Hitachi's ATI Series Satisfies All the Needs of Train-compartment Information Control

Shigenori Iwamura
Satoru Ito
Mikihiko Hata
Toshiki Sato

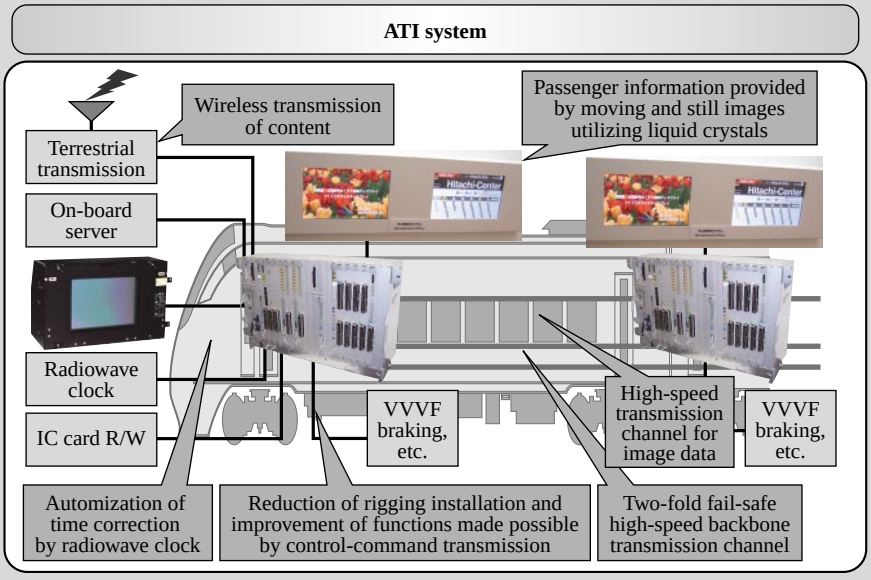
OVERVIEW: As the need to provide higher quality services to crewmen of railway companies and their passengers grows stronger, Hitachi, Ltd. is consolidating the functions and systems concerning ATI — which can flexibly create systems in correspondence with the needs of different railway operators—and creating a series of ATI products. Furthermore, we have developed a 17-inch wide-viewing-angle IPS LCD panel for providing improved services to customers in the form of high-resolution images. This LCD panel is fitted with a CPU and can be configured in an autonomously distributed system. From now onwards, in accordance with the needs of different railway operators, we will continue to improve the functions of our series of ATI products.

INTRODUCTION

IN recent years, railway-vehicle systems are continuing to become intelligent, and highly reliable on-board networks with more functions are in demand. Moreover, to improve passenger services, the switch from using LEDs (light-emitting diodes) for displaying on-board passenger information is continuing. What's more, vehicle-information control devices that respond to the needs of each railway business and vehicle system are also being demanded.

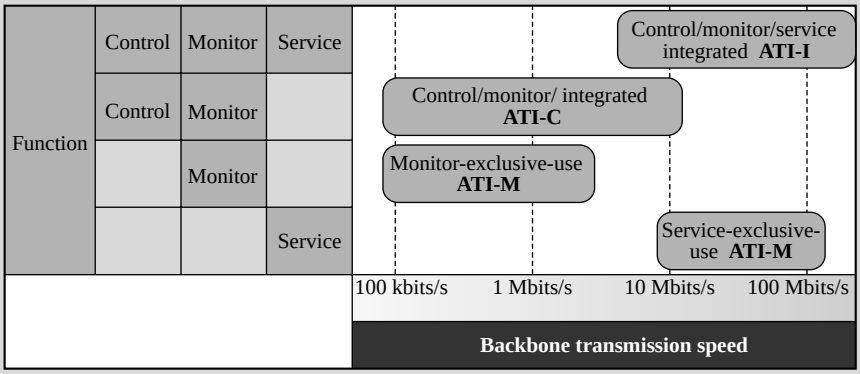
In response to these demands, Hitachi, Ltd. has achieved serialization of so-called ATI (autonomous train integration) products. Moreover, we have developed a system display device — which uses a 17-inch IPS (in-plane-switching) liquid-crystal panel fitted with a CPU (central processing unit) — as an example of creating high quality for an on-board information display device.

The rest of this report describes the serialized ATI systems and developed LCD (liquid crystal display) systems (see Fig. 1).



ATI: autonomous train integration R/W: reader/writer
VVVF: variable-voltage, variable-frequency

Fig. 1—Overview of ATI System. Hitachi has developed ATI (autonomous train integration) systems that meet all the needs of rolling-stock information control in order to sustain safe and comfortable train systems.



