# Telematics Service for Commercial Vehicles to Realize Safe Traffic Society

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**As operation management for commercial vehicles, services that use digital tachograph-based devices have become an industry-wide standard. Here a digital tachograph refers to a device approved by the Ministry of Land, Infrastructure, Transportation and Tourism in Japan that records travel speeds and distances of a vehicle as needed. Digital data including travel speeds is used for visualizing the details of vehicle operation and for allowing the operation manager to give guidance on the operations. The data measured with a digital tachograph system have conventionally been recorded on a dedicated card, and then read and analyzed at the office to which the vehicle belongs. The telematics service for commercial vehicles presented in this paper further develops the digital tachograph described above. The service does not require a dedicated card, which is a mobile medium for the recorded data, and uses the FENICS wireless communication network to send the operation data to the cloud center in real time for analysis. At the cloud center, proprietary analysis middleware is used for analyzing the vehicle diagnosis information and driving operations of the driver based on the enormous amount of sensor data. These advanced forms of information and communications technology (ICT) allow unprecedented real-time provision of guidance on driving and hazard prediction.**

## 1. Introduction

The social infrastructure today is sustained by the transportation industry such as logistics that, for example, facilitate Amazon.com's same-day delivery service, as well as public transport like inter-city highway bus services and local bus services. However, serious accidents involving commercial vehicles are becoming a social issue, a recent one being the case that occurred in 2012, where a highway bus driver fell unconscious while driving on the Kan-Etsu Expressway.

Data from the Ministry of Land, Infrastructure, Transport and Tourism (MLIT)[1)] reveal that commercial vehicle accidents per mileage were increasing in 2012, although the number of serious accidents was declining. There is a marked increase in accidents where the drivers are accountable, particularly because of their poor health condition, and accidents like these have almost tripled in the last 10 years. Given this as a context, MLIT is aiming to spread advanced operation management by leveraging information and communications technology (ICT). Here, the advanced operation management refers to a system in which data generated by recording devices equipped with telecommunication capabilities are stored and managed on the cloud, enabling real-time operation management and analyses of drivers' biometrics to send warnings if necessary. A system such as this will be able to prevent traffic accidents.

This paper describes a telematics service dedicated for commercial vehicle operations that utilizes Fujitsu ICT, to prevent serious traffic accidents involving such vehicles and realize a safe traffic society.

## 2. Issues to be addressed

It is important to address driver errors as well as vehicle failures to eradicate serious road accidents.

In order to prevent accidents due to a mechanical malfunction of vehicles, it is crucial to conduct daily inspections before use, but also it is important to monitor travelling vehicles to identify signs of danger in advance.

Regarding the prevention of accidents due to

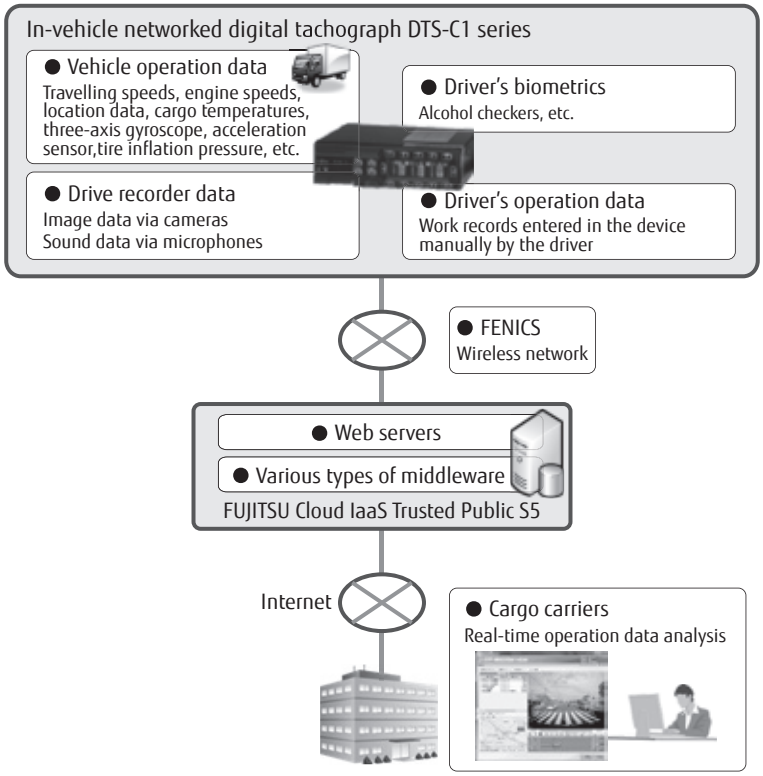


**Figure 1**
**Structure of ITP-WebService.**

driver error, it is necessary to educate drivers about safe driving and control any excessive driving schedules. According to data published by the Ministry of Health, Labour and Welfare, Tokyo Labor Bureau in 2010,[2] 83 cargo carriers operating in Tokyo were examined, and 47% of them were found to be not in compliance with the labor standards regulations.

