# Recent Train Traffic Management Systems for Public and Private Railways

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*OVERVIEW: Train traffic management systems provide a centralized means for the management of train traffic. The increased density of traffic on major routes and the diversification of passengers' needs have resulted in increased demand for such systems in the rail transportation business. To meet the needs of both public and private railway operators, Hitachi, Ltd.'s train traffic management systems have the ability to evolve from systems the transport management of a single line into integrated operation systems for multiple lines, and even total railway systems that tie in with other systems for the management of electric power management and other facilities. In recent years, railway operators have taken the opportunity to establish integrated operation centers when updating existing train traffic management systems or when building new routes, and a growing number of railway operators are building integrated operation systems to comprehensively manage the train traffic on multiple routes. As a result, these integrated operation systems have evolved into integrated traffic management systems that manage the traffic on multiple lines or entire networks. In the future, Hitachi aims to strengthen the links between passenger information service systems and train operation schedule systems, and to construct a system that operates and manages entire rail systems more efficiently.*

## INTRODUCTION

SINCE the 1970s, public and private railway operators have been introducing train traffic management systems for purposes such as automating route control, making dispatch operations more efficient, and improving passenger service. These days, train traffic management systems lie at the core of railway systems, and form a total railway system by tying in with the systems for related functions such as ground-train signaling, wayside signaling, electric power management and facility management.

In recent years, passengers have benefited from the formation of dense rail networks in urban areas. The operators of these urban rail networks are also making efforts to consolidate their facilities and improve their operating efficiency by developing integrated operator centers to combine the train traffic management systems previously introduced for each line. By doing

**The integrated operation center for Teito Rapid Transit Authority's eight railway lines (left)**

**The operation center of Transportation Bureau, City of Yokohama (right)**

*Fig. 1—Integrated Operation Systems for Multiple Railway Lines. By constructing integrated operation systems in which the operations of multiple railway lines (traffic dispatch, electric power dispatch, rolling stock dispatch, facility dispatch, etc.) are centrally controlled, efforts are being made to comprehensively improve the efficiency of dispatch operations across all the railway lines, thereby ensuring safe and stable transportation and increasing the traffic density.*

so they aim to ensure that passengers are transported safely and stably by making the dispatch operations faster and more efficient.

Hitachi has already supplied integrated operation systems for multiple lines that are capable of supporting a network of railway lines (see Fig. 1).

Here, we will discuss the development of future integrated operation systems based on the experience gained so far, and their relation to passenger information service systems and train operation schedule systems.

## INTEGRATED OPERATION SYSTEMS FOR MULTIPLE LINES

### Integrated Operation Systems

Railway operators that operate multiple lines are making efforts to consolidate their facilities and improve their operating efficiency by combining together the train traffic management systems hitherto introduced individually for multiple lines into integrated operator centers, thereby ensuring safe and stable transportation by making the dispatch operations faster and more efficient.

Typical examples of multiple line systems include Sapporo City Transportation Bureau (three subway lines), Teito Rapid Transit Authority (eight lines), Transportation Bureau City of Nagoya (five lines), and Osaka Municipal Transportation Bureau (seven lines).

To address the needs of these operators, Hitachi has been constructing integrated operation systems for multiple lines. The aims of an integrated operation system are shown in Fig. 2.

Besides being responsible for traffic dispatch, an integrated operation system is also linked with other functions such as electric power dispatch, rolling stock dispatch and facility dispatch to allow the entire railway system to be managed and operated more efficiently. Examples of integrated operation systems can be found at the general dispatch office of the Teito Rapid Transit Authority (eight lines), or at the operation center of Transportation Bureau, City of Yokohama.

### Integrated Traffic Management Systems

An integrated traffic management system improves the efficiency of dispatch operations by systematically managing the train traffic management system of each line so as to automate management operations across multiple lines. The concept and functions of an integrated traffic management system are outlined in Fig. 3.

