Fujitsu's Approach to Smart Mobility

● Akira Kawasaki

The various problems related to urban transportation depend on several factors such as the country, region, and stage of economic development, so one solution is insufficient. However, there is an approach that can not only solve transportation problems but also provide the optimum solution in line with urban growth: use of a platform to aggregate and visualize massive amounts of information about movement including automobiles, public transportation systems, and people's demand for movement. A combination of analysis and prediction programs can be applied to such information, and improvement criteria can be quantified in accordance with the respective country, region, and stage of economic development. Fujitsu is leveraging its technology for developing telematics services that it has built up over the years and technology for using probe data collected from running vehicles to build a mobility platform that visualizes urban transportation.

1. Introduction

Urban transportation in the modern world faces a variety of problems.

1) Urbanization is progressing throughout the world, and the number of megacities (cities with a population of 10 million or more) now stands at 29. This trend toward urbanization is expected to continue in conjunction with economic development. According to World Urbanization Prospects from the United Nations Statistics Division, 60% of the world's population is projected to be concentrated in cities by 2030.[1)] Such concentration leads to traffic congestion in urban areas.
2) In developing countries, rising income levels due to rapid economic development are producing a surge toward motorization. China, for example, was the top country in automobiles sales in 2009; car ownership increased about 17 times over the 20 years from 1990 to 2011 and reached about 120 million vehicles in 2012.[2)] The demand for energy accompanying such a dramatic jump in the number of automobiles aggravates environmental problems. In China, $PM_{2.5}$ pollution is a serious environmental problem, and 22% of this pollution originates in automobile exhaust.[3)]
3) Transportation measures are needed to deal with an aging population. There are also concerns that public transportation in rural areas will become unsustainable due to declining populations. In regions with insufficient public transport facilities, the elderly must rely on their own car as a daily means of transportation. With aging, however, a decline in the cognitive, decision-making, and operating skills needed to drive an automobile cannot be avoided, but the elderly often have no choice but to use their own car despite the risks involved. Thus, securing a safe and easily accessible means of movement for the elderly and people with disabilities is a major problem.

In short, the many problems related to urban transportation are variable and depend on the country, region, and stage of economic development. A single, across-the-board solution is therefore insufficient; a multi-faceted approach is needed.

This paper introduces Fujitsu's role and activities in smart mobility policies that are being advanced by the Japanese government to deal with urban transportation problems worldwide.

2. Systems defined by smart mobility

According to the issues and proposals set forth by the Smart Community Forum of the Ministry of Economy, Trade and Industry (METI), smart mobility defines three new innovative transport systems.[4)]

1) A system that merges energy and transportation using energy storage as a core technology
2) A system that forms a network of automobiles as sensors
3) A highly convenient and environment-friendly transportation system

In the light of these system definitions, the Transportation Policies Council of the Japan Productivity Center made two recommendations in 2012 for "Achieving a Smart Mobility Society."[5)]

Recommendation 1

Create a "Next-generation Intelligent Transportation System (ITS)" that applies smartphones to the transportation system and provides seamless far-reaching support from vehicles to walking compatible with an aging society.

- Develop systems that use smartphones to provide seamless support of individual movement from vehicles to walking and that can achieve low-cost operations management for transport operators and announce these systems as the "Next-generation ITS" from Japan at the 2013 ITS World Congress (Tokyo).
- Position next-generation automobiles and the "Next-generation ITS" as "government-designated strategic fields for international standardization."
- Develop indoor/outdoor seamless information gathering technology to make effective use of smartphone probe data (personal information such as location). Specifically, 1) standardize the various data formats used by different companies and 2) develop indoor/outdoor 3D navigation that includes the use of Japan's Indoor Messaging System (IMES), a form of indoor GPS, from the viewpoint of cultivating Japanese brands.

Recommendation 2

Create low-speed zones and bicycle paths with expanded criteria to facilitate the spread of personal mobility vehicles (PMVs), which increase freedom of movement for the elderly.

- Promote intermodal transport by adding PMVs to the current categories of road transportation modes (pedestrian, bicycle, automobile) and by establishing a PMV usage environment based on a cooperative system extending beyond ministries and agencies.
- Establish low-speed zones for use by PMVs that can travel on roadways or widen/create bicycle paths for use by PMVs.
- Set up PMV parking lots at connecting points between PMV paths and public transportation nodes (stations, terminals, major bus stops, etc.) and create an environment in which PMVs can be easily used even outside one's area of residence such as in a neighboring town by promoting "rental PMV" facilities.

