Aiming at improving information services for passengers, we have developed a system to deliver to smartphones of passengers on trains according to their present location real-time railway operation information and information on the area along the line. That system was installed on a train on the Yamanote Line for field tests on information delivery with the “Yamanote Line Train Net” service for about a month from October 2011. The system worked stably for the most part throughout the test period. Access logs revealed that more people than expected used the system, and a questionnaire survey confirmed that the service was highly appreciated. This article will mainly introduce the configuration of the developed system and an overview of the field test.

**Keywords:** Smartphone, Wireless LAN (Wi-Fi), WiMAX, Information service, Information design

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### 1 Introduction

JR East has been working on research and development for improving in-cabin comfort and amenity, with the aim of achieving improvement of customer satisfaction as declared in the JR East Group Management Vision 2020. Regarding information services, trains on many lines have been provided with services to provide information to all passengers onboard using LED or LCD displays in the cabin.

As utilization of smartphones has been increasing in recent years, and high-speed and large-capacity communications environments also have been developed, we see an emerging environment where detailed and diverse information can be delivered according to passengers’ individual needs.

Under these circumstances, the Frontier Service Development Laboratory installed the infoPiC* onboard information system for individuals to a train on the Yamanote Line and tested that “Yamanote Line Train Net” information service for about a month from October 4, 2011. In this field test, we conducted a questionnaire survey for passengers and collected access logs for content provided to assess and analyze the service.

*infoPiC: Information Providing System for Individual Customers

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### 2 Concept of the infoPiC Service

Fig. 1 illustrates the concept of the infoPiC service.

The fundamental premise is that the onboard space is a location where restriction of passenger’s activities cannot be avoided. There could be many possible approaches in regards to this premise, and we believed that the approach of information services utilizing ICT could potentially improve customer satisfaction regarding railway use.

(2) Fostering New Business

By our delivering content such as books and movies and campaign information and coupons of in-station shopping malls and shops along the line, passengers can obtain timely information according to locations and make better use of time on the train. From the perspective of content suppliers, the cabin will be a valuable space to deploy new business.

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### 3 System Configuration

Fig. 2 shows an overview of the configuration of the developed infoPiC onboard system. infoPiC is the collective term of the system...
components such as a personalized information supply controller, Wi-Fi access points and WiMAX antennas. Those are connected to the existing media terminals that control onboard displays.

Passengers can connect to the personalized information supply controller using smartphones via Wi-Fi and see the content stored on that controller.

There are two routes for the data the personalized information supply controller obtains. One is via the onboard train information management system (TIMS). TIMS is connected to conventional line digital train radio to receive operation and delay information from the wayside at fixed intervals. TIMS itself has information on its current location and cabin condition (congestion level, room temperature). That data are transmitted to infoPiC.

The other route is via WiMAX. InfoPiC receives marketing information (information on the area along the line, coupons, etc.) through this route and delivers it via Wi-Fi to passengers' terminals after processing the accumulated data.

With these features of infoPiC, the following onboard information services will be newly achieved:

(1) Direct information delivery from the train to terminals of individual passengers onboard
(2) Delivery of optimal railway operation and marketing information according to the current location and situation
(3) High-speed content delivery via Wi-Fi

In the field test system, the content was stored in an onboard device, and the passengers' smartphones could obtain only content data in that device. In other words, while accessing the onboard network, passengers could not access the Internet.

4 Overview of Content

This section will introduce the design concept of the content delivered by infoPiC and the overview of the content.

4.1 Design Concept

(1) Initial Screen with Balance of Content Displayed
As previously mentioned, the content this system delivers is separated into railway operation information and marketing information. On the initial screen, easy-to-find and balanced layout of those two groups of content on one screen is important (Fig. 3).

More specifically, the top half is allocated for railway information and the bottom half for marketing information, with three icons each. Background colors are also differentiated to easily identify which content group the displayed information is for.

(2) Constantly Displayed Current Location
The current location is always on the top, regardless of which content screen is viewed. That is done so passengers can enjoy the content without worrying about missing their stops by knowing their current location and to make them aware that the service delivers dynamic content according to the location.

4.2 Railway Information Content
Content related to railway operation is as follows.

(1) Operation Information
This displays operation delay or disruption information for lines in the greater Tokyo area if any (Fig. 4). This information is already provided on the onboard LED or LCD displays, but the difference is that passengers can obtain such information when they need it. The screen is designed to display information about the present line (the Yamanote Line in Fig. 4) always on the top.

