

# Automotive Car Server/Communication Gateway supporting new E/E architecture

**Dr.-Ing. Adam Korbel**

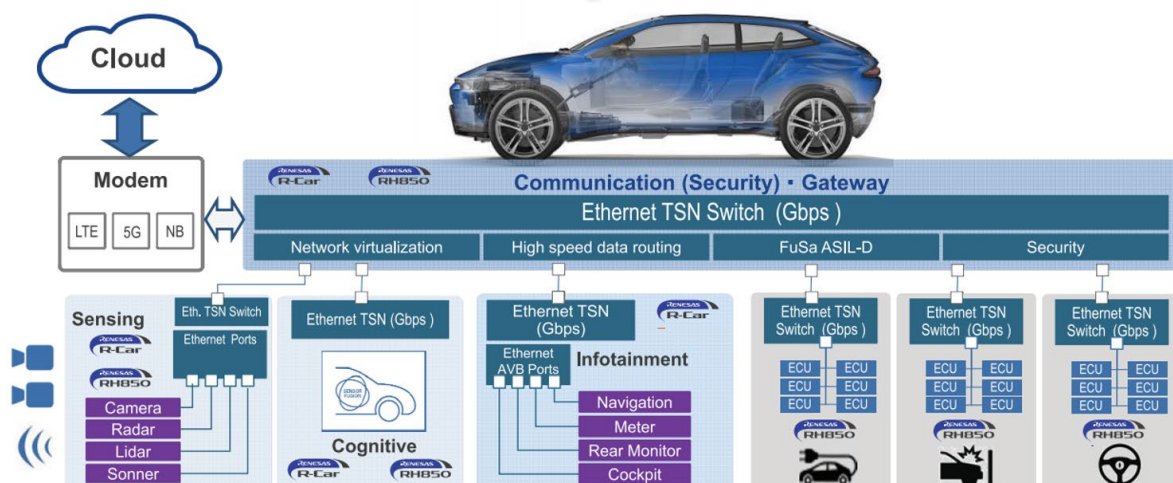
Senior Staff Engineer, Automotive Digital Products Marketing Division, CoGW Section

December 2020

## Communication Gateway with New E/E architecture

Did you know that Renesas is the market-leading chip maker in the new Automotive Car Server/Communication Gateway (CoGW) market segment? To set the background, a combination of regulatory and market factors is forcing dramatic change today. From conventional cars with combustion engines, toward electrification, autonomy, and connected cars. New business models are emerging that apply pressure to enable new vehicle features, subscription services, entertainment apps, and car-sharing services over the entire lifetime of a vehicle. The days are numbered for production of cars with features and capabilities that are static.

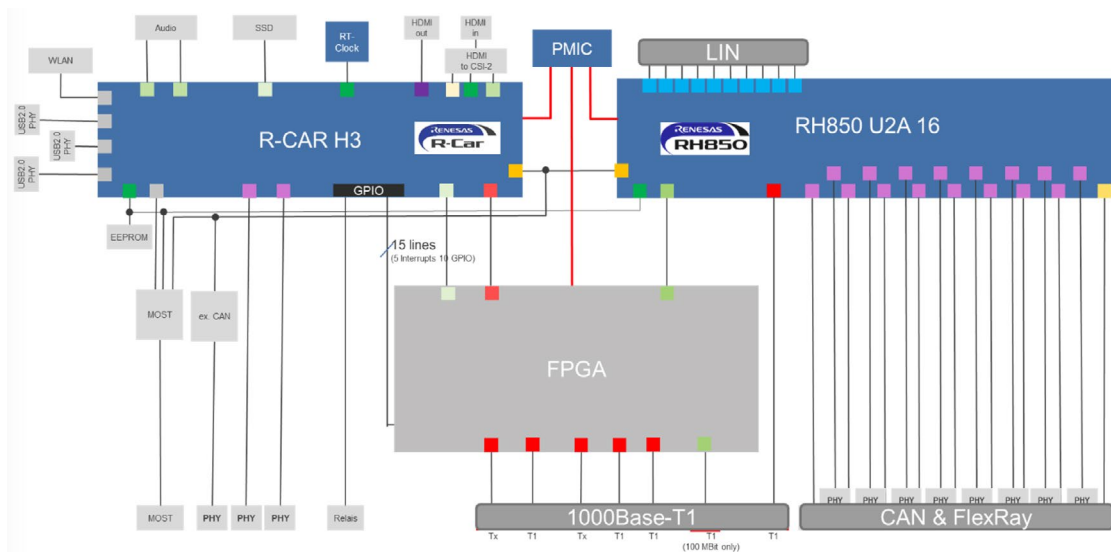
The vision of car makers today is a vehicle that is more of a smartphone on wheels than a conventional automobile. Among the challenges on the road toward realizing this vision are the exponential growth in data-bandwidth requirements, and complete re-thinking of the way that software is architected and deployed. The number and capability of vehicle features can increase with the availability of more data, but software size also increases in accordance with increased feature content. Management and scaling of the increasing volume of software requires the conversion to a service-oriented-architecture (SOA) style of software design, and up-integration of software features to more powerful, centralized, electronic control units (ECUs). SOA enables the fast-paced development and deployment of software in the world of mobile computing. Centralization of vehicle software enables new software-development and software-ownership models. In addition, as vehicles take increasing control of their own motion and integrate more deeply into our lives as smartphones have done, advanced functional safety and enhanced security features are needed to enable secure, over-the-air transfers of data and software updates between connected cars and Cloud services.