3. Fujitsu's approach to smart mobility

Recent years have seen the spread of in-vehicle devices such as event data recorders in addition to vehicle navigation systems, and at the same time, the penetration of smartphones has reached about 50%. These developments are making it relatively easy to create mechanisms for collecting and visualizing vehicle probe data. However, as described in the introduction, there are many urban transportation problems that need to be solved, and they vary by country, region, and stage of economic development. Thus, in addition to the smart mobility definitions presented by METI's Smart Community Forum, optimal solutions optimal solutions for variable problems are needed.

Fujitsu has studied the use of big data to help implement the systems described in the previous section, focusing particularly on cyber physical systems (CPSs) that create new value by consolidating sensor data on the cloud for analysis and prediction purposes. As an information and communications technology (ICT) vendor, Fujitsu aims to provide such analysis and prediction technologies in combination with a platform for storing collected data and to use these technologies for achieving smart mobility. In fact, Fujitsu has already used the results obtained from its participation in METI's "Advanced Society Infrastructure Construction Software Development Project" to develop a practical traffic information generating system based on taxi probe data.[6)]

An overall image of a platform to be provided by Fujitsu for visualizing mobility is shown in **Figure 1**. The services that need to be provided by the national

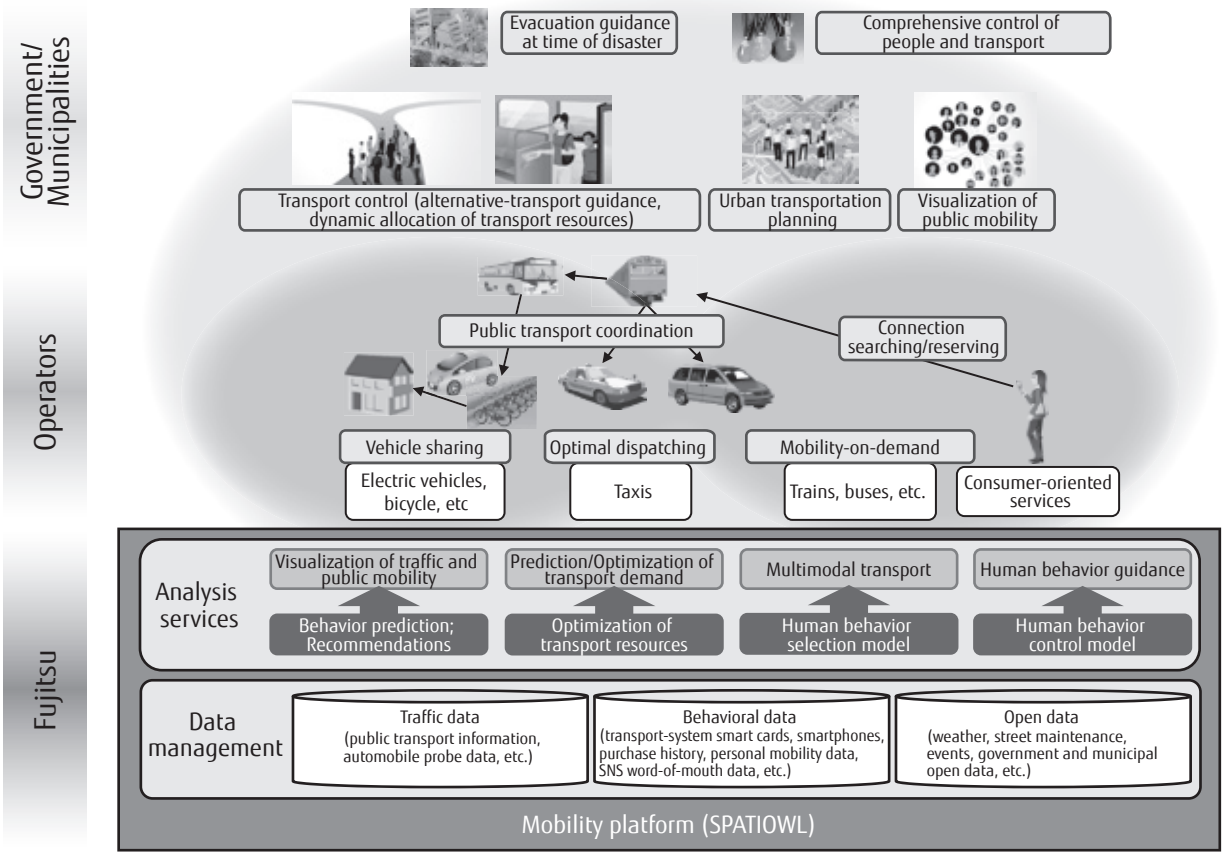

Figure 1
Overall image of Fujitsu's mobility platform.

