How Data Will Transform Future Urban Transportation

Advances in vehicle network connectivity and the spread of smartphones over recent years have led to the collection of data on the flow of cars and people, creating a demand for the development of new transportation services that make use of these data. The Society 5.0 vision being promoted by the Japanese government seeks to create a society in which people can enjoy a quality of life that is both comfortable and vibrant through the high-level fusion of cyberspace and physical spaces, with the provision of sophisticated transportation services forming part of this vision. With the aim of resolving societal challenges, including reducing traffic congestion and accidents, while also creating a society in which everyone has the freedom to move around in safety and comfort, Hitachi is working on services that utilize IoT data to deliver new value.

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1. Introduction

Advances in vehicle network connectivity and the spread of smartphones and other devices over recent years have created an environment in which it is possible to collect and utilize data on things like traffic congestion and the flow of cars and people.

Because these data are collected continuously and in large quantities, they have the potential to be of value to the public and private sectors and to individuals. Anticipated examples of how these data can be used as sources of information include their use by national or local governments for new town planning or urban development, their use by transportation operators and other private sector businesses for providing the best possible services to their users, and their use for helping users enjoy transportation services that are better than ever before.

The development of transportation systems at the vanguard of the super smart society as part of the Society 5.0 vision being promoted by the Japanese government is also anticipated.

Alongside these developments, Hitachi has launched a service for utilizing transportation data that will allow it, in the future, to offer solutions that use these Internet of Things (IoT) data.

2. Concept behind Service Utilizing Transportation Data

Hitachi has developed a new transportation data analysis platform for use in its service for utilizing transportation data. The service supports collaborative creation during the development of new added-value services by road and transportation service operators, among others, as well as helps to formulate measures that enhance convenience for users and improve the operations of these service operators, making their businesses more efficient. This is achieved using formats such as maps or graphs for visualizing IoT data, including origin and destination (OD) and other location information for roads and other forms of transportation, and by subjecting these data to multifactorial analysis (see **Figure 1**).

This service for utilizing transportation data is also oriented toward platforms that have been designed with a view to being further developed into mobility-as-a-service (MaaS), which presents users with a choice of transportation options that best suit their needs.

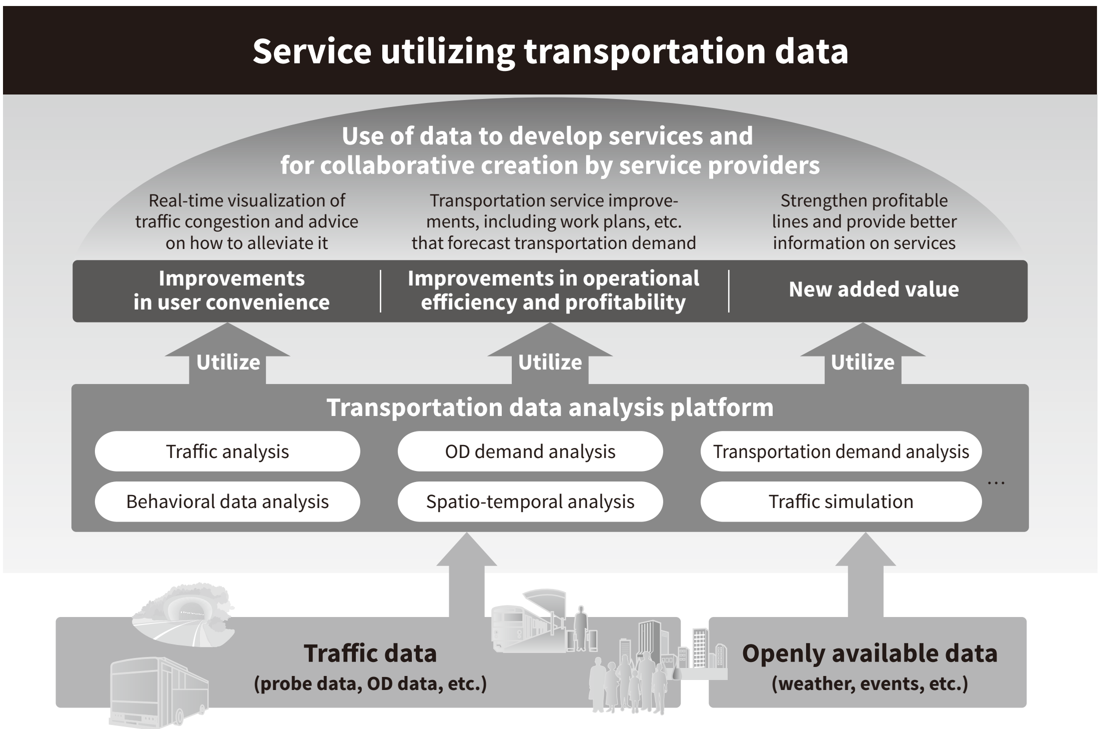
3. Features of the Transportation Data Analysis Platform