While these trends are driving toward the goals of agile development and faster feature deployment, the gears of the Automotive industry are still spinning up, and preparatory work has been ongoing for years to push the necessary fundamental changes in technology to the market. In fact, the R&D for a Communication Gateway/Car Server ECU platform has been underway for more than 4 years at our market-leading [customer](#). They were pioneers in this innovative, new market segment. At the time, they chose a semiconductor supplier with highest device quality, functional-safety capabilities, best-in-class ratio of computing performance to power consumption, and high commitment to the Automotive market. It should come as no surprise that the choice was Renesas.

The first volume production using this new Electrical/Electronic (E/E) architecture began at the end of 2019 with an electric vehicle (EV) line. The automaker’s plan is to expand the use of this E/E architecture platform to every other vehicle line over the next few years. To provide a sense of scale, an eight-digit yearly run rate is expected in full mass production by this company alone. We are proud to have contributed to this innovative Body High Performance computer project. New E/E architectures from many other automakers are rolling out quickly, and we will continue to facilitate the rapid growth of this market segment.

## Renesas Communication Gateway chipset solution and evaluation platform (Vehicle Computer)




For new projects, customers that already use similar Renesas SoC and MCU devices in various, legacy IVI/ Cockpit and Body-application ECU platforms can enjoy a high level of software and hardware re-use. This is a great benefit, as software has a major impact on development cost and Time to Market (TTM).

Even new customers can benefit from the strong software ecosystem for R-Car and RH850 devices and begin rapid prototyping or proof-of-concept evaluation. Renesas is the first chip maker to provide a comprehensive reference design for the Connected Gateway/Car Server application, complete with the CETITEC communication software stack. This evaluation platform, called "[Vehicle Computer](#)," has been developed in cooperation with our eco-system partner CETITEC. It is based on a complete Renesas chipset, covering the Connected Gateway/Car Server application up to a performance level of 40k DMIPS. The box can be used for evaluation, rapid prototyping, or data logging, and offers specific support for automotive requirements and communication standards such

as CAN-FD, LIN, MOST, FlexRay, PCIe, and Ethernet. Various IEEE802.1/IEEE802.3 Ethernet Time-Sensitive Networking (TSN) protocols are supported to realize high-bandwidth, real-time communication. For more details on the box and it's features, please refer to this [video](#).

The third generation of the Vehicle Computer evaluation platform, VC3.0, is now released to the market. It offers key improvements such as Gigabit Ethernet and support for all TSN features, while increasing the numbers of available classical automotive network interfaces like CAN-FD. It is the ideal candidate for pre-silicon evaluation of next-generation R-Car devices for communication gateway systems, and allows our customers to proceed with system development and rapid prototyping of future Communication Gateway ECUs.

### Vehicle Computer VC3.0 – CoGW Evaluation Platform



- **Real-time Gateway**
  - RH850/U2A with 16 MB Flash
  - 1 x 100MBit, 1x 1Gbit Ethernet AVB
  - 16 x CAN\_FD
  - .....
- **Application Processing**
  - R-CAR H3 with 40k DMIPS
  - CAN, FlexRay, LIN
  - .....
- **Multi port Ethernet Switch**
  - 3x 1Gbit, 1x 100Mbit
  - Support of "all" TSN features
  - IPv4/ IPv6 routing support
  - .....
- **Evaluation kit**
  - USB
  - WiFi
  - MOST
  - HDMI
  - .....

