The Frontier Service Development Laboratory is undertaking research and development on a method for easy-to-understand information provision to railway users. This article will introduce InfoPic, an information system we developed with an aim of providing information to individual passengers on trains, particularly individuals using mobile phones. We have continuously worked on providing information to individual passengers onboard since the development of a demonstration system in FY 2006, and in FY 2009 we installed the system on the MUE-Train test train and connected it to the actual train control system. System operation tests demonstrated that the system could obtain data from the actual train control system without problem and continuously update and deliver data to mobile phones while running. Service evaluation by test subjects also proved that the high level of acceptability of content provided.

Keywords: Information service, Information technology (IT), Mobile phone, Wi-Fi, Near field communication (NFC), Information design

1 Introduction

At the Frontier Service Development Laboratory, we are aiming to achieve service not only at points (stations) but also in lines (railways). Our goal in those efforts is to "conduct R&D on innovating station and onboard services by cutting-edge technology and a customer perspective and achieving secure structures to support that."

This article will introduce InfoPic (Information Providing System for Individual Customers), an information system we have developed for onboard information provision that is indispensable for linear information provision, particularly information provision to individual users.

2 Concept of the Research

Fig. 1 illustrates the concept of this research. In general, we can say that passengers on trains are restrained in time and space. The flow on the left side of Fig. 1 shows things we aimed for in improving convenience by providing information on operation and transfers in such a restrained situation and for reducing stress due to lack of information in operation disruptions.

In contrast, the flow on the right side of Fig. 1 is based on a perspective that such a situation can be a business chance. Specifically, cabins can become beneficial information spaces by providing information on the area along the line and entertainment information. What is new about this system is that it provides information from the train to mobile phones of individuals according to the location, time and travel direction of the train.

3 Development History

Fig. 2 shows the history of development in this research.

Development started in FY 2006. In FY 2007, the demonstration system was presented in a conference of the Research and Development Center and the CEATEC JAPAN comprehensive exhibition cutting-edge IT and electronics. Through those presentations, we were able to confirm how great the need is for services we were aiming for in this development (Fig. 3). Accordingly, we launched in FY 2008 full-scale development of a system to be installed to actual trains. The system was installed to the MUE-Train test train in FY 2009, and we checked operation and details of services.
4 Overview of InfoPic

4.1 System Configuration

Fig. 4 shows the configuration of the system installed on the MUE-Train. InfoPic is the name of the system for providing to mobile phones via the onboard IT server and train information controllers information obtained from the train control system. The main feature of this system is that it uses a FeliCa IC chip reader/writer (R/W) or Wi-Fi access points on the train to provide information to mobile phones of passengers.

When we introduced this development project in Summer 2008 issue of JR East Technical Review (Japanese version only), we assumed that we would use infrared communication as a means of wireless communication. But smartphones exemplified by iPhone have recently been gaining popularity. The infrastructure for Wi-Fi is thus rapidly increasing since those come standard with a Wi-Fi function. In light of that situation, we have decided to use Wi-Fi instead of infrared communication.

As for the method of obtaining information with a reader/writer, we used ToruCa, a function built into NTT DOCOMO mobile phones.

We developed in this research the part of the system within the dotted line in Fig. 4. The core of the system is the onboard IT server. The server collects from the train information controller (MON8 for the MUE-Train) data such as the schedule of the train and passenger load factor that can be used for information services for passengers as well as operation information from our data center and ATOS (Autonomous decentralized Transport Operation control System) data. The IT server then has the job of processing that data into easy-to-understand screens for passengers. The processed screens are transmitted through onboard information control terminals to VIS (Visual Information System) already used on the Yamanote line and other lines, Wi-Fi access points and FeliCa control terminals.

4.2 Information to be Provided to Mobile Phones

This section will cover the type of information that the InfoPic system can provide to individual passengers. Sample screens for mobile phones (mobile phones with IC chips and smartphones with Wi-Fi functions) are also shown. Fig. 5 shows the initial screens to be displayed when the mobile phones obtain information.

(1) Guide to Stops and Transfers

Information on stops ahead of the present location is shown on the screen with scheduled arrival time for each of those (Fig. 6). This utilizes data of the schedule for rolling stock usage intended for drivers. For transfer stations, users can also check information on connecting trains including any delay information (Fig. 7). Such a service is possible by utilizing onboard ATOS information intended for conductors.
(2) Operation Information and Proof of Train Delay
We enabled train operation information displayed on VIS screens to be shown on the mobile phones (Fig. 8). Locations of trains before and after the present train are also shown along with operation information for the train and line the passenger is currently using. While still just an idea, we are also considering allowing proof of train delays to be issued onboard (Fig. 9).