(2) Stops and Transfers
This consolidates basic railway information such as stops on the line, platform facilities of each station, and transfer information (Fig. 5). The system can display operation delays down to the minute on the transfer guide screen. This feature was achieved by making use of the information for the conductor's announcements transmitted to trains from the Autonomous Decentralized Transport Operation Control System (ATOS).
(3) Cabin State
This displays real-time changes in information on each car of the train, such as the congestion level and cabin temperature from TIMS, and fixed information such as which cars have wheelchair spaces and reduced air conditioning. (Fig. 6)

Fig. 6 Cabin State Screen

4.3 Marketing Information Content
The content introduced here was content delivered in the “Yamanote Line Train Net” field test in October 2011.

(1) News About Area Along Line
News and event information related to the area along the line was classified in six separate areas (Tokyo, Ueno, Ikebukuro, Shinjuku, Shibuya, and Shinagawa areas) and delivered (Fig. 7). Scrolling area-related news was displayed at the center of the initial screen.

(2) Entertainment Information
E-books, movies, and other entertainment content that could be enjoyed on the train was consolidated here. That included movies of skits by comedians and electronic editions of magazines and comics (Fig. 8).

Fig. 7 Area News Screen

(3) Movie Ads Linked to Onboard Ads
Seeking new possibilities for advertising, we delivered commercials linked to adds on LCD displays above the doors (Train Channel) and the hanging ads (Fig. 9). The service was named Train Channel+, to signify that it evolved from Train Channel.

Fig. 9 Train Channel+ Screen

(4) Information on In-station Malls, Shop Coupons, and Promotional Campaigns
We delivered information on in-station shopping malls along the Yamanote Line and coupons for those shops along with information JR East Group promotional campaigns. To make information more searchable, that on shops at nearby stops was displayed with priority (Fig. 10).

Fig. 10 Commercial Information Screen
To assess and verify the services delivered by the system, we equipped the infoPiC system to a train on the Yamanote Line and carried out a field test.

5.1 Test Overview
For about a month from October 4 to November 2, 2011, we installed the infoPiC system to a train on the Yamanote Line and carried out a field test called Yamanote Line Train Net. As shown in Fig. 11, we announced the test and encouraged passengers to take part in the test using ads inside the test train (stickers, hanging ads, displays above doors) and ads on the car body.

5.2 Method of Providing Information
Users could access all the content free of charge by accessing the onboard Wi-Fi network and opening a dedicated app or a browser. The content delivered was as introduced in section 4. In order to have as many people as possible participate in such a small-scale test using only one train for one month, we took the following measures other than advertising on and in the train.

(1) Opening a Train Net Official Website
We opened a website to introduce Train Net (Fig. 12). That site introduced the service offered, explained how to access the onboard wireless Wi-Fi network, had a link to the download site for the dedicated app, and indicated the current location of the test train to allow users find the train. Location information was delivered by making the train periodically upload its current location to a server on the Internet.

(2) Distributing Dedicated App
We developed a dedicated app for both iPhone and Android devices for free downloading. In particular, we designed the iPhone app to display different content according to whether or not the iPhones was connected to the onboard Wi-Fi network. The screen on the left of Fig. 13 was a screen for the iPhones connected to the onboard network, and it is the same initial screen as the explained in section 4. The screen on the right of Fig. 13 was a screen for iPhones not connected to the onboard network. It showed the location of the test train and procedures to receive onboard information such as how to connect to the onboard network.

5.3 Test Results
The results of the field test for about a month can be summarized as follows.

5.3.1 System Assessment
We developed a system that connected to an actual TIMS. We were able to confirm that the system could stably receive data such as current location information and congestion level without affecting train operation. The system to deliver the received data to smartphones worked stably too.

However, we found from the questionnaire survey and comments on Twitter that many participants were dissatisfied with not being accessible to the Internet while accessing the system network.

5.3.2 Access Log
The details of access logs for the one-month test period were as follows.

(1) Number of Service Users
The number of unique users was approx. 33,000, and the number of accesses to the initial screen of Train Net displayed onboard was approx. 240,000 in total (daily mean approx. 8,000). The number of downloads of the app for iPhones was approx. 12,000 and for Android terminals approx. 6,000.

The number of accesses to the Internet website reached approx. 540,000 in total (daily mean approx. 18,000), indicating a high degree of interest in this service test.

(2) Attributes of Users
Fig. 14 shows information on the attribute of users. It was found that more than 80% of users were male. Concerning the age composition, users in their 30s had the highest proportion, followed by users in 40s and 20s. Those users accounted for
nearly 90% of the total users. By occupation, it was found that approx. 80% of the total users were company and public employees.

(3) Number of Times Content Was Displayed

Fig. 15 shows the numbers of times each of the six icons on the initial screen displayed onboard were clicked and the button for details of news about the area along the line was clicked.

The most selected information was found to be cabin state, and that was followed by commercial information and stops and transfers.

Sorted by gender, the top three types of content selected were as follows:

[Male]

[Female]

The results indicate that male users had relatively higher needs for railway information, while female users were more interested in marketing content.