ATI-T: ATI-totalized transmission ATI-M: ATI-monitoring
ATI-C: ATI-control ATI-S: ATI-service

Fig. 2—Manufactured ATI Products. As part of the expectations for multi-functionization and speeding-up of compartment information-control equipment, products that flexibly combine types of information required by this equipment are being systemized.

SERIALIZATION OF ATI

Transition of ATI

As regards transition of vehicle monitoring devices — starting with the switch to dedicated devices for monitoring functions of individual pieces of equipment — in recent years, there has been a change to wirelessly transmitting command data related to vehicle control. It has thus been possible to significantly reduce the amount of electrical rigging and improve support functions for maintenance and repair staff by enhancing on-board inspection functions. Moreover, in recent times, functions such as operation-status recording and information transmission concerning service equipment (for example, LCD panels) and monitoring are being implemented in correspondence with the evolution of vehicle systems. Hitachi has been developing ATI technologies, subsequently satisfying the needs of railway operators and passengers alike.

Transmission Information of ATI

As vehicle systems, the key transmission data of ATI can be categorized as the following three main types.

(1) Control command data

Although information directly related to the running of a train, such as powering and braking data, is small by volume, it must possess fail-safe and real-timeliness characteristics.

(2) Monitoring data

Information concerning control of equipment not directly related to the running of a train, such as train-status displays (mainly in the driver's cab), fault-detection equipment, various inspection functions, and air-conditioning units, is moderately sized by volume, and it needs a certain degree of real-timeliness.

(3) Service data

Information related to functions centered on passenger services, such as video and voice data for providing passenger information as well as image data for surveillance use, is mainly based on non-periodic data, and real-timeliness is definitely unnecessary. Moreover, at the interface between information devices, compatibility with multipurpose IT (information technology) is required.

Serialization of ATI

Manufactured systems for ATI (including the newly developed "ATI-S," which was added to the conventional ATI lineup) are shown in Fig. 2.

As for "ATI-T," by transmitting three kinds of data (i.e. control, monitoring, and service), cutting the amount of rigging of the power-transmission line between train compartments (used for on-board transmission channels) is being targeted. As a result of a control-system priority-transmission function,

TABLE 1. Features of Each ATI Product
The transmission media used for ATI-T, ATI-C, ATI-M, and ATI-S and their respective features are listed.

Product name	Transmission medium	Characteristics
ATI-T	Coaxial cable	• Double system transmission considering fail-safe ability • Save amount of wiring by means of wireless transmission of powering/braking commands, etc. • Strengthening of monitoring function and simplifying logic parts
ATI-C	Twisted-pair line	• Double-system transmission considering fail-safe ability • Control-command transmission
ATI-M	Twisted-pair line	• Specialization of monitor inforamtion • Single-system transmission
ATI-S	Twisted-pair line/coaxial cable	• Twisted-pair line/coaxial cable • Specialization of service inforamtion • Single-system transmission

control-system information for controlling and monitoring has an undisturbed configuration even when large-volume service-information data is transmitted. "ATI-C" has a control-command transmission function, and "ATI-M" is specialized for transmission of monitoring information. The special features of each ATI system are summarized in Table 1.

Development of ATI-S

Up till now, Hitachi has been developing a transmission channel integrating control-command information, monitoring information, and service information on a principle channel as broadband solutions via on-board high-speed networks and a concept of environmentally-friendly railway vehicles.

However, to more flexibly meet the needs of railway operators who want a separate transmission channel for control commands and information systems, we have developed a large-capacity transmission unit, called ATI-S, specialized for keeping service-information transmission separate from that of control-command information and monitoring information. As the key point in regard to the time of constructing these systems, simplification of rigging wiring has been cited. Accordingly, to achieve this rigging simplification, we chose as a development concept, a transmission system that enables high-speed, high-capacity transmission by using a twisted cable (usually used for rigging lines of rolling stock). Moreover, in consideration of expandability, the interface chosen for connecting the IT equipment of the ATI-S and LCD systems was based on Ethernet*1 technology.

ATI-operational-status Recording Function

In line with the revisions to ministerial decrees of the Ministry of Land, Infrastructure, Transport and Tourism of the Japanese Government in place since July 2006, establishment of equipment for recording the operation-control status and running conditions was made compulsory on a temporary basis. ATI can mark off each device and interface, and sequentially take in a lot of information. By setting up a circuit board for operating records in a conventional rack for computer circuit boards, it becomes possible to do the necessary recording in less space. Moreover, to ensure information is recorded more accurately, correcting of time from the antenna of a radiowave clock has been implemented. Furthermore, a train recorder for capturing operation records — even in train compartments in which monitors are not installed — was developed. And this system undergoes a similar time correction via the radio antenna mentioned above. The recorded data is downloaded onto a CF (CompactFlash*2) card, and read out on a dedicated PC (personal computer). The functions of the train recorder are listed in Table 2, and the set up of the train recorder and radio-clock antenna is shown in Fig. 3.