Please visit our [website](#) for more technical detail about the Renesas multi-protocol gateway solution for all major Automotive communication interfaces, including Ethernet TSN. Related R-Car SoC and RH850 MCU documentation can be found there as well.

### Renesas Solutions for Connected Cars

In the past, car connectivity consisted mainly of unidirectional data flowing either to the vehicle, as in the case of map or software downloads, or from the vehicle, as in the case of telemetry. With the addition of cloud-enabled features to modern vehicles, however, two-way communication has become a requirement, and real-time cooperation with cloud services is increasing.

To illustrate the need for coordination between cloud services and in-vehicle edge computing, consider vehicle maintenance for increasingly computerized vehicles. There is no argument against regular monitoring and maintenance for complicated electromechanical systems like automobiles, just as regular medical exams are important to maintaining good health. However, in the past, computing technology has been used primarily in offline failure diagnosis, looking mainly at the snapshot in time when the system is actively tested, or at small data sets captured at the time of failure. In much the same way that wearable technology is revolutionizing healthcare and optimizing athletic performance, constant vehicle system monitoring paired with prognostic algorithms enable detection of the earliest signs of wear and future component failure. This ensures that issues can be addressed before they affect system performance in a critical way. To accomplish this task, it is necessary to extract both individual data points and long-term trends from single-vehicle data sets and analyze them using algorithms derived from big data analysis. As the sharing economy expands rapidly, predictive maintenance is one key to safe transportation in a system that relies much less on human intervention and control.

In addition to improved maintenance, cloud computing enables new automotive business models. Examples include Usage Based Insurance (UBI), fleet management, and extended driver monitoring via cloud computing algorithms. However, during periods of limited connectivity, and for functions that require real-time, low-latency performance or privacy protection, embedded edge computing can fill the gap and satisfy the privacy and performance constraints for these system features. Renesas R-Car SoC's include embedded hardware designed specifically to support such important edge-computing capabilities.

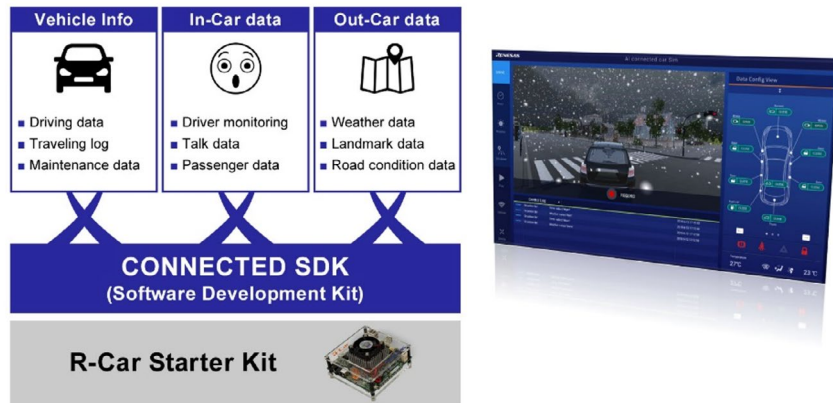
To ease application development and promote system scalability, this distributed computing environment requires a cloud-native service-app execution environment. Furthermore, to bring about a digital transformation of in-vehicle software, it is necessary to introduce cloud IT elements into the vehicle. To this end, Renesas has developed a connected car solution – a development platform that assists development and operations (DevOps) in implementing in-car software and integrating it with the cloud.

The platform consists of two main components:

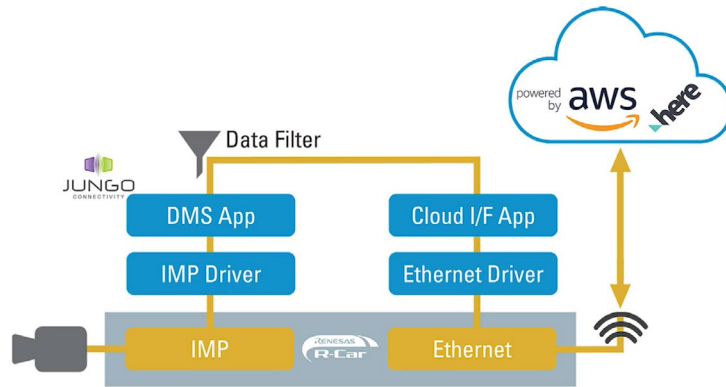
1) The Renesas Connected Software Development Kit (SDK) is a simulation environment.