3. 1 Structure of the Transportation Data Analysis Platform

To facilitate its use by a diverse range of road and transportation service operators, the transportation data analysis platform uses the architecture of Hitachi's Lumada IoT platform. The platform is made up of five function groups: Edge, for collecting and processing IoT data held by the service operator to standardize its format; Core, for integrating this standardized data; Analytics, to provide the functions needed to analyze road and other transportation data;

Figure 1 — Concept behind Service for Utilizing Transportation Data

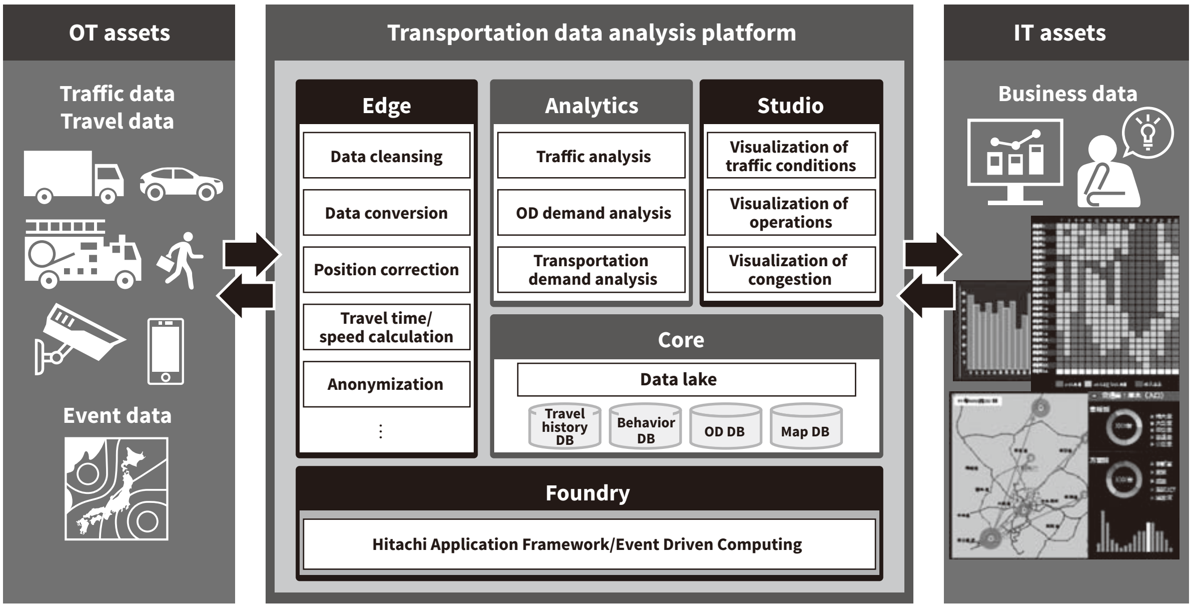
The service helps improve user convenience and enhance service provider operations through the multifactorial analysis and visualization of points of departure and arrival (origin and destination) and other location information held by road and transportation service operators.



OD: origin and destination

Figure 2 — Block Diagram of Transportation Data Analysis Platform

The transportation data analysis platform uses the architecture of Hitachi's Lumada Internet of Things (IoT) platform and is suitable for use by a variety of different road and transportation service operators.



OT: operational technology DB: database IT: information technology

Studio for presenting the results in formats such as maps or graphs; and Foundry, to provide the underlying framework for high-speed analysis of large amounts of IoT data (see **Figure 2**).

3. 2 Suitability for Use with IoT Data from Diverse Applications

The transportation data analysis platform processes large quantities of data of various different types, including openly available data on things like events or the weather, as well as location, OD, and other transportation data.

Accordingly, to enable analysis to be performed efficiently in Analytics, the Edge group for data collection and processing converts the various different sorts of data into standardized formats that can be handled the same way.

Edge also includes a function for correcting positioning information that provides high-accuracy correction for the global positioning system (GPS) positioning errors in the processing of this information.