Taking the above into account, the telematics service for commercial vehicles to realize a safe traffic society must address the following functions:

- Real-time analysis of travelling vehicles to issue an alert when there are any signs of danger
- Real-time monitoring of vehicle maneuvers of driver
- Analysis of working conditions for drivers, including their states of health, and support for giving advice

## 3. System structure

The previous package products for commercial vehicle operation management come at a high start-up cost because many appliances have to be purchased including in-vehicle digital tachograph units, dedicated cables, servers, data card readers/writers, and PCs to upload data from the cards. The system is also complicated to set up. These presented cargo carriers with a major obstacle when they considered introducing the system.

Transtron Inc.[note 1)] strives to lower the threshold for introducing the system, and offers a cloud-based service called ITP-WebService for commercial vehicles, using Fujitsu's networked digital tachograph DTS-C1 series (provided as a service in Japan with the configuration shown below), FUJITSU Cloud IaaS Trusted Public S5[3] for the cloud infrastructure, and the FENICS wireless network service[4), note 2)] (**Figure 1**).

The DTS-C1 series has a conventional digital tachograph and added features that send sensor data to the cloud center via the FENICS network, as described

note 1) A subsidiary of Fujitsu and Isuzu Motors Limited, it is developing new technologies by integrating transportation technology and electronics.
note 2) A service to connect a mobile terminal to a secure wireless network.

below:

1) Vehicle operation data

Travelling speeds, engine speeds, location data, cargo temperatures, three-axis gyroscope, acceleration sensor, tire inflation pressure, etc.

2) Drive recorder data

Image data taken by a camera, and sound data from a microphone

3) Driver's operation data

Data which a driver enters by manually operating the device, recording his/her work hours, breaks and stopovers

4) Driver's biometrics

Alcohol detection, etc.

The sensor data transmitted to the cloud center are analyzed with proprietary analysis middleware for the vehicle and driver operations, and the aggregation middleware uses the outcomes to prepare daily operational reports and visually represent drivers' engagement statuses. Cargo carriers can access and manage an operational data interface and various forms via Web servers using computers connected to the Internet.

This service made it necessary to handle without delay a large amount of data from over 30 000 cargo vehicles as they were generated. To this end, a unit-structure was developed, as shown in **Figure 2**, where one unit handles a few thousand vehicles at a time, and units were added as more vehicles were included in the system. The deployment of Fujitsu cloud infrastructure means that the sudden load increase can be handled by adding servers flexibly. In order to counter unpredictable Web access surges, the load balancer also allows for custom load distributions by adding Web servers. The middleware programs running on the servers for data transmission, analysis, aggregation and other processes can be separated by function. This offers flexibility in terms of unit scale-out as well as server scale-up, making it easy to address performance issues and conduct maintenance and customization.

This is a comprehensive system running on components made by Fujitsu in all aspects of hardware, software and cloud infrastructure. It makes it easier to quickly respond to troubles by ensuring close cooperation between the relevant sectors, and realizes a service that comes at a remarkable price.