(3) Cabin Information
Information on items fluctuating in real time such as the passenger load factor and room temperature transmitted from the train information controller is shown along with fixed information such as the location of the ladies-only car and mildly cooled car (Fig. 10).

(4) Information on Locations along the Line
One idea for content taking into consideration the flow of the system concept on the right side of Fig. 1 (new business) is showing information on shops along the line and coupons on mobile phone (Fig. 11, virtual information). The method for distribution of the information of this type is still under consideration.

5 System Operation Check on MUE-Train, Evaluation and Verification of Service
We equipped a MUE-Train with the developed InfoPic system and implemented system operation checks for the four days of July 21 and October 19 to 21, 2009 in the section between Minami-Furuya Station and Osaki Station on the Saikyo line. We also evaluated and verified the service on the MUE-Train and with a mockup train laboratory of the manufacturer with which we conducted joint development.

(1) System Operation Check
We checked whether the system could properly work in the flow from obtaining information from the MON8 train information controller of MUE-Train, adding dummy operation information, ATOS information for conductors and advertisement and coupon information according to the current location, then delivering such information to mobile phones. We confirmed stable operation of the system while running with data for items fluctuating in real time such as the passenger load factor and room temperature that are sent to the IT server every second and static data such as the schedule for rolling stock usage that are sent at every update.

(2) Evaluation and Verification of Service
In the above-mentioned system operation check, 18 employees of JR East evaluated the details of the service. Fig. 12 is a photo.
of the system components on the MUE-Train and Fig. 13 is a photo of service evaluation by our staff members.

Fig. 12 System Components  Fig. 13 Evaluating Service

The evaluation method is as follows.
· Inform the test subjects of the test situation, assuming that they have taken a train at Musashi-Urawa Station on the Saikyo line and are going to Yokohama Station.
· Give tasks to each subject as the train travels and have them obtain information both with an IC mobile phone and a smartphone with Wi-Fi.
· Assign interviewers for each subject and conduct interviews and ask questions between tasks.

Six tasks each were given for using a mobile phone with IC chip and smartphone with Wi-Fi function as follows.
[Task 1] Obtain information.
[Task 2] Check the travel time to Osaki Station.
[Task 3] Something has happened. Check the onboard information display and obtain further related information using the mobile phone.
[Task 4] You are nearing the transfer station. Check the departure train time on the line to transfer to.
[Task 5] Check the level of congestion for the present train.
[Task 6] Check for information on locations along the line.

Fig. 14 (a) shows the five-level rating results for each task performed by staff members. Positive values are positive responses and negative values are negative responses.

Those test subjects gave balanced responses for each task overall, and they too showed slightly higher acceptance of Wi-Fi as a method of acquiring information. Information on locations along the line received somewhat low favor.

We omit diagrams per attribute because of space limitations, but here are some characteristic responses.
· Elderly people: High acceptance of operation and transfer information
· Housewives: High acceptance of schedule time information and cabin information
· Students: High acceptance of information in general, including information on locations along the line
· Company employees: Response tendency was similar to the total average.

6 Future Schedule

We will proceed with development from FY 2010 onward for the following two goals.
(1) Introduce the system to actual trains
We will develop a low-cost and expandable system with an aim of introducing the system to commuter trains in the future. We are also considering field tests of the system on trains in commercial service in FY 2011.

(2) Expand rank and scope of service
The rank of service provided to passengers should be built on safety and security, followed by convenience, comfort and enjoyment (Fig. 15). We have developed service content mainly for the areas of safety and convenience so far, so we will consider deploying content to other service ranks.

Also, we will use the Smart Station laboratory and the 209 series cars set up in that laboratory (called the Smart Train) to go forward with research and development to expand the scope of personal information provision to platforms and in-station spaces in addition to the train (Fig. 16).

Fig. 15 Service Rank and Area Aimed at in the Development

Our final goal is to build an environment where we can offer personalized information services according to the location in our total business space such as on train, on the platform, in the station and in in-station shops. Through that effort, we hope to make the system a tool to utilize the overall strengths of JR East.