Toyota’s “Open Strategy” of Connected Vehicle

June 21, 2018

Ken-ichi MURATA
Project General Manager
– Connected Strategy, Connected Company,

Masato ENDO
Project Manager
– Intellectual Property, Advanced R&D and Engineering Company,

Toyota Motor Corporation
1. Toyota’s contribution to open activities for technical challenges
2. Toyota’s contribution to open activities for non-technical challenges
Data Flow of Connected Vehicle

Automotive Business
- R&D, Engineering
- Vehicle Functions
- Vehicle Data
  - Sensor Data
  - Driver Monitor
- Marketing
  - Use-case Analysis
  - Next Gen Design
  - EDER
- Maintenance
  - Fault Diagnosis
  - Fault Prediction
- Data Analytics
  - Anonymity
  - Filtering
  - AI
- Public Cloud
  - Processed Data
- Public Data

Non-Automotive Business
- Telematics Services
  - Driving advice
  - Remote functions
  - SOS
- Insurance, Finance
  - AYD insurance
  - Resale value
  - E-Toll
- MaaS
  - Traffic Info
  - Traffic Control
  - Sharing
  - Multi-modal
- Other business
  - Fault Diagnosis
  - Fault Prediction
- Integration with other devices
  - Music
  - SNS
Issues on Technologies

3. Communication Infrastructure

1. Vehicle Software Platform
2. Smart Device Integration
Contribute to establishment of AGL

Input Requirements

Requirement Spec. v1.0

Contributing Code to AGL UCB

Deploy IVI system base on the AGL specification from 2017 Toyota Camry

System development aligned with AGL
1. Mirroring

Smartphone

Apps

Screen Image

X/Y axis touched

The IVI system only show the screen image sent from the smartphone.

2. SDL (Smart Device Link)

Smartphone

Apps with a SDL library

Buttons + Caption

Button # pressed

Contributing API spec and Open Source of the libraries.
AECC: Automotive Edge Computing Consortium

Contributing to establish the consortium

Contributing requirements from Car OEM viewpoint

Contributing system requirements and standardization
Issues on Non-Technologies

To reduce OSS copyright risks  To reduce OSS patent risks

Hybrid strategy!

- We are working together with the communities to reduce OSS legal risks for customers and developers.
- TOYOTA is the first corporation to become a top level member in both OpenChain Project and OIN.
OSS Copyright Risks

If the obligations prescribed in the license are not fulfilled
⇒ The license is invalidated and there is the possibility of legal action for copyright infringement.

If this obligation is not fulfilled and the products are sold...

Sorry...

Let's use it in our product.

Source Code

License

Source Code

License

Please use our source

Developers

OSS community

Released

Adopted

You violated the license! I'll sue you!!

Legal action
Mixing OSS in the supply chain may cause unknown copyright risks. A company with no or weak OSS governance system may cause risks to the whole supply chain.
OpenChain is a project of Linux Foundation that aims to create and distribute standards for OSS compliance. TOYOTA is the first Automaker and the first Japanese company became platinum member of OpenChain.

Platinum members:
Qualcomm/SIEMENS/HARMAN/WIND RIVER/Adobe/ARM/HPE CISCO/GitHub/Western Digital/TOYOTA/HITACHI/Sony/Comcast
Major output of the project

Specification

<table>
<thead>
<tr>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Introduction</td>
</tr>
<tr>
<td>2) Definitions</td>
</tr>
<tr>
<td>3) Requirements</td>
</tr>
<tr>
<td>Goal 1: Know Your FOSS Responsibilities</td>
</tr>
<tr>
<td>Goal 2: Assign Responsibility for Achieving Compliance</td>
</tr>
<tr>
<td>Goal 3: Review and Approve FOSS Content</td>
</tr>
<tr>
<td>Goal 4: Deliver FOSS Content Documentation and Artifacts</td>
</tr>
<tr>
<td>Goal 5: Understand FOSS Community Engagement</td>
</tr>
<tr>
<td>Goal 6: Certify Adherence to OpenChain Requirements</td>
</tr>
</tbody>
</table>

Appendix I: Language Translations

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>12</td>
</tr>
</tbody>
</table>

Curriculum

Self-Certify

[Diagram showing FOSS Review Oversight]

- The FOSS Review process should have executive oversight to resolve disagreements and approve the most important decisions.
Pros of applying OpenChain to the Supply Chain

We’d like to follow the OpenChain specification to set up our OSS governance system.

Let’s promote OpenChain conformance!

Let’s use OpenChain materials for in-house education!

Follow the OpenChain standard to manage OSS.

OpenChain materials will provide strong OSS governance throughout the whole supply chain!
TOYOTA, HITACHI and Sony formed the Japanese Work Group last December and have already initiated OSS compliance activities in Japan and elsewhere in Asia.
Even if we use open source, it is challenging to avoid litigation completely. However, understanding all OSS-related patents would be a difficult challenge.
All members agree to mutually cross license, exclusively to use in the Linux System, their patents which are directly related to the function described in the OIN Linux System definition.
- To reduce AGL patent risks, TOYOTA is trying to include AGL into revised OIN Linux System definition.
- The OIN board is scheduled to approve AGL inclusion in OIN Linux System Definition by “Summer 2018”!!
Over ten OEMs and many suppliers already became members of the OIN, and more OEMs may join OIN in the near future.
Welcome new Automotive Member!!

Today we’re pleased to announce that IWATA oriented automaker Joined OIN!!
We’ll continue to have activities with OSS community to develop “better” software society.

## TOYOTA’s Open Strategy

Find solutions with the community!

<table>
<thead>
<tr>
<th>Technical Issues</th>
<th>Compliance Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Linux Foundation" /></td>
<td><img src="image2.png" alt="Automotive Grade Linux" /></td>
</tr>
<tr>
<td><img src="image3.png" alt="openinventionnetwork" /></td>
<td><img src="image4.png" alt="openchain" /></td>
</tr>
<tr>
<td><img src="image5.png" alt="sdl" /></td>
<td><img src="image6.png" alt="fsfe" /></td>
</tr>
<tr>
<td><img src="image7.png" alt="AEC" /></td>
<td><img src="image8.png" alt="IP Issues" /></td>
</tr>
</tbody>
</table>

Promoting Issues | IP Issues
--- | ---
![openchain](image4.png) | ![fsfe](image6.png)
| ![sdl](image5.png) | ![AEC](image7.png)
Vehicle demo: AGL HMI-FW using vehicle information

This demo is expanded CES 2018’s AGL demo

Adding vehicle device control on AGL via CAN
・Get CAN data in real time
・Operate the door windows and the side mirrors

Changing display mode for safer driving by the vehicle condition
・Cover the screen of the movie

Structure of interface software

- R-Car M3
  - 13inch touch panel display
- Vehicle CAN connect H/W
- CAN⇔USB I/F
- HDMI/USB
- USB

LEXUS RX450h

Control of vehicle devices
Safe HMI management

AGL Binder
HMI-FW
CAN High-Level
CAN Low-Level
CAN-USB device driver
Demo location information

- Demo Schedule
  - Coffee Break (AM, PM)
  - Lunch

- Back Entrance
- Driveway
- Ev Hall
- Escalator to Event Floors
- Coffee shop
- Main Entrance

1F