

Connected Vehicle as Smart Object(s)

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I. CONNECTED VEHICLE

Some cars today have telematics service which are service sets for connected vehicles. The services are covered from entertainments like Music, Video, Maps update, etc to automotive specific one like automotive diagnostics, collecting sensing data (aka probe system) for congestion map and weather map, etc.

A car equips with various sensors: GPS, temperature, speed, breaking system (ex. detection sleepy road). However, the sensed data is utilized only by each automotive or car OEM for some internal services. Obviously, if car is connected and these data are shared, our daily life can be much improved. By using a huge number of cars on road, the real-time data can be provided. If all cars are connected, we need better connectivity management due to possible congestion in morning commute time, etc. As Internet grows, once the technology is ready, we will face to quick deployments. If smartobjects would get realized, a car can adapt these technology and be definitely one of smartobjects. We need to investigate how we can manage connectivity from a car to the Internet and how we collect data more efficiently from the large number of cars. The objective of smartobjects and IoT are well-fitted to our problem domain.

In addition to it, automobiles are recently equipped with several devices which are used for driving control, stability control, usability management, environmental management, and safety management. Electronic control unit (ECU) is a device to control automobile according to sensed information and actuator's actions. After advancements of IT technology, a typical vehicle now have about 100 ECUs and high-end vehicles have a few hundreds ECUs inside. Several local area network technologies dedicated for vehicles have been introduced such as Local Interconnect Network (LIN) and Controller Area Network (CAN). This in-vehicle network is the another area where IoT technology can be applied. A vehicle consists of full sensors and small objects. How to manage these objects effectively and efficiently is another challenging of car OEMs. 6LowPAN, Roll and COAP may deploy to some of in-vehicle networks,

although there is one missing criteria from those protocols such as reliability and stability. Any technology being available in a car must be reliable and stable due to safety requirements. IP will be initially used in an audio-visual network connecting display, speakers, mic, and back-cameras, etc. This network is not directly effect to vehicle motion, but it is used more for comfort and fun. For more information, please refer to our internet draft published to ROLL Working Group 3 years ago. see <http://tools.ietf.org/html/draft-wakikawa-roll-invehicle-reqs-00>.

Finally, as you see in the market, electronic vehicle (EV) and Plug-in Hybrid car will be majority of future cars due to fuel and environmental issues. Once we have those cars ready, a car must be part of smartgrid network where IoT technology will be widely adopted. A car potentially connects to home network or network in charging stations.

II. INTERESTS TO THE WORKSHOP

We are investigating the applicability of IETF protocols to future automobiles. The IoT related protocols can enhance automotive network capability and bring better user experience to drivers. As my personal interests, IoT is mixture of wireless and mobile technology which are my main research areas. I've participated in standardization activity in mobility working groups in the Internet area. I also chair AUTOCONF Working Group right now. AUTOCONF solutions (address autoconfiguration for MANET) will be designed for mobile ad-hoc network (MANET). We found some overlap to 6LowPAN and ROLL working groups. 6LowPAN NDP document refers to one AUTOCONF document about the addressing model. Therefore, it is important to me to understand technology and needs from IETF participants in the smartobjects area, too.

At the end of this paper, I want to share what Toyota thinks a car in 20xx. A video titled "Toyota SmartCenter in 20XX" is available at the following link. It is released in early 2011. It is English movie with Japanese subtitles. <http://www.youtube.com/watch?v=BMIVyY2EpLA>