Linkage of a conventional line dispatch system with the Shinkansen dispatch system

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Abstract

With the partial opening of the Shin-Yatsushiro to Kagoshima-Chuo section of the Kyushu Shinkansen in March 2004, management of the connection to the conventional line limited express trains at Shin-Yatsushiro Station. It became important to provide a service in the Hakata to Kagoshima-Chuo section that was comparable to that of the transport system up to then. For that reason, station facilities were made to enable transfers between the Shinkansen and conventional line trains at the same platform. In addition, linkage functions between the Shinkansen and conventional line dispatch systems were set up as follows.

- Referencing of conventional line timetables when considering revised Shinkansen timetables
- Adding conventional line connection management functions to the Shinkansen programmed route control
- Adding conventional line occupation display to the Shinkansen line occupation display and route control monitor
- Displaying the conventional line timetable (planned and actual) on the Shinkansen timetable display monitor
- Sharing of operation information provision between the Shinkansen and conventional lines
- Guidance of trains and operation, including information relating to conventional line train connections on indicators for passengers

The work is supported by means such as allowing dispatchers to identify the timetable of the day for the other type of train system and the current train operation status.

Keywords: system linkage, transfer, operation control.

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1 Introduction

With the partial opening of the Shin-Yatsushiro to Kagoshima-Chuo section of the Kyushu Shinkansen in March 2004, management of the connection to the conventional line limited express trains at Shin-Yatsushiro Station. It became important to a provide service in the Hakata to Kagoshima-Chuo section that was comparable to that of the transport system up to then (Fig. 1). For that reason, station facilities were made to enable transfers between the Shinkansen and conventional line trains at the same platform (Fig. 2). Additional functions were also established so as to enable necessary information exchange between the Shinkansen and conventional line dispatch systems and allow dispatchers to identify the timetable of the day for the other type of train system and the current train operational status.

2 Outline of SIRIUS (super intelligent resource and innovated utility for Shinkansen management)

SIRIUS consists of the following subsystems that form a total support from train operation planning to actual daily operation. The system configuration is shown in Fig. 3.

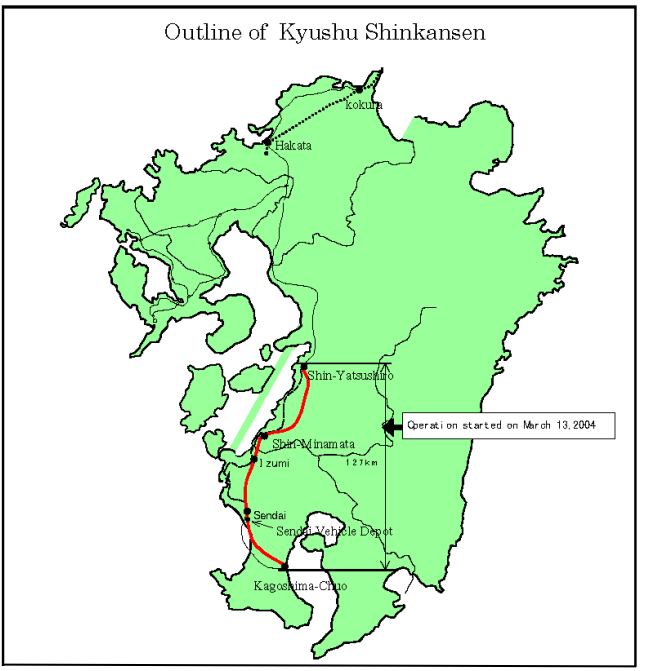

Figure 1: Kyushu Shinkansen.

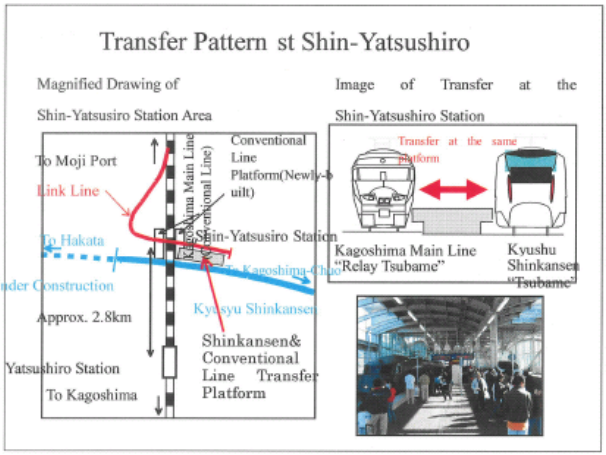

Figure 2: Transfer between the Shinkansen and the conventional line.

