

## Introduction of the Station Common Network



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A variety of information such as that on train operation and in-station shops is used in a station. Many kinds of systems utilizing information and communication technology (ICT) have also been developed with a view to providing real-time information to passengers and station personnel. We have introduced a “Station Common Network” as an infrastructure for telecommunication systems in Tokyo Station, and that is expected to shorten the construction period, reduce the initial costs of the systems, and provide easy to use of sources of information. In this paper, we describe the purpose, concept, effects, and potential of the “Station Common Network”.

●Keywords: Common infrastructure, Open network, Virtualization technology, Wi-Fi

### 1 Introduction

Diverse information is transmitted and received in a railway station. Such information includes operational information such as train location information and train departure information, business information such as shop guidance for *Ekinaka* in-station commercial facilities and advertisements, equipment and facilities control information, and image information such as that of security cameras. It is thus important to provide customers and station personnel with such information in a timely manner.

On the other hand, a user environment where users themselves can obtain the information they desire from the Internet via smart devices such as smartphones and tablets has been spreading.

In light of that background, we believe we need to develop

and build a network fulfilling the following requirements as a measure for future conveyance of information in railway stations.

- (1) Provides customers with high-speed Wi-Fi service that befits smart devices now in broad use.
- (2) Is a high-speed and large-capacity backbone optical network that is capable of integrating many systems.
- (3) Has a Wi-Fi environment accessible from anywhere in the station.

In this context, JR East introduced to Tokyo Station the Station Common Network with an optical network and Wi-Fi environment and started service for that in all areas of the station in March 2014.

The following will explain the features, effects of introduction, and future possibilities of the Station Common Network.

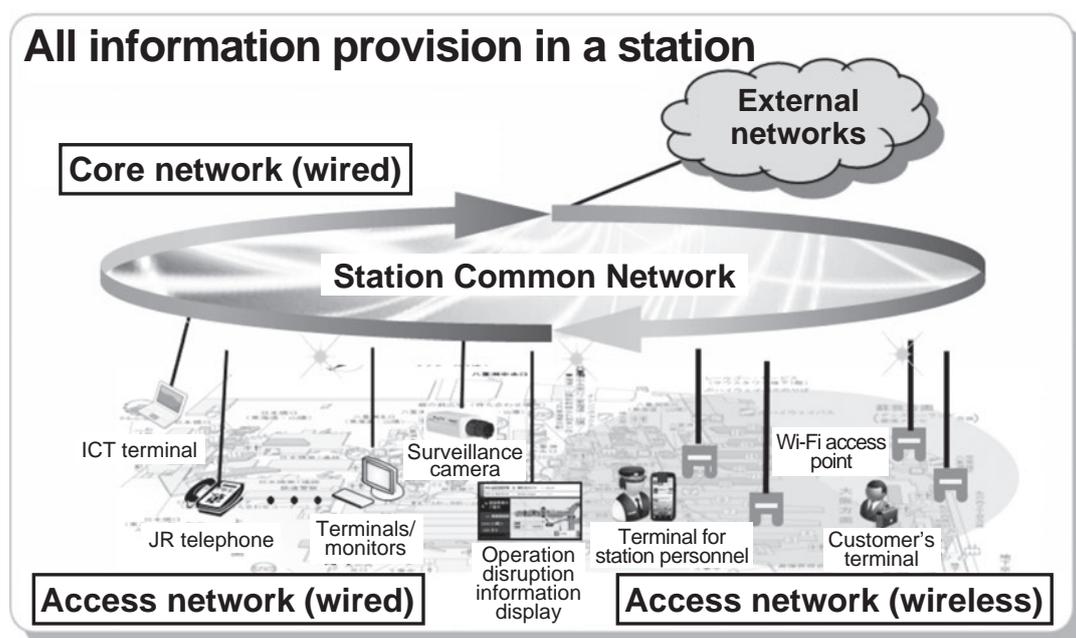


Fig. 1 Station Common Network

## 2 Features of the Station Common Network

The Station Common Network has the following features as an infrastructure for transmitting a variety of information (Fig. 1).

### 2.1 High-speed and Large-capacity Communications

Extremely diverse information is transmitted and received in a railway station. That includes train departure board information, operational information, guide announcements, dispatcher calls, dispatch information, camera images, and advertisements. Moreover, the amount of that information is tremendous. For the Station Common Network, we took into account comprehensive transmission of such information in designing the network channel.

For the wired network, we provide transmission speeds up to 10 Gbps on the core network and up to 1 Gbps on the access network.

The wireless network uses Wi-Fi communications supported by almost all smart devices, with a transmission speed of up to 300 Mbps (theoretical value). Table 1 lists the wireless standards the network supports.

Table 1 Wi-Fi Standards Supported

Standard	Transmission speed	Frequency band
IEEE 802.11a	54 Mbps	5 GHz band
IEEE 802.11b	11 Mbps	2.4 GHz band
IEEE 802.11g	54 Mbps	2.4 GHz band
IEEE 802.11n	300 Mbps	2.4 GHz band/5 GHz band

### 2.2 Open Flow Network

Renovation work is often taking place in a station. Each time that is carried out, obstacles interfering with communication cables need to be relocated and settings of network devices changed. Settings of logic paths often need to be changed too. While physical relocation cannot be avoided, network devices need to be capable of easily changing settings. Furthermore, the system configuration needs to accept easy additions in order to increase the speed of the network to handle increased future

traffic and to expand functions due to addition of components in station renovation.

