Improved Passenger Services for Local Existing Railways — Uchibo Line Transportation Management System (Operation Control and Passenger Services) —

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OVERVIEW: Existing local railways constitute complex transportation infrastructures encompassing a range of station scales from tiny unmanned stations to large regional hubs. Boosting the operational efficiency of local railway operating companies calls for flexible traffic control systems that accommodate the full range of small-to-large station operations. Today even smaller unmanned stations are demanding the passenger information services that until now have only been available at the larger stations. Hitachi, Ltd. is a leader in the development of robust traffic control systems for local existing railways that promote safer, more secure transportation, and also accommodate the diverse needs of railway operating companies. Leveraging Hitachi's expertise and accumulated knowledge in cutting-edge information technologies, we are developing innovative systems tailored for existing local railways. Focusing on the specific needs and concerns of local rail companies, these systems can be installed on a station-by-station basis for a cost-effective phased deployment.

INTRODUCTION

MUCH effort has gone into the development of train traffic control systems — the nerve center of rail dispatch operations — to streamline dispatch work and procedures, to improve passenger services, and to ensure safe, secure rail transportation. But more recently, rail companies are calling for broader-range operational efficiency enabling better management of

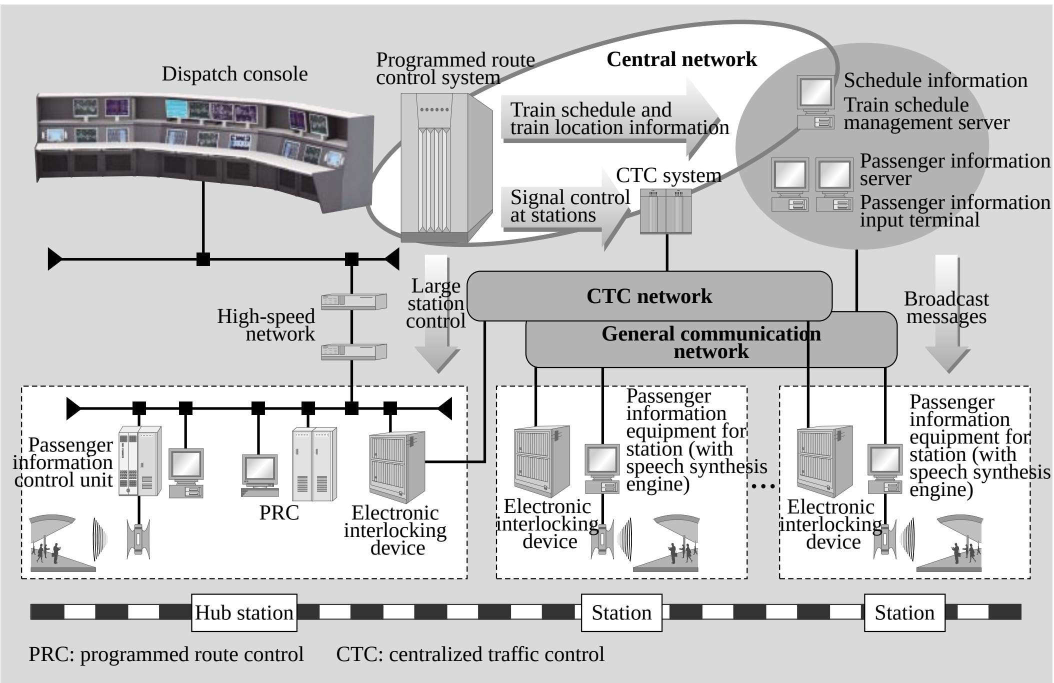

Fig. 1—System of Local Existing Railways Schematic.
Leveraging the latest IT (information technology) advances, a new system has been developed that upgrades and improves the efficiency of dispatch operations of local existing railways.

an entire rail line's large-scale and complex system of stations and upgraded information services. Hitachi has addressed these evolving needs of the rail operators by flexibly expanding train traffic control systems, upgrading system capabilities by incorporating the latest IT (information technology) advances, and developing robust and innovative systems tailored for local existing railways. Here we will highlight some of these local system initiatives shown schematically in Fig. 1 by focusing on the Uchibo Line, a railway line operated by East Japan Railway Company (JR East) on the western shore of the Boso Peninsula.