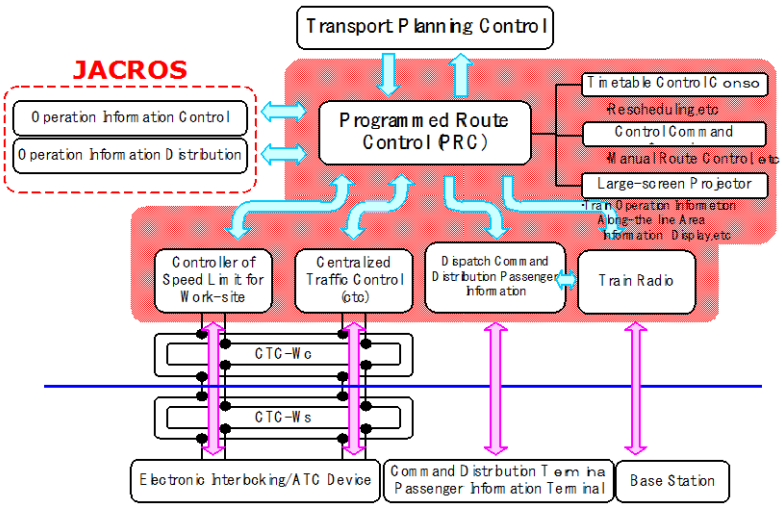

Figure 3: System configuration.

2.1 Transport planning system

This system makes train timetables as well as schedules for vehicle operation and for drivers and conductors. In making train timetables, the system checks the travel times between stations and conflicts among trains at the stations. Then it plans departure, passing, and arrival times and tracks for each in-service and deadheading train (Fig. 4). It also makes vehicle scheduling and driver/conductor scheduling based on the created train timetables. For vehicle scheduling, the vehicle use plan is made based on the identification check of arrival and

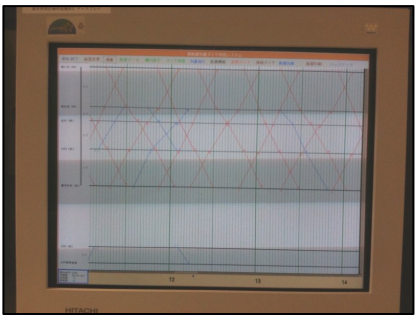

Figure 4: Timetabling system.

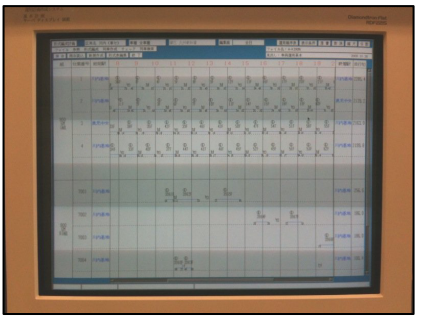

Figure 5: Vehicle/crew scheduling system.

departure stations, the check of the night stay station, etc. For driver and conductor scheduling, the work conditions are checked, and driver and conductor scheduling is made (Fig. 5).

For each planning, the basic plan, the base for the train timetable revision, and the daily change plan, which is based on the basic plan and includes test runs in association with the passenger fluctuation and inspection, are necessary. This system can make either plan.

2.2 Transport planning control/planned information distribution system

Each plan made by the Transport Planning System is controlled as a part of the database of this system (Fig. 6). This system develops the daily train timetable based on the basic plan and the daily change plan, and it distributes the information to the train operation control system. It also receives the actual train running results from the train operation control system to be incorporated in the actual operation results.

In addition, this system distributes various plans to each station and crew offices to notify them of the basic and daily change plan, and it also makes various forms such as for business at the station and for driver and conductor's duties. In this way, this system aids in the accurate and effective performance of duties.

2.3 Train operation control system (programmed route control/centralized controller of speed limit for work-site/CTC)

This system implements daily train operation of all lines based on the train timetables received from the Transport Planning Control/Planned Information Distribution System. Programmed Route Control determines train positions based on the information of line occupation, train number and switches and signals received from the on-site interlocking devices and automatically controlled signals based on train timetables. In the case of train delays etc., the dispatcher changes the timetable to recover, and the system adjusts accordingly.

Figure 6: Transport planning control/planned information distribution system.

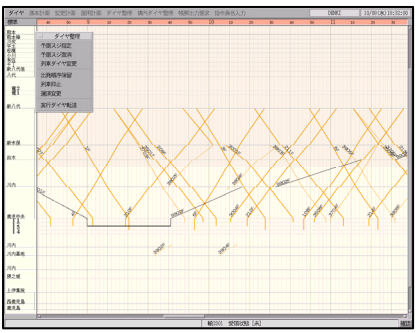

Figure 7: Timetable display monitor.