Integrated traffic management systems are currently

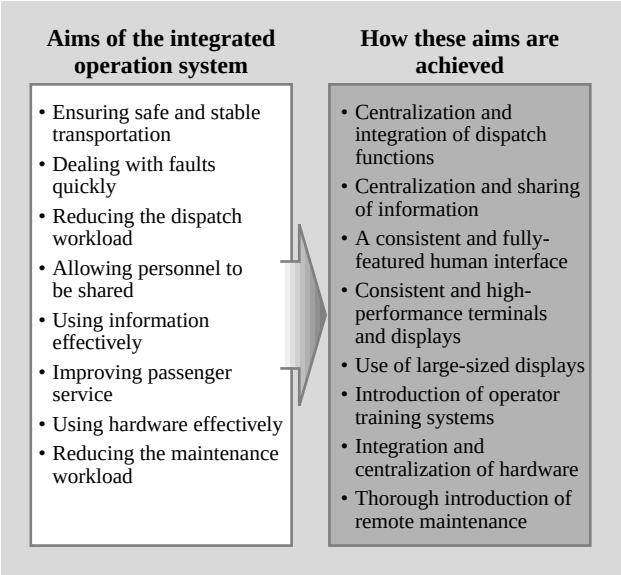


*Fig. 2—Aims of Integrated Operation System.*
*By incorporating the train traffic management systems of multiple lines into a centralized integrated operation center, it is possible to improve the operational efficiency while ensuring safe and stable transportation.*

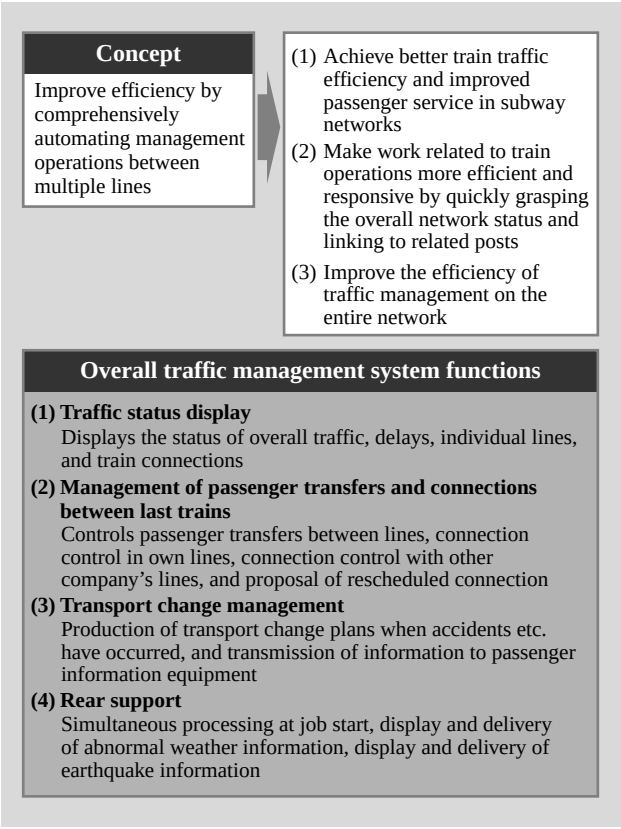


*Fig. 3—Functional Overview of Integrated Train Traffic Management System.*
*By comprehensively automating the management operations between multiple lines, the efficiency of dispatch operations can be improved.*

evolving by tying in with related systems and communication networks in addition to managing the traffic on multiple lines. There is also a trend towards the provision of information services in addition to traffic management. As a result, it will eventually become necessary to supplement the integrated traffic management system functions with control and information service functions and with cooperative control functions that span across lines based on the monitoring and observation functions of each line. The future development of integrated traffic management systems is shown in Fig. 4.

