Introduction to Vehicle Domain Services Provided by Connected Cars

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1. Expectations for Connected Cars

With the spread of Information and Communication Technology (ICT), all objects related to daily life are expected to be connected to the Internet. Vehicles are no exception, and there is increasing anticipation for new services that will emerge when they do connect to the network. There is not strict definition of a connected car, but it is generally understood to mean a vehicle that is connected to a network and is able to provide various new services.

Many services to be provided by connected cars have been studied, and among these, ITU-T has proposed the Vehicle Domain Service, which we introduce here.

2. Vehicle Domain Service (VDS) Concept

Generally, vehicle domain information refers to the traffic conditions surrounding the vehicle. The primary basic information elements are related to actively moving bodies such as the types, sizes, positions, and speed of vehicles operating near the vehicle, but also include other traffic participants, such as pedestrians and cyclists.

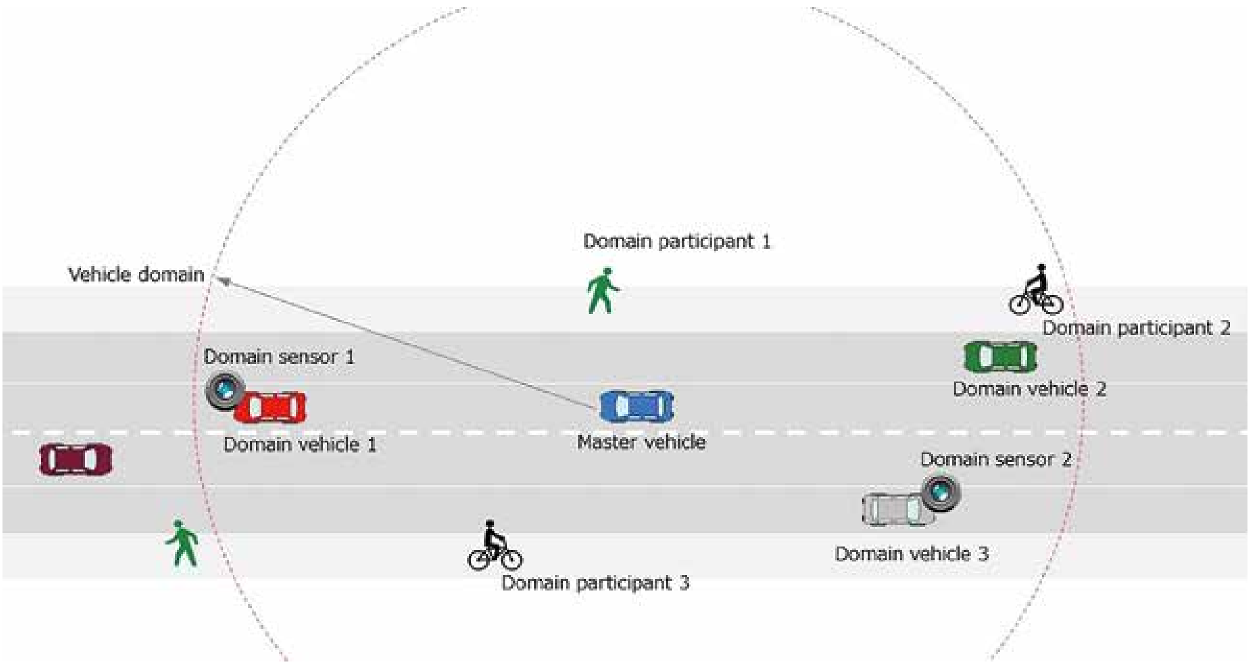
Vehicle domain information also includes road conditions such as vehicle width, number of lanes, the shape of the road ahead and intersections, and static information such as whether there are traffic signals or cross-walks, and generally comprises all traffic information surrounding the vehicle.

This vehicle domain information is very important as basic information for making driving decisions, but its value is increasing dramatically as input for advanced systems that support vehicle operators, and the new autonomous driving systems that are being developed feverishly around the world today.

Vehicle domain information is collected through communication with other traffic participants near the vehicle, and by detecting information using various types of sensors in the vehicle. VDS information is generally defined as being constructed using both of these types of sources.

A configuration for obtaining VDS information in this way is shown in Figure 1. A vehicle provides the VDS, generating it by integrating information obtained through communication and from its sensors.