We thus divided the Station Common Network into a core network layer and an access network layer, aiming to make system configuration change for function expansion easier. As technology to easily handle such change of system configuration, we adopted open flow network technology.

### 2.3 Open Network

For the wired network within the Station Common Network, we used network virtualization technology so network devices and communication cables could be common for each system. And, for easier use by those who introduce the system, we placed access switches at intervals of about 200 m to enable connection of systems at any place in the station.

This can eliminate the need to build a communication infrastructure as was needed individually for conventional systems, thus cutting cost and time of system construction.

### 2.4 Wi-Fi Covering the Whole Station

We expect for Wi-Fi to be used both by customers and station personnel. For that reason, we placed Wi-Fi access points to cover the whole area of the station backyard including offices as well as the area where customers walk. The coverage area of each access point is overlapped to allow handover, achieving seamless use in a wide area of the station (Fig. 2).

In order to avoid interference of radio channels and enable batch control of those Wi-Fi access points, we adopted a Wi-Fi controller.

### 2.5 Improvement of Failure Resistance and Reliability

As different systems are incorporated in the Station Common Network and a huge amount of data is transmitted, there are concerns that the impact of a network failure could be very significant.

Thus, to improve the failure resistance, we made the components redundant and communication paths duplex for the core network of the Station Common Network. The introduction of open flow technology explained in 2.2 allows

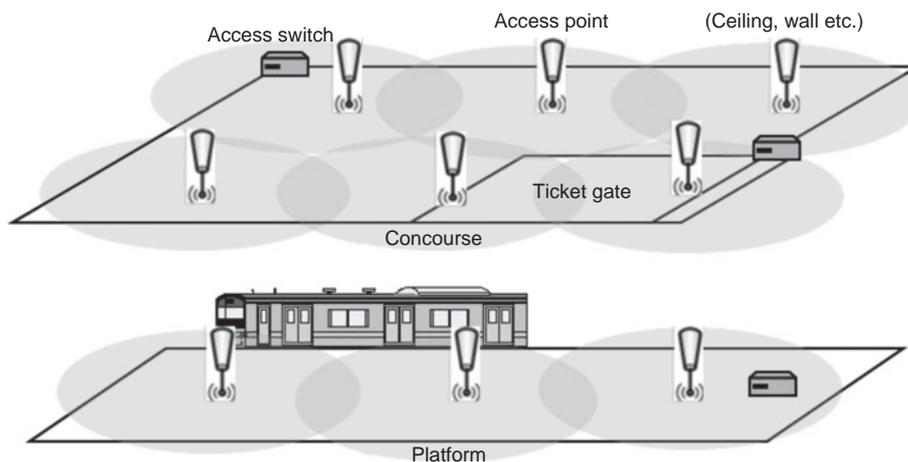


Fig. 2 Conceptual Image of Wi-Fi Coverage

automatic setting of bypass paths in case of congestion or failure as well as priority control, thereby improving reliability as well.

### 2.6 Simplification of Operation and Maintenance Work

In case of a network failure, accurate isolation of the point of failure is important to reduce downtime of the systems.

For better maintainability, we introduced to the Station Common Network a monitoring device that allows visual confirmation of the communication channels and resources (Fig. 3).

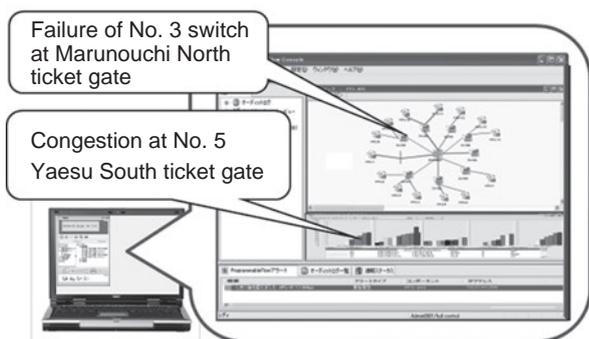


Fig. 3 Example of Monitoring Device Allowing Visual Check

## 3 Services Provided and Their Effects

The services provided in Tokyo Station by the Station Common Network up to May 2014 were as follows.

### 3.1 Hotspot Service

The volume of data in communications has been increasing with the popularization of smart devices and as rich content such as images and movies has come into wider use in recent years. The Ministry of Internal Affairs and Communications announced that the mobile data traffic in Japan is increasing by approx. 1.6 times a year.<sup>1)</sup> Mobile phone carrier networks are becoming strained, so the carriers offer high-speed Wi-Fi environments to offload some of that data volume.

In Tokyo Station, four mobile carriers (Softbank Mobile, NTT DOCOMO, KDDI, and Wire and Wireless) offer hotspot services using the Station Common Network. The services are highly appreciated, with many users commenting that you should go to Tokyo station if you want to use your smartphone with stress-free smoothness.