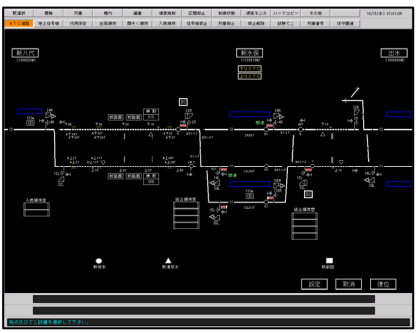

Figure 8: Line occupation/route control monitor.

The following terminals are provided to dispatchers; the timetable display monitor; the line occupation/route control monitor that displays line occupation and controls the signals including signal indication (Fig. 7). (Fig. 8) In addition, the large-sized operation indicator panel is provided to indicate the conditions of all lines.

With the Centralized Controller of speed limit for work-site', slow speed signals can be controlled by the dispatcher in the case that trains need to reduce speed due to climatic conditions, such as excessive precipitation, strong wind, and earthquakes, and other necessities so as to ensure safe operation (Fig. 9).

Two lines of transmission paths, regular and detour, are provided to the Centralized Traffic Control (CTC) that connects the site and the dispatcher's office in order to be able to continue train operation should one of the transmission paths be out of order (Fig. 10).

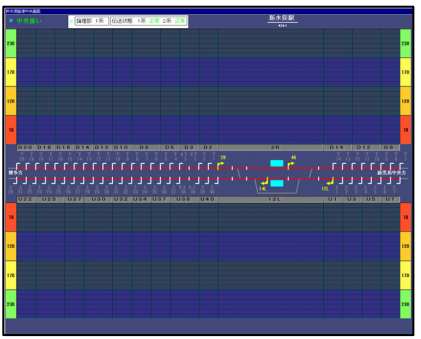

Figure 9: Speed limiting system.

Figure 10: Centralized train control.

Figure 11: Command information distribution system.

2.4 Command information distribution system

Working with the operation control system, it sends the timetable change of the day to each station and crew office in real time so as to ensure immediate response to that change of the day. It sends out information from the dispatcher's office (Fig. 11).

2.5 Passenger information system

For passenger information at each station, the train timetable is transmitted from the dispatcher's office to each station to control the train information display board and the automatic announcement system. The information includes the train operation information in advance based on the train timetable and the line occupancy, in addition to the above-mentioned train information indicator and automatic announcement that are provided at an appropriate timing such as when a train is approaching, arriving, or departing. Not only the train information, but also the business and accident information can be inputted in text and displayed on the board (Fig. 12).

Figure 12: Passenger information board at station.

3 Function of connection control

3.1 Referring to the conventional line timetable when reviewing the Shinkansen timetable revision

The transport Planning Control system can be connected to the system that makes the timetables for the conventional lines so as to review the Shinkansen timetable while the conventional line timetable under review is displayed (Fig. 13). In the opposite way, the Shinkansen timetable can be displayed when reviewing the conventional line timetable. In this way, this system assists mutual linkage and adjustment.

3.2 Conventional line connection control function is added to the Shinkansen programmed route control

With the Programmed Route Control, the other layover trains can be registered in the timetable in advance, and if a registered train is delayed and cannot make the connection, an inquiry is outputted asking whether the connection is to be executed or not, and the dispatcher decides whether the train is to depart or not. In addition, with the Programmed Route Control for the conventional lines, the layover Shinkansen trains can be registered in advance to be used for judging the control (Fig. 14).

3.3 Shinkansen: line occupancy information of the conventional line is displayed on the line occupancy/programmed route control monitor

To be able to determine the operating conditions of the conventional line train that is to be connected at the same platform, the line occupancy information of the conventional line trains can be displayed on the line occupancy display/Programmed Route Control monitor at Shin-Yatsushiro Station (Fig. 15). This is the same as with the large-sized operation indicator board.