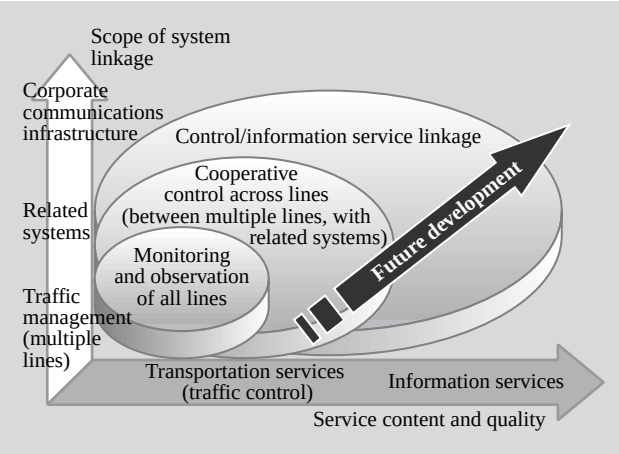


*Fig. 4—Future Development of Integrated Train Traffic Management System.*
*In the future we aim to develop from a system that provides monitoring and observation functions for all lines to a system that provides control and information services and services for cooperation and control between lines.*

## TRAFFIC DISPATCH INTEGRATED SYSTEM

To allow this system to provide efficient dispatch operations, IT is exploited to integrate the hardware of the traffic operation systems between multiple lines (see Fig. 5). The main functions are discussed below.

### Integration of Traffic Operation Systems on Multiple Lines

The traffic management system and telecommunication system integrate all the line systems to form a single network line. In this way, it is possible to provide a flexible operator's environment that does not depend on the hardware configuration. For example, during off-peak or night time periods, a single operator at a single operator's desk can assume responsibility for multiple lines, thereby improving the efficiency of dispatch operations.

### Expanding Scope of Telecommunication System Operator's Desks

Using the VoIP (voice over Internet Protocol), an IP (Internet Protocol) network is constructed via a VoIP gateway in the central control equipment of the existing telecommunication system, and a configuration is adopted in which integrated telecommunication terminals are provided. The telecommunication system is also connected to the train traffic management system and the IP network. This makes it possible to establish telecommunication links from any integrated telecommunication terminal to a dispatcher telephone or train radio on any line, and it also makes it possible to perform operations such as communicating with

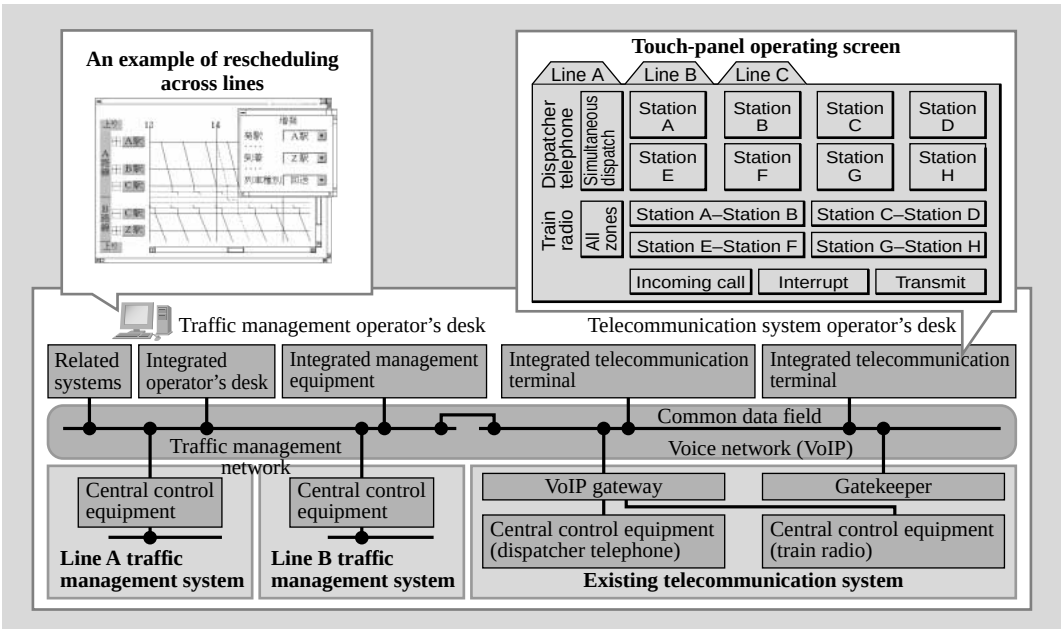


*Fig. 5—Outline Structure of Traffic Dispatch Integrated System.*
*By joining together all the line systems to construct a single network line, the resulting system allows mutual cooperation and linkage between the systems of different lines and between different traffic management and telecommunication systems.*