■ Figure 1: Information retrieval with VDS



3. Standardization Activities for VDS for Driving Decisions

The primary application area for VDS is to provide information needed for vehicle operation. This corresponds to vehicle domain information as implemented in the vehicle, so the applicable standardization area would be ISO TC 22 (Road vehicle). As such, initial proposals were under TC 22, sub-committee 31 (SC 31); Data communication.

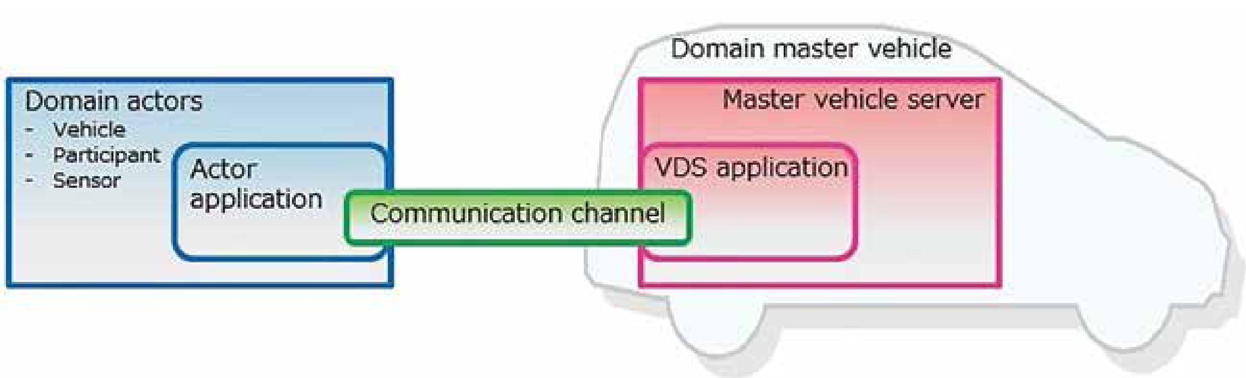
Detailed discussion is beyond the scope of this article, but work was proposed at the SC 31 general meeting held in September 2017 in Germany, and a new work item proposal (NWIP) was submitted in November of that year. Work began when it was approved as ISO 23239 in January 2018. In April of that year, it was registered as working group 8 (WG8) under SC 31.

The scope of ISO23239 is shown in Figure 2. VDS is implemented in a vehicle, and provides information for making driving decisions.

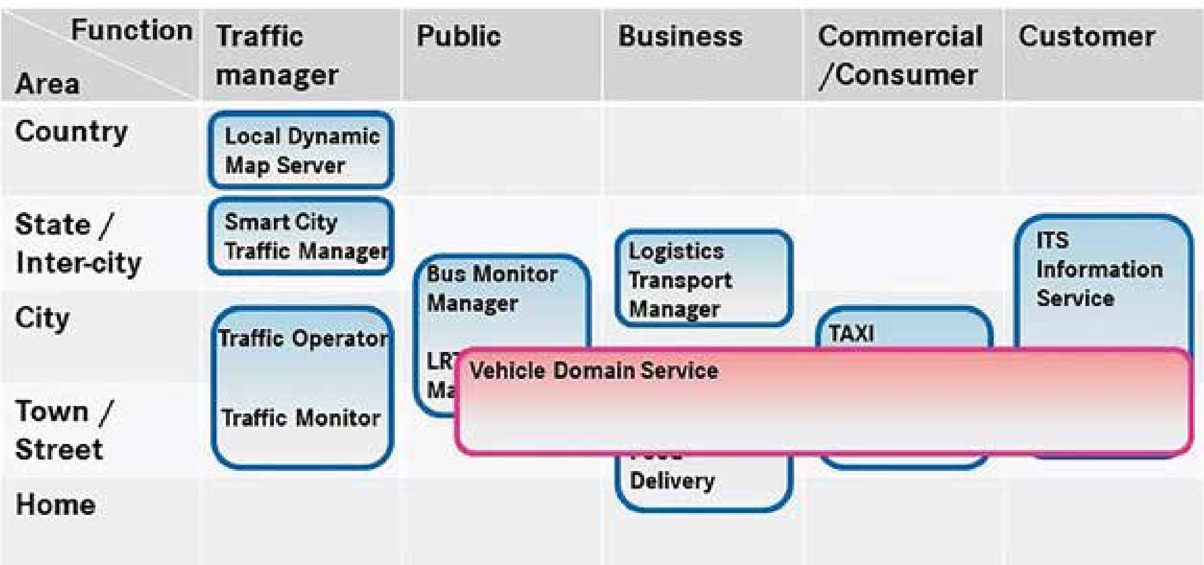
4. VDS in Smart City Traffic

VDS collects information for making driving decisions, but this is not the limit of its value. The latest traffic and road conditions are part of the information generated, so it can have significant influence on driving plans for other vehicles, either

■ Figure 2: Scope of standardization work



■ Figure 3: Smart City data structure model



approaching or planning to follow the same route. If many vehicles transmit such information and it is consolidated and provided to other nearby vehicles, vehicles sharing this information will be able to make better decisions. VDS bundled and shared in this way could function as information infrastructure for traffic conditions in the city.