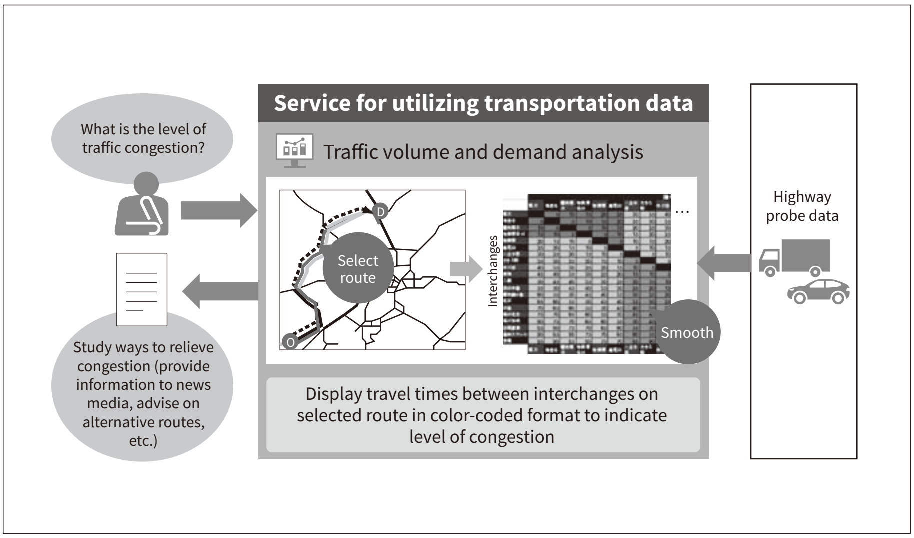
3. 3 Multifactorial Analysis

The standard analysis functions of Analytics are provided in the form of application programming interfaces (APIs). These include an OD demand analysis function that collates information on the rate at which vehicles or people travel between their points of departure and arrival based on the OD, location, and other information collected in the Core data layer; a transportation demand analysis function that collates details such as speeds, travel times, traffic volumes, and transportation conditions on the route being traveled; and a traffic analysis function for tracking the locations and flow of vehicles and people.

Studio includes business intelligence tools that can use these Analytics APIs, providing users with the ability to present the results of analysis in maps, graphs, and other formats.

As the Analytics APIs are also available to external applications, they can be used in ways that are suited to different user requirements or system environments. This can provide the infrastructure for more advanced

Figure 3 — Use by Highway Operators
Probe data and data on vehicles passing through tolling stations (OD information) can be used to assess the level of traffic congestion and study its causes.



operating practices, for example, by integrating the results of analysis by Analytics with existing systems.

3. 4 Use of Distributed Architecture for High-speed Processing of Big Data

The transportation data analysis platform requires performance scalability in order to process large quantities of IoT data in real time. To achieve this, Foundry uses Hitachi Application Framework/Event Driven Computing (HAF/EDC) for high-speed distributed processing.

Furthermore, because HAF/EDC supports automatic expansion in a cluster configuration, services can be scaled up smoothly from the Proof-of-Concept stage to a production system without interrupting operation.

4. Applications of Service for Utilizing Transportation Data

4. 1 Highway Operations

This section describes the use of the transportation data analysis platform for highway operation.

The service provides highway operators with a platform-based analysis environment by building up a data lake in which data on vehicles passing through tolling stations is treated as OD information and Electronic Toll Collection (ETC) 2.0 probe data as location information.

By using the platform's OD demand analysis function, for example, it is possible to use maps or graphs to analyze things like the volume of traffic between tolling stations, volume of traffic departing from an origin tolling station, and the incoming volume of traffic arriving at a destination tolling station. Likewise, the transportation demand analysis function can be used to visualize and analyze factors such as traffic congestion and the time taken to reach a destination, and the traffic analysis function can be used to study the causes of congestion based on information such as changes in the speeds of individual vehicles.

These analysis functions also have potential uses in other highway-related applications such as traffic demand management (see **Figure 3**).

4. 2 Bus Operations

This section describes the use of the transportation data analysis platform for the operation of bus services.

The service provides bus operators with a platform-based analysis environment by building up a data lake in which data on passengers getting on or off a bus is treated as OD information, and bus positions as location information.

