies hosting node**
  Each service name, being unique across the system, carries enough information for Service Discovery to identify where the node can be found.

- **Hide network complexity**
  All service interaction with other services are done through the service name space, allowing the actual communication to be carried out behind the scenes.

# Services – Service Name Example




| # | Name | Description |
|---|---|---|
| 1 | Organization | Specifies a sub-section hosted by a specific entity |
| 2 | VIN sub-tree | Specifies sub section for all vehicles |
| 3 | VIN | Vehicle Identification Number |
| 4 | Service name | Name of service |
| 5 | Command | Command supported by service |

# Services - Routing

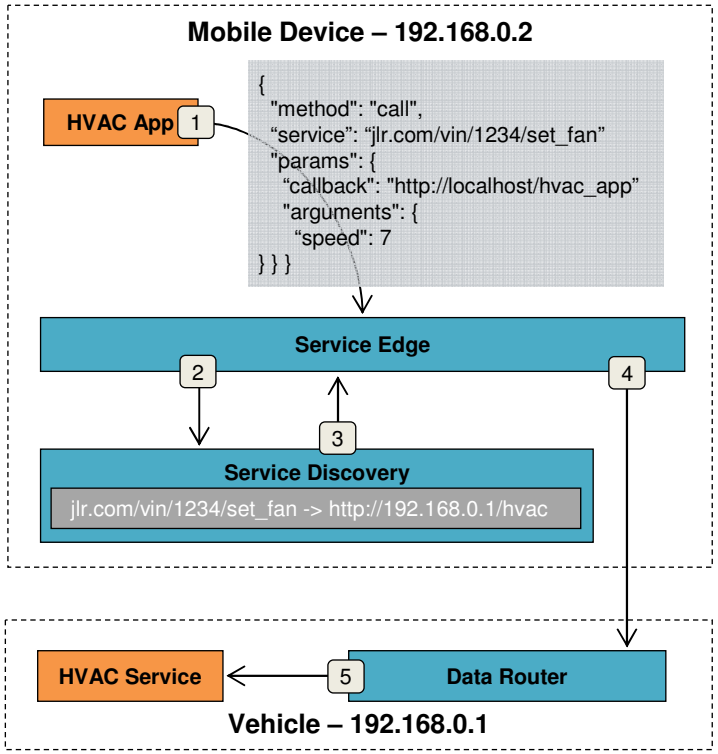
1. **Application sends command**
   HVAC App sends an message, targeting a given service URI, to Service Edge.

2. **Locate target node**
   Service Edge asks local service Service Discovery to resolve service name to a network address.

3. **Return network address**
   Specifies where the target service can be reached.

4. **Send request to Vehicle**
   The vehicle data router processes the command.

5. **Forward request to HVAC Service**
   The HVAC Service in the vehicle executes the command.





# Authorization


# Authorization – Overview



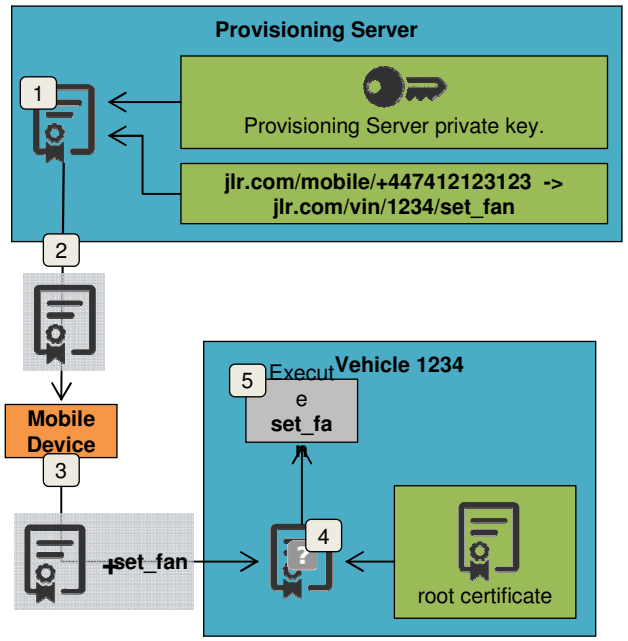
- **Certificate based**
  Certificates, signed by a trusted provisioning server, grants node access to services.

- **Self-carried authorization**
  A node presents its certificates to another node to access its services, without provisioning server connection.

- **Service – service specific certificates**
  A certificate authorizes a specific set of services to access another specific set of services, and cannot be used outside that context.

# Authorization – Use Case

1. **Create and sign certificate**
   A certificate granting access to the mobile device is created and signed with provisioning server's private key.
2. **Distribute certificate to mobile device**
   The targeted device receives its certificate
3. **Send request and certificate to Vehicle**
   The certificate states that mobile device has the right to execute the given request
4. **Validate credentials**
   The certificate and request is validated by the vehicle through a root certificate
5. **Execute request**
   The validated command is forwarded to the target service for execution



# Authorization – Examples

**Access List Format**

`[organization]/[path]` + wildcards

`jaguarlandrover.com/vin/sajwa71b37sh1839/body/lock`

Specifies a specific vehicle's lock command in the body service.

`jaguarlandrover.com/vin/*/media/volume`

Specifies the volume control command of the media service on all vehicles.

`jaguarlandrover.com/cloud/vehicle_tracking/*`

Specifies all commands under the vehicle_tracking service.


# Authorization – Topics not covered



- **Protection of certificate inside a node**
  A credential received by the mobile device needs to be secured in accordance with the mobile device/IVI/server platform

- **Certificate – device binding**
  A stolen certificate can be presented by another device to gain service access. Device binding is done on an implementation level using hardware-specific mechanisms

- **Secure communication**
  Protocol implementations are responsible for securing data transmission between nodes using SSL/TLS or similar technologies


# Conclusion



- **Connected Vehicle architecture for next generation services**
- **Open source design, specification, and reference implementation**
- **Benefits the whole industry**
- **Hosted and driven by AGL**


# Next Steps



1. **Joint projects**
   OEMs and other industry actors are being invited to collaborate under the AGL banner.

2. **Continued technical development**
   The RVI reference system is incrementally implemented, with demos released as proof of concept and progress.

3. **Widen scope to IOT**
   While RVI is tailored for the unique requirements and constraints of the automotive industry, its design lends itself very well to the Internet of Things environments where connectivity is an issue.


# Thank You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http://wiki2.automotivelinux.org/eg-rvi

http://github.com/PDXostc/rvi