When all traffic and road condition information in a city is available as data, and vehicles moving within the city are connected, it is referred to as a smart city, or smart traffic. VDS can be incorporated into smart city data transmission structures and can function as part of the information infrastructure.

City transportation functions are grouped according to the scope of geographical links and the objectives of mobility and transport. Traffic in a city has a hierarchical structure, geographically and functionally, so transmission of information related to traffic also has a similar structure.

Figure 3 shows an example model of the information structure in a smart city. The vertical axis shows geographical expanse, ranging from homes (the starting point for mobility in a city) to the entire country. The horizontal axis shows types of function or objective for mobility in the city. It comprises individual transport (Customer), commercial transport (Consumer), business transport (Business), goods transport (Logistics), public transport (Public), and traffic control (enterprise). VDS can share information among various functional groups in the range of Home to Street, and can provide various services.

5. VDS Standardization Activities in Smart City

The scope of ISO TC 22/SC 31 work is communication implemented within vehicles, so standardization of information sharing with surrounding vehicles, and functionality for exchanging information in a smart city as described above, are beyond its scope. So far, most of the work has been in the area of on-board control communication, such as controlling electric car charging, diagnostic device communication, the controller-area network (CAN), the Local Interconnect Network (LIN), and on-board Ethernet. For this reason, there has been a shortage of standardization professionals who specialize in new work areas such as that discussed in this proposal.

Accordingly, it has been necessary to collaborate with standardization organizations in the area of information exchange in smart cities.

Recently at ITU-T, Study Group 16; multimedia (SG16), has been standardizing data interfaces with vehicles, and Study Group 20; smart city (SG20), has been standardizing data transmission for smart cities. Several focus groups (FG) were also started in March 2018 to find new standardization themes in the field of communications, and one of these was Focus Group Vehicle Multimedia (FG-VM), to explore new standardization themes within and outside of vehicles. In light of such activity, it seemed necessary to be cooperating with ITU-T.

6. ITU-T and VDS Collaborative Study

To consult with the ITU-T on how to collaborate on standardization, we first consulted with the Japanese government Telecommunications Technology Committee (TTC), and were directed to the open coordinating committee within ITU-T standardization committees, called the CITS. CITS consults on how to proceed in cooperating with other related standardization organizations. Accordingly, we participated in the CITS meetings held in Nanjing, China, in September 2018 on September 6 and 7. ITS-2018 workshops were held for the first day and a half, on topics related to autonomous driving, next-generation communications, and Smart City, and CITS was held on the afternoon of the second day.

In the ITS-2018 workshops, we heard about activities in Europe regarding Smart City, and upon hearing discussion of the multi-layer implementation of urban transport their point seemed very relevant. When we introduced VDS, we received generally favorable responses.

At the CTS meetings, we gave an overview of VDS, and offered a proposal for collaboration. There were questions regarding the relationship with SAE and TC 204, some exchange of ideas, and we received positive responses. As a result, it was agreed to investigate collaboration with SG16 and SG20, and to send a letter explaining these circumstances to other related standardization organizations.

7. Other Developments and Future Prospects

Using consultation results from CITS, we coordinated with ITU-T SG16, and it was decided to initiate a Joint Project Team (JPT). This was reported to the ISO TC 22/SC 31 council, and preparation to issue a liaison letter is progressing.

On other fronts, an ITU-SAE Workshop was held in Detroit, USA, on October 8-9 2018, and during the same week, on October 11, the first meeting of FG-VM was held in Ottawa, Canada. We participated in both of these, introducing VDS, and discussing future developments.

We also received positive responses at these meetings, but discussion was broader, focusing on general, non-specialized issues, particularly at FG-VM, to give more open access to the JPT for SG 16, which was less familiar with VDS.

Thereafter, technical and specialist discussion began at ISO and ITU-T, checking against the specifications of the JPT. Many issues arise when standardizing a new field, but given participation from many experts and stakeholders, we hope to achieve a very meaningful standard.