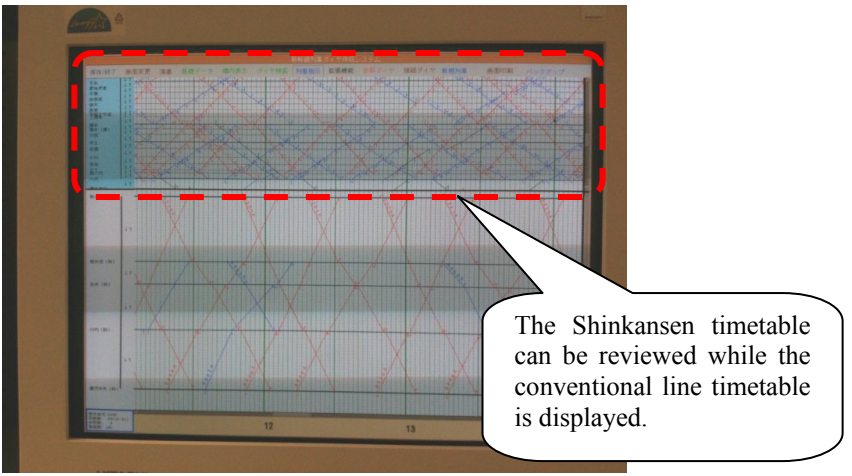

Figure 13: Timetable display for both Shinkansen and conventional lines.

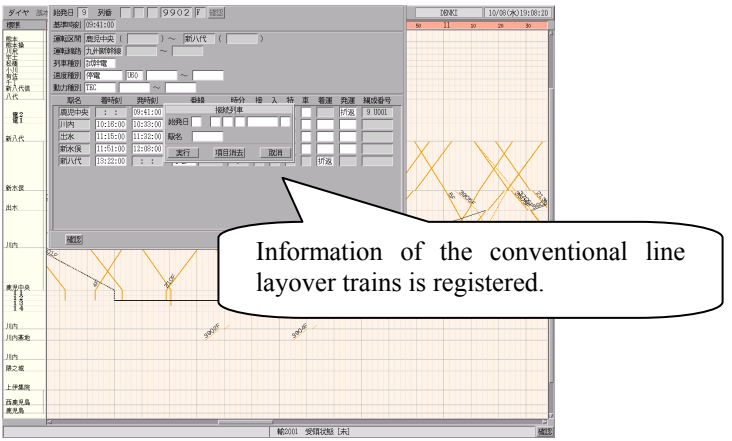

Figure 14: Connection control from the conventional line to the Shinkansen line.

3.4 Displaying conventional line timetable (planned/actual) on the Shinkansen timetable display monitor

In addition to the Shinkansen timetable and results, the conventional line timetable and results (for the sections between Hakata and Yatsushiro, Sendai and Kumanojo, and Kami-Ijuin and Kagoshima of Kagoshima main line) are displayed on the timetable display monitor, and the Shinkansen timetable can be changed while checking the current operation conditions and the future prospect of the conventional lines (Fig. 16). On the conventional line timetable display monitor, the Shinkansen timetable and results are displayed, enabling train timetable management in coordination with the Shinkansen.

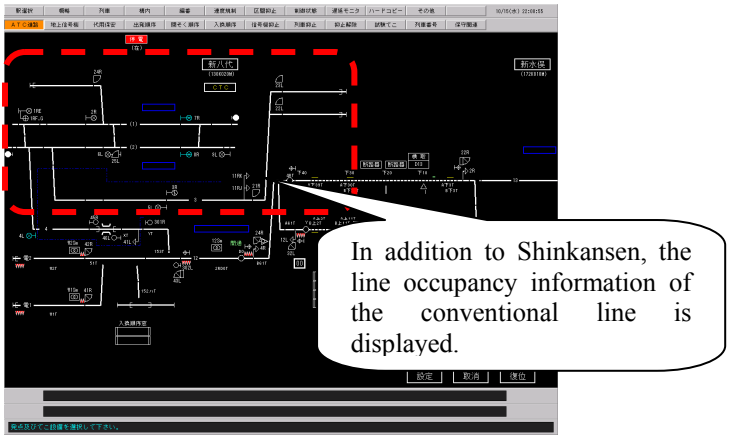

Figure 15: Line occupation display for both the Shinkansen and conventional lines.

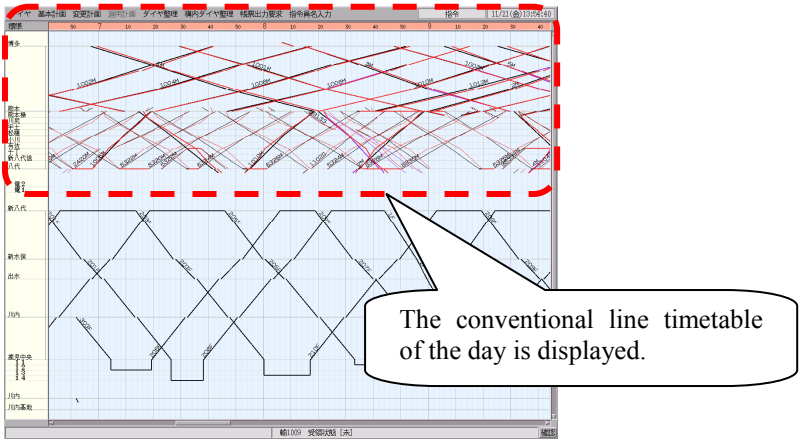

Figure 16: Timetable display for both the Shinkansen and conventional lines.