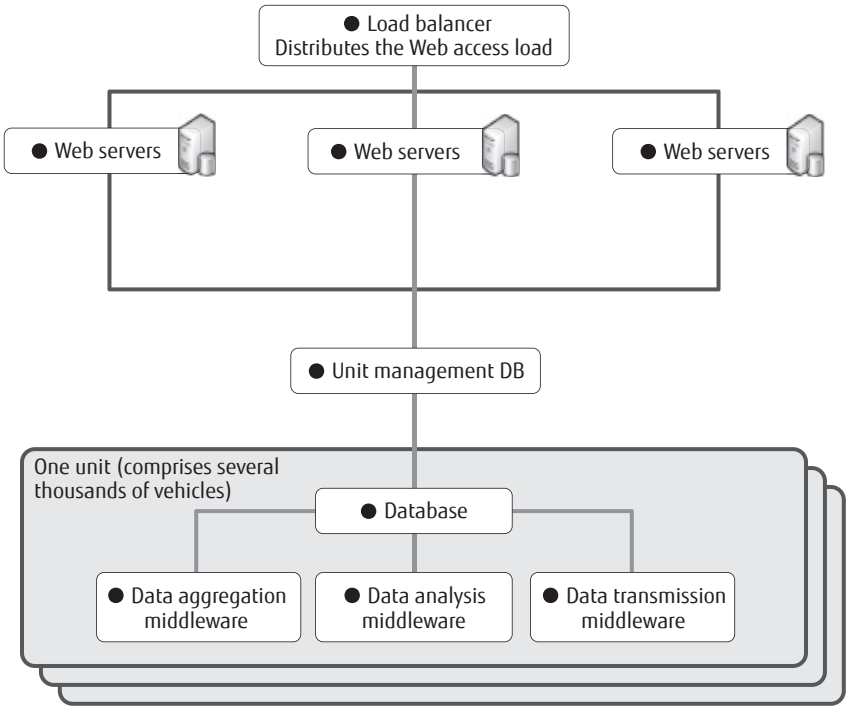


**Figure 2**
**Unit-structure of ITP-WebService.**

## 4. Concierge function for operation managers

Operation managers of cargo carriers have a variety of responsibilities from roll call and vehicle allocation to safety instructions and labor management. They hardly have time to give carefully considered instructions to each driver. The operation management system needs to reduce the burden on the operators while helping them to give efficient instructions. This service provides a concierge function for operation managers to give them support in both vehicle and driver management, as described below:

1) Vehicle perspective

The following points must be ascertained to manage vehicles.

- Daily mechanical inspection
- Tire pressure management
- Oil change
- Routine inspection

Oil change and routine inspection need to be carried out according to a vehicle's traveling mileage and period. The system compares the vehicles' accumulated mileage against preassigned mileage, and the date of the last inspection against the present date, and the system automatically notifies operation managers when an inspection is due, thereby reducing their workload as well as helping to prevent accidents caused by mechanical errors.

Typical vehicles of cargo carriers have 10 tires, and it is mandatory to check their pressures daily. Neglect may result in a serious accident caused by burst tires, and fuel efficiency could be adversely affected if the pressure is too low. The Tire Pressure Monitoring System (TPMS) with dedicated sensors mounted on vehicle tires measures tire pressure and temperature, helping to reduce operation managers' daily workload. The system also prevents accidents as it sends alarms when there is a sudden loss of tire pressure or abnormal tire temperature.

2) Driver perspective

To manage drivers, the following points need to be covered:

- Roll call and instructions
- Alcohol detection
- Labor management
- Overwork control
- Driving operation checks

For end-shift roll call and instructions, the system provides automatically generated daily reports based on data sent from the on-vehicle digital tachograph, together with analytical results on travel speeds, engine speeds, three-axis gyroscope, and acceleration sensors processed on the servers. It displays items of higher importance on the screen so that the managers can give the drivers to-the-point instructions easily. They can also analyze specific drivers' past data stored on the cloud to make references to the drivers' dangerous driving or signs of fatigue.

In relation to measures to prevent drink driving, which has been of particular importance in recent years, they can employ alcohol checkers in the office in combination with mobile-type checkers, and take measurements when the driver is on an overnight assignment. The in-vehicle camera can send images of the drivers' faces. These measures facilitate real-time checks not only on drink driving, but also on drivers' fatigue.

For checks on working hours, the system enables managers to review the time that drivers are on duty, on break and so on for the past day, week and month in real time. This helps them understand each driver's availability and timing of taking a break, serving as a useful reference point to arrange driver shifts.

## 5. Conclusion

Fujitsu's operation management system for commercial vehicles sets out to help cargo carriers with instructions leading to safe and economically viable operations, and to reduce management workload. The system was developed around in-vehicle computers to analyze various types of data of travelling commercial vehicles. The cloud-based service started in 2010, and today it is used by 1500 cargo carriers, handling 35 000 vehicles. Since the launch of the service, biannual system updates have been conducted to incorporate user needs or regulatory trends into new features to offer.

We will continue our efforts for further developing services for commercial vehicles and their drivers, and contribute to traffic safety in society.

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