TRAIN TRAFFIC CONTROL SYSTEM

The traffic control system is a system that monitors the location and status of trains and controls routes based on the train schedule. The Uchibo Line serving the 21 stations between Hamano and Tateyama and the system also provides programmed route control for trains entering and leaving the line at Kisarazu and Tateyama hub stations. The basic challenge of this project was to integrate a decentralized PRC (programmed route control) system based on the hub station Kisarazu into the existing Uchibo traffic control system which is based on the usual centralized architecture.

Train Traffic Control System Configuration

The central PRC system supporting route control for the Uchibo Line is installed in the main operation control center. Movement and status for all the trains on the entire line are tracked on monitors in the operation control center, which also has the ability to alter the train schedule as required. As illustrated in Fig. 2, the train schedule is received daily from the integrated railway operation system that maintains the master train schedule for all JR East lines, and this schedule can be flexibly modified to accommodate extra trains and other situations.

The typical arrangement in existing systems is to remove the larger stations with many routes and station-based trains from the central PRC system, and conduct signal control and schedule management on an individual station basis. Decentralized station PRC systems have been installed at Kisarazu and some other hub stations, and the programmed route control is being automated. One significant drawback was that, since communication between these individual stations and the main operation control center was by phone and fax, dealing with control issues became quite complicated. To address this situation, digital lines

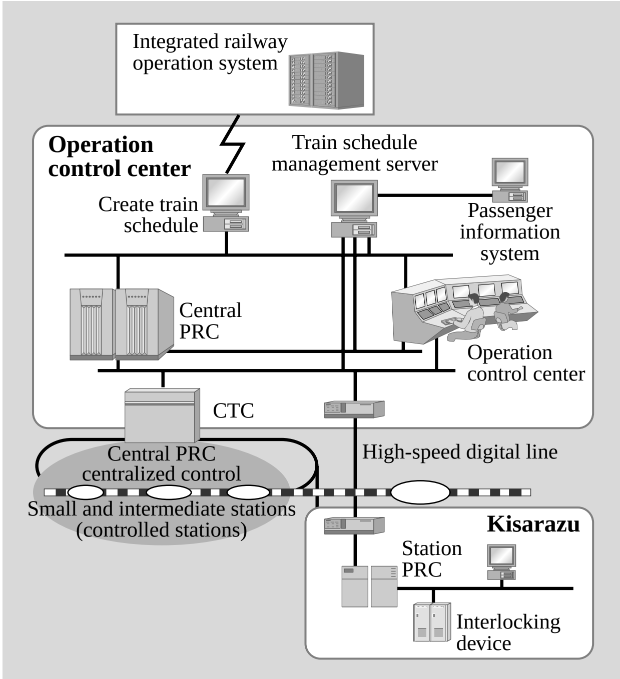

Fig. 2—Traffic Control System Schematic.
Based on a centralized architecture, but incorporating decentralized PRC systems.

have been deployed directly connecting the station PRC and central PRC systems, so the information seen by the two systems has been updated and synchronized in real time. This enables the main operation control center to directly control and manipulate signals for all of the stations on the line, including the larger stations. Even in situations where the schedule has to be updated manually due to an accident or some other sudden disruption, the train schedule for the entire line can be synchronized in real time, thus greatly alleviating the burden on personnel in the stations and in the main operation control center alike.

Schedule Change Servers

The Uchibo Line transportation management system is supported by schedule management servers, because the information required by the passenger information system is sent from the traffic control system. Various kinds of information are collected from the traffic control system in real time — train schedule information, train sequence information, and field information (whether a section of track or route is clear, a train's location, etc.) — and transmitted to the passenger information system at regular intervals. Existing traffic control systems can be upgraded with the new passenger information system in stages by installing schedule management servers.