government and local municipalities include urban transportation planning, comprehensive control of people and transport based on that planning, and transport control when a traffic problem occurs. In addition, operators that provide mobility (transport in a broad sense) will provide not only various means of public transport but also public-transport coordination services that combine different transport authorities as well as services such as mobility-on-demand[note)] and vehicle sharing. These services can be easily achieved through analysis services for visualizing traffic and public mobility and predicting transport demand, all of which can be provided on the mobility platform.

This platform uses the FUJITSU Intelligent Society Solution SPATIOWL location data service, which was launched in 2011. The SPATIOWL service can store and analyze data collected from a variety of probes on separate data layers. This feature enables it to divide public transport information, government and municipal open data, automobile probe data, personal mobility demand, social networking service (SNS) word-of-mouth data, etc. on different levels. This enables the provision of individual solutions while maintaining the independence of these different types of data and ensuring security. In addition, the visualization of traffic conditions, quantification of criteria for improvement, and repeated execution of a plan–do–check–act (PDCA) cycle will contribute to the solution of transportation problems and enable the ongoing provision of optimal solutions in combination with urban growth.

Smart mobility as provided by Fujitsu can be classified into "personal mobility," "safe and secure mobility," and "pleasant mobility." The following summarizes each of these categories and introduces their associated technologies, which are described in more

note) A system for operating vehicles adaptively in accordance with customer demand instead of on a fixed schedule.

detail in other articles in this special issue.

3.1 Personal mobility

Although the ideal is to enable all people including the elderly, disabled, and children to freely meet their individual mobility needs, it is unrealistic to provide each and every person with individualized means of movement. For this reason, combining individual mobility needs with public transportation (mass transit) and intermediate means of transportation (paratransit) and optimizing that combination for efficiency, economy, and environmental load can lead to urban transportation solutions. Fujitsu is developing a variety of technologies to support individual mobility combined with a mobility platform. In this special issue, we introduce a proposal for a next-generation cane to support elderly mobility, technology for indoor positioning to support indoor individual mobility, a proposal for an on-demand transport system to achieve sustainable regional transportation services, and technology for effective use of rechargeable batteries essential to the spread of electric-powered, environmentally friendly PMVs.

3.2 Safe and secure mobility

Deaths attributed to automobile-related traffic accidents continue to decline in Japan, but the number of traffic accidents itself, while leveling out, is not declining. Fujitsu is developing technologies and solutions to prevent accidents from even occurring. In this special issue, we introduce a safe-driving support solution using big data analysis that includes images collected by an event data recorder or smartphone, a solution for preventing driver fatigue using a communications-capable digital tachograph mounted in a commercial vehicle, technology for detecting stress and fatigue in the driver's voice, and millimeter-wave radar technology for use in active safety systems requiring high distance resolution and in surroundings monitoring systems for automated driving.

3.3 Pleasant mobility

Fujitsu has been involved for many years in the building of telematics systems that connect a vehicle navigation system and data center through a mobile communications network and has gained much experience and know-how in this field. It has a track record of providing its customers with advanced and attractive telematics services obtained by connecting in-vehicle devices to a data center. In this special issue, we introduce a vehicle navigation system that provides ease-of-use through operation support and voice interaction achieved with a smartphone connection, solutions to issues in using mobility machine-to-machine (M2M) in which a vehicle is continuously connected to the network, and Fujitsu's front-line global expansion of telematics services using big data. We also introduce Fujitsu M2M network services for linking mobile terminals to a mobility platform as technology supporting the operation of such a mobility platform.

4. Conclusion

The spread of in-vehicle devices and smartphones, advances in mobile networks, and the development of platform technologies for processing big data collected by mobile terminals are helping to make large-scale mobility platforms a reality.

This special issue introduces Fujitsu's approach to smart mobility centered about proposals and enabling technologies for a variety of mobility services that make use of a mobility platform.

Today, as we welcome the Internet of Things (IoT) age, in which all manner of things are connected to the Internet, Fujitsu aims to extend its Human Centric Intelligent Society vision for the future to the transportation field. Fujitsu is committed to solving urban transportation problems throughout the world and contributing to sustainable mobility.

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