(4) Content Views by Time

Fig. 16 shows the number of times the initial page of onboard content was displayed per hour (actual numbers on the vertical axis not disclosed).

We found that the peak was 8:00 - 8:59 in the morning, and the second peak came in 18:00 - 19:59 in the evening. Separated by gender, the evening peak for female users was 18:00 - 18:59 and for male users 19:00 - 19:59, while the morning peak was the same at 8:00 - 8:59.

5.3.3 User Questionnaire Survey

In the one-month proving test, we carried out a questionnaire survey for 100 subjects recruited through a research company. Fig. 17 is the overview of the survey.

<table>
<thead>
<tr>
<th>1. Survey method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaire survey conducted for subjects recruited in advance</td>
</tr>
<tr>
<td>Recruited persons who meet the conditions used Train Net twice or more in the monitoring period and replied to the questionnaire.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total of 100 male and female smartphone users in their 20s to 40s who use the Yamanote Line once or more a week</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>iPhone</th>
<th>20s</th>
<th>30s</th>
<th>40s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>9</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Female</td>
<td>8</td>
<td>9</td>
<td>8</td>
</tr>
</tbody>
</table>

Fig. 17 Questionnaire Survey Overview

(1) Assessment of the Initial Screen

90% of the respondents replied it was “easy to find the desired information.” In the free comments field, some commented that “indicating the next stop was convenient,” while some female respondents said “the design is not refined.”

(2) Assessment of Railway Information Content

For each type of content, we asked the following three questions.

- Was the content shown new to you?
- Did you find the content shown useful?
- Was the information that which you would like to use?

Table 1 shows the rate of the replies “yes” and “yes to some extent” to those questions.

Table 1 Assessment of Railway Information Content

<table>
<thead>
<tr>
<th>Operation information (delay, suspension)</th>
<th>57 %</th>
<th>95 %</th>
<th>85 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guide to stops and transfers (station information)</td>
<td>55 %</td>
<td>86 %</td>
<td>79 %</td>
</tr>
<tr>
<td>Guide to stops and transfers (platform facilities information)</td>
<td>66 %</td>
<td>95 %</td>
<td>88 %</td>
</tr>
<tr>
<td>Guide to stops and transfers (transfer train timetable)</td>
<td>70 %</td>
<td>92 %</td>
<td>84 %</td>
</tr>
<tr>
<td>Cabin state (congestion level, cabin temperature)</td>
<td>93 %</td>
<td>81 %</td>
<td>74 %</td>
</tr>
</tbody>
</table>

n=100
For information that was familiar to users such as operation information and stations/platform guides, around 60% replied that it was “new”, while more than 90% found the cabin information screen that indicated the congestion rate and cabin temperature to be “new”.

However, for content that was useful or that subjects would want to use, operation information, platform facilities guides, and train timetable for transfer ranked high. For the cabin condition information, many respondents commented they would “like to view before getting on the train.” These results were as we anticipated, but we were able to confirm that passengers would find such information accumulated on trains useful. We will accordingly discuss how to provide such information in stations and on platforms.

(3) Evaluation of Marketing Information Content
For in-station shopping mall information, coupon information and ads from JR East in the marketing information content, we asked the following three questions:
- Do you find it good that this information is provided as content?
- Do you feel you would like to use the service when you see this information?
- Will you need this information when the service is started?

Table 2 shows the rate of the replies “yes” and “yes to some extent” to those questions.

<table>
<thead>
<tr>
<th>Information Type</th>
<th>Good to have</th>
<th>Would like to use</th>
<th>Need when starts</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-station shopping mall information</td>
<td>88%</td>
<td>71%</td>
<td>71%</td>
</tr>
<tr>
<td>Coupon information</td>
<td>93%</td>
<td>77%</td>
<td>85%</td>
</tr>
<tr>
<td>Notices from JR East</td>
<td>78%</td>
<td>67%</td>
<td>66%</td>
</tr>
</tbody>
</table>

We found that coupon information was highly appreciated. For the in-station shopping mall information too, approx. 70% of total respondents replied they feel they would like to use the service when seeing this information. Therefore, we can conclude that the information service proposed in this research will be sufficiently effective for delivering marketing content.

(4) Overall Assessment of the Service
To the question “what is your total assessment of Train Net after using?” 85% of the respondents gave positive assessments of “good” or “relatively good”.

The field test verified the stability of the system and the high demand for an onboard information service for individuals. In light of that, we have improved the system configuration and content in view of actual implementation (for example, enabling access to the Internet while accessing the network), and we carried out the second field test on the Yamanote Line from September 2012 to January 2013.

As explained herein, the developed system is a dedicated onboard information service system. In the future, we intend to expand the scope to beyond just cabin spaces, conducting research and development with the aim of building an information platform that can deliver information according to time and place on all flow lines of passengers including those on platforms, in stations, and on the town (Fig. 19).

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**Reference:**