train radios from the traffic rescheduling window in the traffic management operator's desk. In this way, dispatch operations for multiple lines can be performed from a single operator's desk, allowing dispatch work to be performed flexibly and efficiently. Furthermore, since the operator's desk environment can be made more compact, the space occupied by equipment in the dispatch room can be reduced.

## PASSENGER INFORMATION SERVICE SYSTEM

### Trends in Passenger Information Systems

Railway passenger information systems have been developed with the important aim of providing passengers at train stations with accurate information about train arrivals and departures. Recent developments in IT and information infrastructures have made it easy to provide train operating information in real time over a wide area, and passenger information systems are evolving into passenger information service systems.

Conventional passenger information systems are set up to provide passengers with information such as the order in which trains will depart, their destinations, the type of train, the departure times, and which platform they will depart from. However, as lines become increasingly networked and the density of traffic increases, it is becoming important to provide timely transit guidance information and information about the status of train schedule disruption. This sort of traffic information is prepared by the train traffic management system. In integrated traffic management systems that manage multiple lines, it is especially important to be able to provide this sort of information.

### Passenger Information Service System

In a passenger information service system, train traffic information prepared by the integrated traffic management system is provided by such means as the traffic management network, intranet, Internet and train radio to station platforms, concourses, onboard information systems in the trains themselves and other related company posts, and also to mobile users and offices and households. In this way, efforts are being made to expand the scope of passenger information services, improve the convenience to railway users, and increase the number of passengers. A passenger information service system that employs Internet technology is outlined in Fig. 6.

In a passenger information service system, the quality of services provided to passengers such as the timely provision of passenger information across different lines is improved by receiving guidance information from integrated traffic management system functions such as connection-among-last-train management, transit-management and transport-change-management functions. It also helps to increase the number of railway users by providing various different types of message information such as track-side information and advertising.

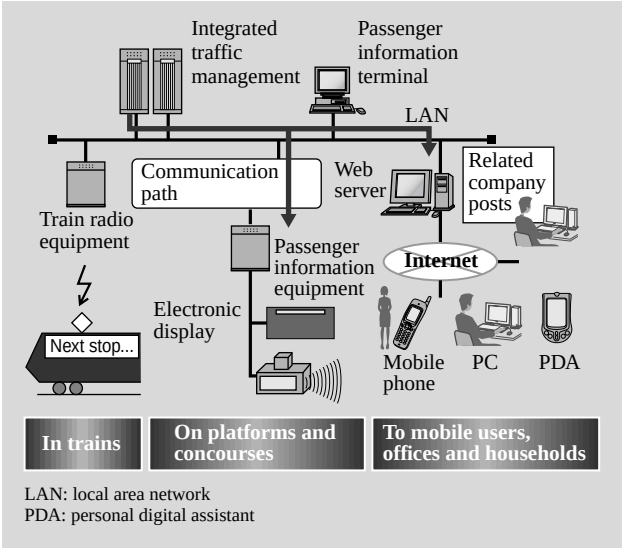


*Fig. 6—Example of Configuration of Passenger Information Service System.*
*In an integrated traffic management system that manages multiple lines, in addition to the conventional passenger information provided at each station, high quality information services are provided to related company posts and external users via intranet and Internet connections.*

## TRAIN OPERATION SCHEDULE SYSTEM

### Overview

The railway operator operates trains based on plans such as train operation schedules and crew scheduling. Specialist know-how is needed to draw up these operation plans, and recent trends towards increased traffic density and more complex train schedules are making it necessary to use advanced techniques to produce these plans.