### 3.2 JR East App

The JR East App for which service started on March 10, 2014 via high-speed Wi-Fi can be used on the Station Common Network. The app enables timely provision of train operational information, train departure information, in-station information, and the like.



Fig. 4 JR East App

### 3.3 Own Positioning Identification System

In a large-scale station like Tokyo Station, there is a need not only for a station map but also for a service showing the current position of the user. However, correct positioning using GPS is impossible in a station because there are many places where GPS does not work well such as underground and in shielded locations. In light of that, the Station Common Network has achieved a function where the current position of the user is indicated on the user's smartphone (Android device) using the location information of Wi-Fi access points, and this function has been incorporated in the JR East App, described in 3.2 (Fig. 5).

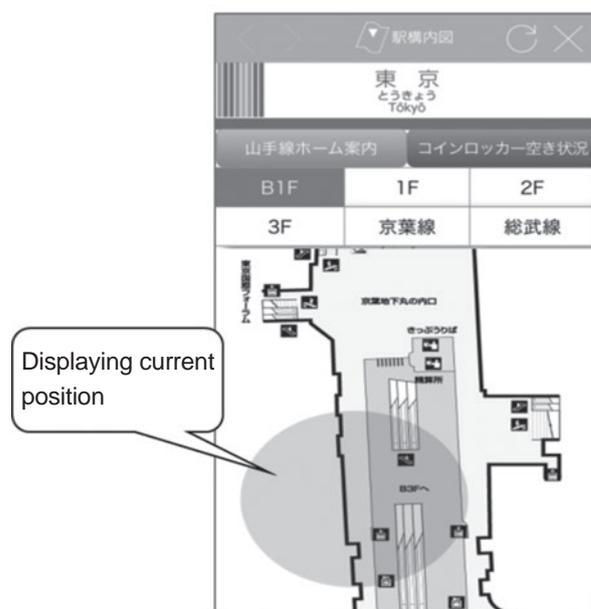


Fig. 5 Current Position Display System

### 3.4 Movable Display System

In fiscal 2014, we carried out field tests of a movable display system that can be transported to where it is needed to show train operational information and other information (Fig. 6). The system uses the wireless network of the Station Common Network as its communications channel, and it was utilized for guidance for passengers at the New Year's holidays and in other busy seasons.



Fig. 6 Movable Information Display System

### 3.5 Suica-compatible Locker Availability Information

We offer a service where information on availability of station lockers is delivered to a user's smartphone. Although the service has been offered since before the introduction of the Station Common Network, its costs have been reduced by connection to that network. We were able to reduce the number of the lines for which a contract with an Internet provider is needed from one for each set of lockers to a single line by centralizing the Internet connection to the Station Common Network.

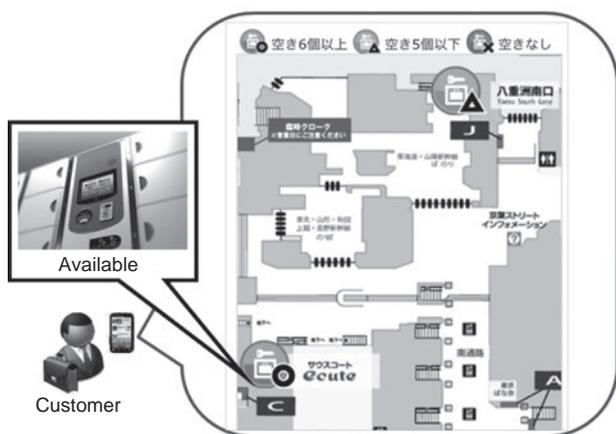


Fig. 7 Suica-compatible Lockers

## 4 Future Outlook

By introducing the Station Common Network to Tokyo Station as network infrastructure, we became able to quickly promote measures using ICT technology, eliminating the need to build a separate network for each individual measure. We have also been able to confirm the effect of internal and external needs for Wi-Fi being met.

We will thus consider the possibility of expanding the area for Station Common Network to stations and lines where the benefits of the service are large as in Tokyo Station.

At the same time, we will work out the factors required to promote utilization of the Station Common Network with an aim of improvement and expansion of the services.

One issue that needs to be dealt with is concentration of information of multiple stations, without being limited to a specific station. That would allow us to improve accuracy of information and convenience in providing train location information and operational information. We have to consider a method of connecting the Station Common Network of multiple stations, as greater effects will be gained by concentration of information.

Possible solutions include utilizing JR East's own JR-IPNet network and building a network configuration of multiple stations using optical cable between stations. We intend to further investigate the individual solutions.

## 5 Conclusion

Full-scale provision of services in Tokyo Station by the Station Common Network has just started, but we have already been able to enjoy its usefulness with many services. We believe that the value of that network as a common infrastructure will further increase as more systems are connected.

In order to improve JR East customer service and facilitate decision support and transformation of station personnel duties, we will make efforts to further improve the Station Common Network.

### Reference:

- 1) Ministry of Internal Affairs and Communications, *Current situation of the mobile communication traffic in Japan* (March 2014)