PASSENGER INFORMATION SYSTEMS

Most of the passenger information systems now in service by the local existing railways are standalone systems. At larger stations where there are many passengers, station personnel enter the information content corresponding to the train schedule, and various equipment is installed including TIDs (traffic information displays) and systems providing more detailed information based on actual approaching train contact data. However, in smaller stations including unmanned stations and subcontract stations where there are fewer riders, relatively simple systems are deployed that only indicate when trains are approaching. The drawbacks of this approach are that it limits the amount of information that is broadcast at smaller stations, while involves a lot of cumbersome work inputting information at the hub stations.

In an effort to remedy these problems, we have developed a centralized passenger information system for local existing railways that is connected to the traffic control system and uses speech synthesized technologies to broadcast passenger information at the local stations. This not only saves a great deal of labor at all the stations on the line through centralized management of the train schedule data, but also improves the content of information services at the smaller unmanned and subcontract stations by accurately reflecting changes in the train schedule.

In this scheme, the local station equipment receives text data from the central equipment (including volume, intonation, and speed information), then the synthetic speech output is produced locally by a speech synthesis engine. This eliminates the need to create a new voice recording every time the schedule is revised or the information content changes. And because text data takes so little space compared with audio data, we can leave the legacy communications infrastructure intact despite its relatively slow throughput. The speed synthesis engine has been developed by Hitachi specifically for application to railway passenger information systems.

Passenger Information System Configuration

The schematic overview of the passenger information system in Fig. 3 shows that it consists of a passenger information server installed in the operation control center equipment room, passenger information input terminals deployed at hub stations (Kisarazu Station), and local station equipment

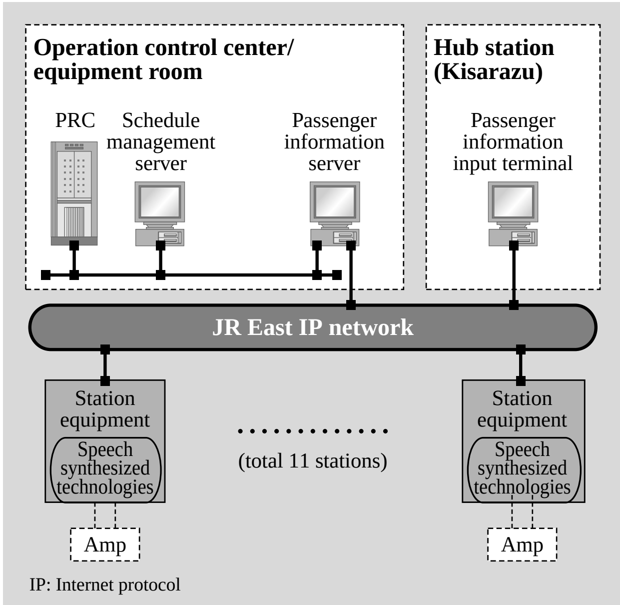

Fig. 3—Passenger Information System Schematic.
Centralized passenger information system is connected to the traffic control system.

installed at all stations along the line. The speech synthesis engine is mounted along with the local station equipment for speech output next to the passenger information input terminal for entering accident announcements and other messages. The information system is connected to the traffic control system through the schedule change server.

Passenger Information Server

The passenger information server receives detailed train schedule information from the schedule management server — the order in which trains depart from stations, train schedule based on departure sequence information, and exact locations of the trains. All this information is processed and tailored for each station, then output as broadcast information text data to the local station equipment. Traffic rescheduling information entered into the traffic control system is received in real time at local stations via the schedule management server, and immediately broadcast by the passenger information system.