What's more, in recent times, efforts to import

TABLE 2. Example of a Train Recorder Function (ATI Substrate Mounted)

Operational records can be imported even if there are no monitors installed.

No.	Item	Specification
1	Measure input power	• Any data from among data imported to ATI can be automatically recorded. • Not just information from the leading car but also information from the whole train arrangement can be recorded. • The same data parameters on the preceding and following cars are recorded, so redundancy is ensured.
2	CF card	• 256 Mbits • Depending on the recorded content, as a standard, data can be recorded for more than 48 hours.
3	Radiowave-clock antenna	• Receiving frequency: 40 or 60 kHz (the one with best status) is chosen automatically. • Weight: about 420 g • External dimensions: 142 (width) × 110 (depth) × 67 (height) mm

CF: CompactFlash

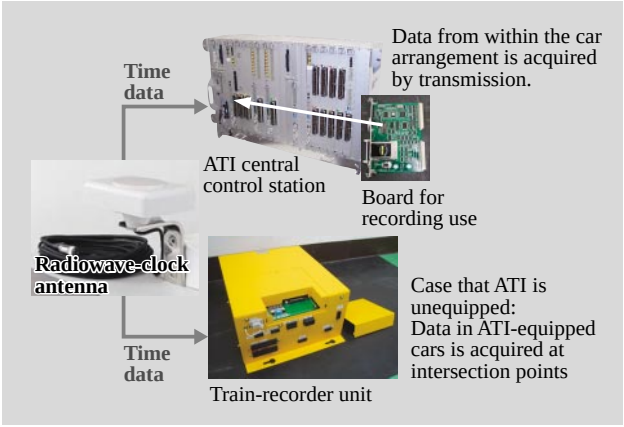


Fig. 3—Radiowave-clock Reception Antenna and Train Recorder.

Time is adjusted via the radiowave-clock reception antenna, and time data is transmitted to the ATI central control station and train recorder.

*1 Ethernet is a registered trademark of Xerox Corporation.

*2 CompactFlash is a registered trademark of SanDisk Corporation in the U.S. and other countries.

positional information from GPS (global positioning system) devices for use in the area outside Japan (where radiowaves cannot be received) and exploit it as ATI information are being pushed ahead.

ON-BOARD LCD SYSTEM

Overview of On-board LCD System

As train-vehicle systems are made more intelligent, information-provision services for passengers are becoming more and more advanced. In addition to "barrier-free" compatibility, on-board LCD systems can provide a multitude of information via still and moving images regarding, for example, business-transaction data and corporate advertisements. As regards information presentation, not only text information but also illustrations about next stop (or present station), arrival announcements, passenger information, and so on can be displayed in accordance with the train's movement. Moreover, in the case of corporate advertising, to make the most of the expressive power of LCDs and present appealing moving and still images, the need for high-resolution and wide-panel LCD devices with more advanced functions is growing.

System Development Regarding New Concepts

As a result of the intelligentization of all devices and the connection of each one to a network, LCD systems are becoming autonomous distributed systems in which each device can autonomously diagnose and operate on the basis of shared information (such as operation status of a train) transmitted from the ATI system. In this way, it is possible to create an architecture that prevents one device fault having repercussions on other devices and that is robust against faults and malfunctions (see Fig. 4).

Moreover, by making video cables in the manner of conventional systems (with a great many constraints on dragging of wiring unnecessary) unnecessary and reducing the line types of application cables, and by having a certain degree of freedom in the connection configuration (if equipment is connected on a network), the amount of wiring can be cut and rigging can be simplified.

Even from the viewpoint of content, since each display device can perform autonomous management, a system architecture that can easily handle upgrading to multi-channels (for example, for presenting information in large characters in the vicinity of priority seating) is created. Furthermore, as a result of combination with ATI-S, transmission of large-capacity data (like advertising content) becomes possible.

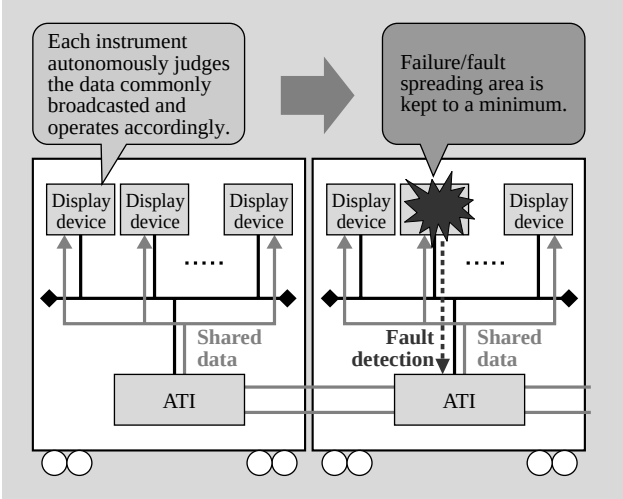


Fig. 4—Autonomously Distributed System.
By means of the autonomously distributed system, a fault in one instrument is prevented from having repercussions in other instruments, thereby creating a system that is robust against faults and failures.