The Connected SDK enables developers of cloud services to create applications and test them against simulated traffic situations and sensor data from real cars. Based on this real-world simulation, cloud services can be stress-tested during the development process to determine how they perform during times when internet or GPS connectivity is poor.

**Renesas Connected Car Software Development Tools  
Enables Cloud-Linked Automotive Applications  
Utilizing Vehicle Data**



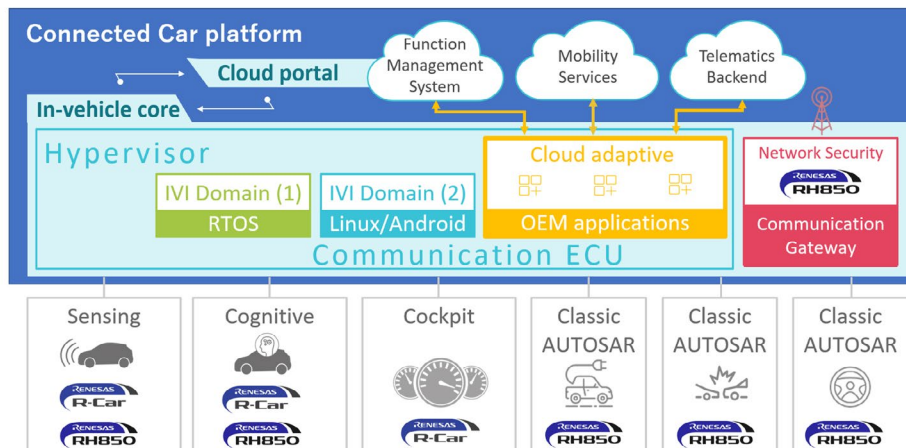
As an example of the use of the SDK, imagine a system that performs cloud cooperation with an edge computing application that implements a driver monitoring system (DMS). The in-vehicle system detects facial expressions and emotion and creates personalized profiles. R-Car embedded hardware accelerators provide this local, high-resolution, low-latency functionality. Data from this in-vehicle feature can then be anonymized, compressed, and optimized to reduce the necessary mobile data bandwidth, uploaded to the cloud, and used for further cloud-based applications, such as analysis to find improvements to vehicle interfaces in order to reduce driver distraction in future designs.



This [demo](#) is supported by Renesas partners AWS (Cloud Server), HERE (Cloud Map service) and Jungo (DMS).

2) The second part of the solution is the Renesas Connected Car platform, which serves as a connectivity framework.

The Connected Car platform is an R-Car reference environment that supports automotive DevOps with modern technology, including a cloud portal, support for Docker/containerization, hypervisor support, and a framework for continuous integration and continuous deployment (CI/CD). This tailored combination of open- and closed-source software conforms to automotive requirements and addresses the particular requirements introduced by the coming digital transformation of vehicle electronic architectures. As a reference environment, it facilitates cooperation on every logical level – between ECUs, between different operating systems, between multiple services (multi tenancy), and more.



For more details and to join the discussion, please visit us at the virtual **CES2021!**

© 2020 Renesas Electronics Corporation or its affiliated companies (Renesas). All rights reserved. All trademarks and trade names are those of their respective owners. Renesas believes the information herein was accurate when given but assumes no risk as to its quality or use. All information is provided as-is without warranties of any kind, whether express, implied, statutory, or arising from course of dealing, usage, or trade practice, including without limitation as to merchantability, fitness for a particular purpose, or non-infringement. Renesas shall not be liable for any direct, indirect, special, consequential, incidental, or other damages whatsoever, arising from use of or reliance on the information herein, even if advised of the possibility of such damages. Renesas reserves the right, without notice, to discontinue products or make changes to the design or specifications of its products or other information herein. All contents are protected by U.S. and international copyright laws. Except as specifically permitted herein, no portion of this material may be reproduced in any form, or by any means, without prior written permission from Renesas. Visitors or users are not permitted to modify, distribute, publish, transmit or create derivative works of any of this material for any public or commercial purposes.