By using the platform's OD demand analysis function, for example, it is possible to use maps or graphs to analyze things like the number of passenger trips between bus stops, the number of passengers getting on at bus stops, and the number getting off at destination bus stops. Likewise, the transportation demand

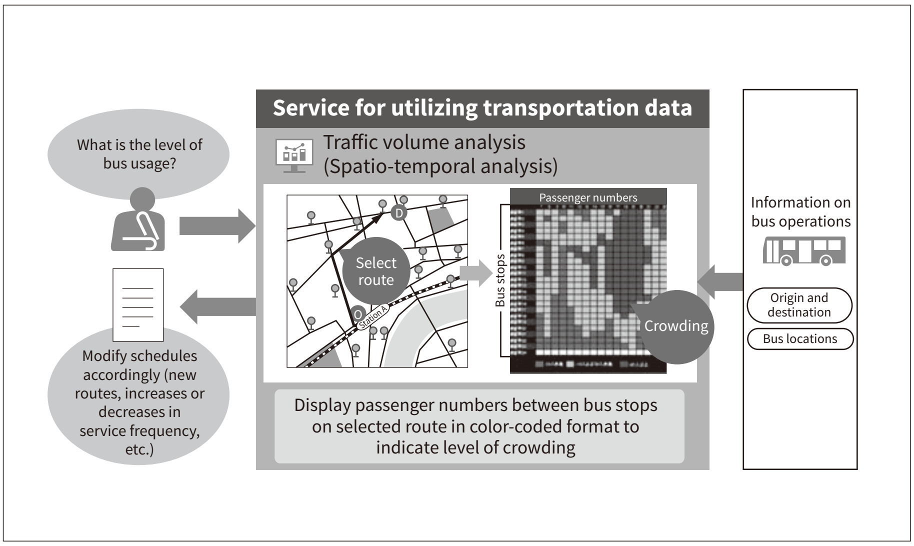


Figure 4 — Use by Bus Service Operators
Data on bus locations and passengers getting on or off can be used to support customer operations such as optimizing schedules based on demand.

analysis function can be used to visualize and analyze the capacity and demand for particular bus routes, and traffic analysis can be used to visualize the operations of individual buses to assess their punctuality.

These analysis functions also have potential uses as planning support tools, such as for revising schedules and routes based on demand (see **Figure 4**).

5. Hitachi's Vision for Future Transportation (MaaS)

Further advances in next-generation transportation services (MaaS) are anticipated around the world. This idea of mobility as a service means thinking of the means of transportation not in terms of vehicles such cars or bicycles, but rather in terms of services that transport people and goods. This opens up the potential for collaboration in ways that transcend past practices, bringing with it a major transformation in how people and goods are transported. In Helsinki, Finland, a city that is working on MaaS initiatives, a smartphone app called Whim* that was developed by MaaS Global Oy provides a common interface from which users can choose, reserve, and pay for a combination of different modes of transportation, including options such as rental cars, taxis, buses, trains, and other public transportation. The available services include an option whereby users choose a package of different forms of transportation to suit their needs that they pay for through a monthly fee.

Implementing MaaS requires the digital integration of mobility services provided by different transportation operators as well as an app that provides users with access to the various different transportation services. Furthermore, to provide the same level of flexibility as owning one's own car, among the most important technologies are those used for collecting, analyzing, and predicting data on transportation operators' services, including availability and demand.

While transportation data has been used in the past, in most cases this has been limited to transportation operators utilizing data they hold themselves. Because MaaS requires managing the data from different transportation operators on the same platform, it is anticipated that this transportation data analysis platform will become a key component.

6. Conclusions

This article has included an overview of a service for utilizing transportation data and described the form that transportation society will take in the future.

In this era, when the IoT and other digital data are transforming social infrastructure and businesses, the development of platforms that can integrate diverse forms of transportation data in ways that users require, and the delivery of services that best meet their needs are becoming crucial challenges.

Based on the service for utilizing transportation data described in this article, Hitachi intends to

* Whim is a trademark or registered trademark of MaaS Global Oy.

contribute to providing safe, secure, and comfortable transportation infrastructure based on trouble-free mobility. It will achieve this by dealing with societal challenges such as resolving congestion and reducing traffic accidents, as well as by meeting the increasingly diverse needs of customers in ways that are closely matched to those needs by using the latest information and communication technology (ICT), including artificial intelligence (AI), to incorporate additional functions such as transportation demand prediction.

Reference

1) Hitachi News Release, "Hitachi Launches 'Transportation Data Utilization Service' for Analyzing/Visualizing the IoT Data of Road and Transportation Service Operators," (Mar. 2018), http://www.hitachi.co.jp/New/cnews/month/2018/03/0314.html in Japanese.

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