Passenger Information Input Terminals

Passenger information input terminals are installed at hub stations and used to enter accident-related announcements, message announcements, and train schedule changes and additions by the permanent personnel stationed at the hubs. The passenger

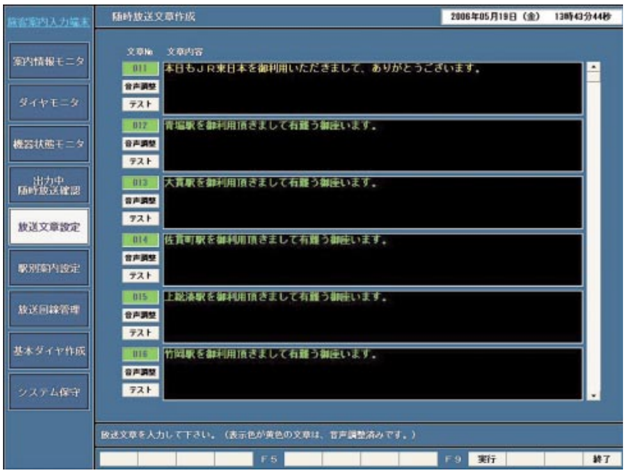

Fig. 4—Screen for Entering Routine Announcement Messages (Free Input).
Enables users to check speech synthesis results of Japanese input.

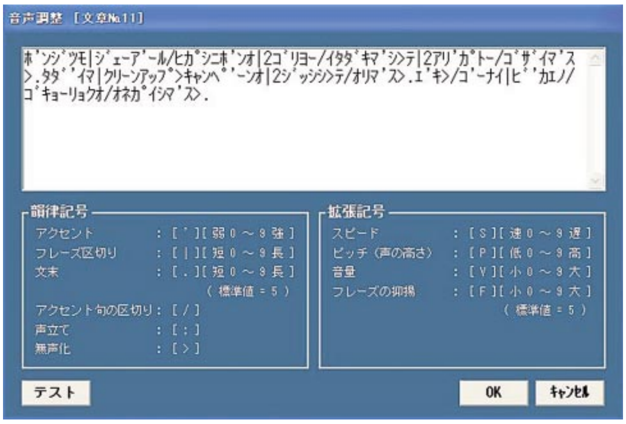

Fig. 5—Screen for Correcting Speech Synthesis.
Enables users to correct reading errors, intonation, and so on.

information input terminals support a range of functions:

(1) Informational content monitor: Display train information for each station broken out direction and track.

(2) Train schedule monitor: Shows schedule information for each train identified by train number. Permits users to change the destination and number of cars making up trains.

(3) Confirms as-needed announcements as they are being output: Displays a numbered list of emergency announcement messages and as-needed announcement messages as they are output at each station.

(4) Creates as-needed announcement messages: Generates emergency announcement messages (inserted in the gaps between other broadcast content) and routine announcement messages (input anywhere) (see screenshot in Fig. 4). Note that routine announcement messages can be delivered in different synthetic voice styles (see screenshot in Fig. 5).

(5) Creates specific train-related broadcast messages: Creates specific train-related broadcast messages supplementing the regular train information, and the supplemental information can be linked to other content generated by the train schedule (see screenshot in Fig. 6).

Fig. 6—Screen for Train-related Broadcast Messages.
Enables users to freely create announcement content supplementing train information, and link the information to the train number.

(6) Passenger information mode settings: Sets the monitor for the information mode of each station (routine information, basic information, offline), and sets the information mode.
(7) Broadcast timing: Sets timing of train arrivals and approaching trains for each station.
(8) Schedule changes: Enters information other than basic schedule settings, including intervals that information is provided, information changes, destinations, and changes in number of cars for regular and irregular trains.
(9) Journal output: Outputs a journal that detailing dates and times of equipment failure, announcements, train locations, and machine operation sessions.

Station Equipment

The local station equipment converts the information broadcast content received in text format from the passenger information server, and outputs the content as audio data. The local station equipment creates messages and keeps a log of messages for each individual station, but saves considerable labor that would be involved in managing and building the system by adopting common specifications shared by all the stations.

CONCLUSIONS

This paper describes innovative new systems developed specifically for local existing railways, focusing on the transportation management system of the Uchibo Line as an example. Combining the company's expertise in robust reliable control technologies with the latest advances in IT (information technology), Hitachi remains committed to the development of ever-better systems for local existing railways that meet the needs of railway operating companies.

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