High-definition Wide-viewing-angle IPS LCD Panel

As regards commuter and local trains, because of the crowded conditions of trains and the seating layout, it is inevitable that displays cannot always be seen from easily viewable positions. Accordingly, in regard to display devices, high-resolution displays with low

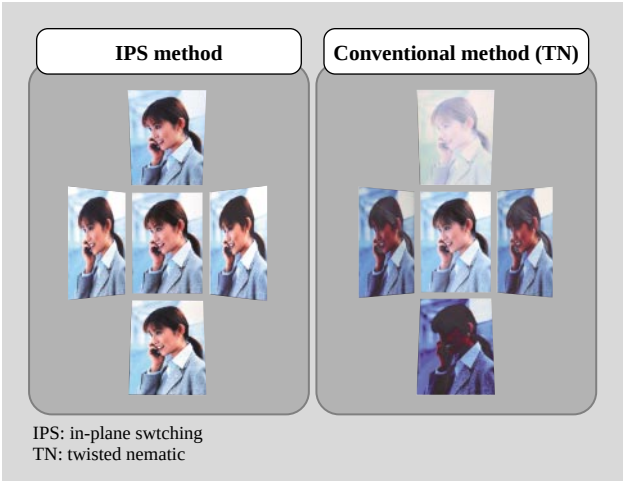


Fig. 5—Comparison of Field-of-view Angles for Conventional and IPS Methods.
As for on-board displays, to meet the demand for good visibility from a wide area, the IPS method (which provides a wide viewing field) was adopted.

Fig. 6—IPS LCD Panels Fitted above Opening Doors for Imaging Current Interior Situation.
By providing high-resolution images, added value is increased.

color-tone variation as well as a wide viewing angle are in demand.

Hitachi has developed, and is practically applying, IPS LCD panels — well-established in the home-use field — for on-board display devices.

Since the announcement of IPS-system LCD technology by Hitachi in 1995, and its practical application in 1996, it has been possible to display natural images with little color variation (that is, no deepening or lightening of images in accordance with viewing angle). Consequently, in regard to in-train display devices — which require visibility across a wide viewing angle — this technology provides the optimum display devices. The difference between the viewing fields of IPS technology and conventional (twisted nematic) technology is shown in Fig. 5.

Thanks to such high-resolution, wide-viewing-angle, IPS wide LCD panels can not only widen the area over which information services are provided for passengers and improve passenger services but also, by providing high-resolution images (with good affinity for content in the future era of digital TV broadcasts), achieve improvement by adding value. Examples of IPS LCD panels are shown in Fig. 6.

CONCLUSIONS

This report overviewed Hitachi's ATI series (composed of separate ATI products with separate functions), and described development and commercialization of ATI-S (specialized for information transmission) and LCD systems for displaying high-quality images from autonomously distributed systems. As a railway system integrator enhancing the added value of ATI — which is becoming ever more important — Hitachi will continue to contribute to upgrading of on-board networks, integration of service-information systems and control systems, and seamlessly linking on-board and ground-based systems in order to improve the efficiency of train systems and passenger convenience.

REFERENCE

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ABOUT THE AUTHORS

Shigenori Iwamura
Joined Hitachi, Ltd. in 1992, and now works at the Rolling Stock Engineering Department, the Rolling Stock Systems Division, the Transportation Systems Division, the Industrial Systems. He is currently engaged in railway car system engineering.

Satoru Ito
Joined Hitachi, Ltd. in 1989, and now works at the Rolling Stock Electrical Systems Design Department, the Mito Transportation Systems Product Division, the Industrial Systems. He is currently engaged in the development of information control equipment for trains. Mr. Ito is a member of the Electrical Engineers of Japan.

Mikihiko Hata
Joined Hitachi, Ltd. in 1985, and now works at the Transportation Planning Department, the Transportation Systems Division, the Information & Control Systems Division, the Information & Telecommunication Systems. He is currently engaged in the development of system engineering for transportation-system-related information technology. Mr. Hata is a member of the Information Processing Society of Japan.

Toshiki Sato
Joined Hitachi, Ltd. in 1988, and now works at the Transportation Control Systems Engineering Department, the Transportation Information Systems Division, the Information & Control Systems Division, the Information & Telecommunication Systems. He is currently engaged in the development of visual information systems for trains. Mr. Sato is a member of the Association for Computing Machinery.