Consequently, a train operation schedule system should not only produce scheduling information for traffic management, but should also function as a device that supports the work of producing operation plans and as a system aimed at improving the efficiency of planning work and achieving improved functionality through the effective use of all the available information.

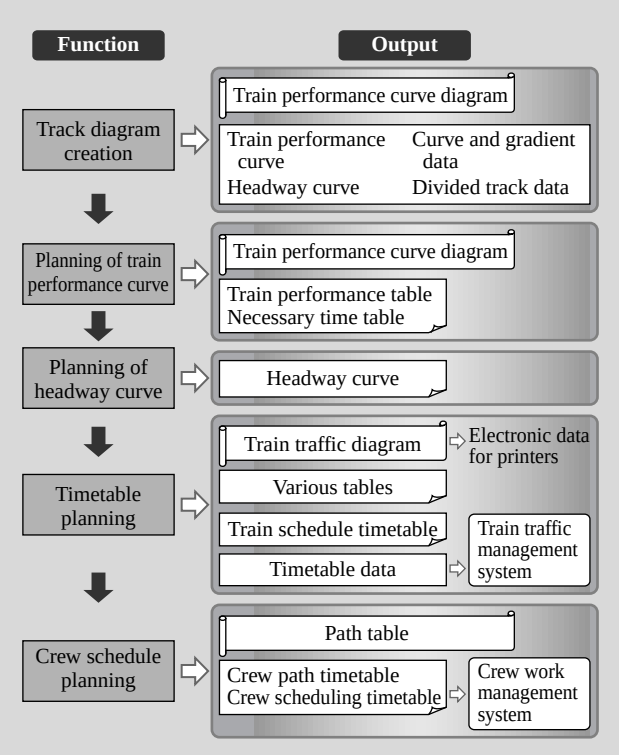


*Fig. 7—Functional Configuration of Train Timetable Planning System.*
*The train timetable planning system broadly consists of five functions. In each function, various types of diagrams, tables and data are output.*

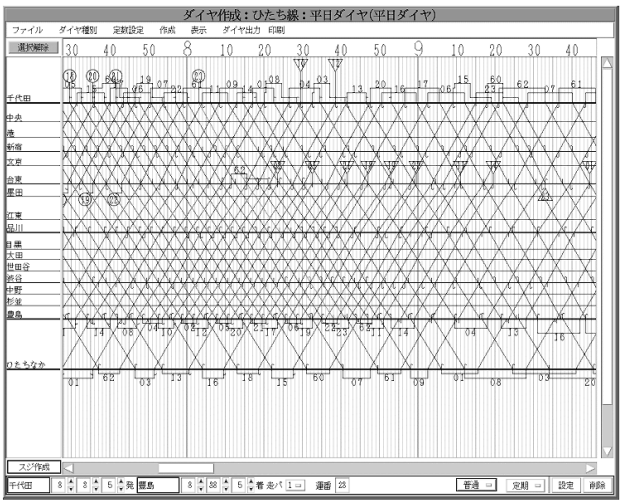


*Fig. 8—Example of Timetable Planning Screen.*
*The system is provided with a carefully designed and user-friendly human interface.*

## Functional Configuration

The train operation schedule system is configured from five functions — track diagram creation, planning of train performance curves, planning of headway curves, timetable planning, and crew schedule planning. These are outlined in Fig. 7, and an example of the screen display produced by this system is shown in Fig. 8.

These functions are all supported by a single device, allowing operation plans to be drawn up for multiple lines. It is also possible to provide the integrated traffic management system with timetable data for each line all at once.

## CONCLUSIONS

We have discussed Hitachi's efforts in connection with the development of an integrated operation system for multiple lines in recent train traffic management systems, and related systems.

Hitachi intends to continue in its efforts to develop a train traffic management system that has control functions and information service functions suited to increasing traffic densities and increasing networking of railway lines.

## REFERENCE

(1) Y. Tanaka, et al., "Recent Train Traffic Management Systems," *Hitachi Hyoron* **83**, pp. 541-544 (Aug. 2001) in Japanese.

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