3.5 Sharing operation information between the Shinkansen and conventional lines

The Shinkansen's line occupancy and delay conditions were added to the traditional operation information distribution system that had been established for the conventional lines so as to enable switching those information displays on the monitor. This allowed the personnel to understand the Shinkansen operation conditions with the terminal installed at each conventional line station. In addition, at each Shinkansen station, both Shinkansen and conventional line operation conditions can be checked (Fig. 17).

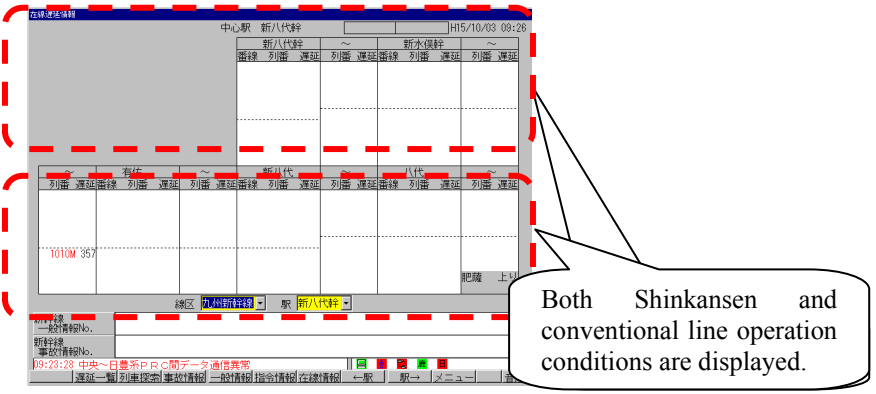

Figure 17: Sharing operation information between Shinkansen and conventional lines.

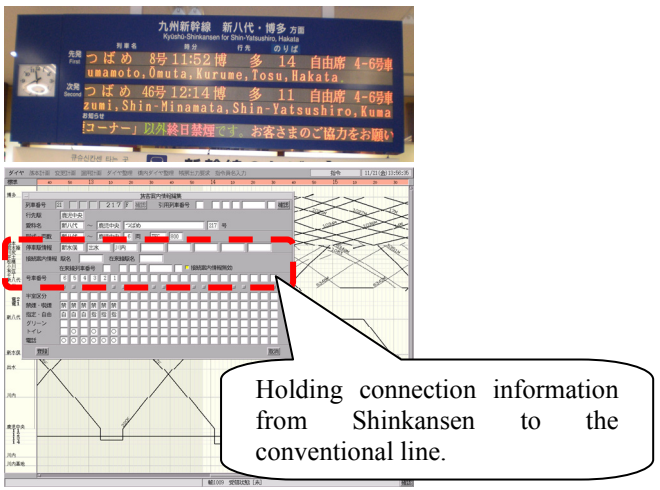

Figure 18: Passenger information system includes connection train information.

3.6 The passenger information display system including information of the conventional line connecting trains

Data of stops and terminal stations of the conventional line trains to be connected from the Shinkansen trains is added to the timetable distributed to the passenger information display system at each station. Doing so, the terminal station for the conventional line train is noted as a destination, and the information of the stations where the train stops is noted, including the conventional line. In the case that the train is delayed and passengers cannot transfer, the connection guidance can be cancelled by the dispatcher (Fig. 18).

4 Conclusion

With this system, we have provided stable transportation for about 7 years by improving customer services, such as guiding connection of the conventional line Relay Tsubame limited express and providing timely and appropriate information when operation disruption occur, and also sharing information smoothly between dispatchers of the Shinkansen and the conventional line.

Currently, preparation for the entire line operation of Kyushu Shinkansen (Kagoshima Route) including the route between Hakata and Shin-Yatsushiro is proceeding with a spring 2011 operational start target. We are currently working on system development for operation commencement.

References

[1] Yamasaki. K., Kyushu Shinkansen Operation Management System (Japanese). *Journal of Japan Railway Engineer's Association,* pp 36–41, 2005.