

Development of Latest Solution for Emergency Services to Keep Citizens Safe

To respond appropriately to demands for emergency services, which have become more complex and diverse in recent years due to a changing social environment, the functionality of command and control systems for emergency services is expected to advance even further. This advanced functionality consists not only of the response to large-scale disasters caused by earthquakes, climate change, and other natural disasters, but also the response to demands for emergency services in an aging society, for providing appropriate services to the hard-of-hearing, and for receiving emergency calls in foreign languages. To support fast and accurate emergency services activities that address these social needs, Hitachi is developing new solutions that apply the latest technologies such as smartphones and artificial intelligence as a part of Hitachi's multi-function command and control system. By focusing on using information from a perspective closer to the caller or incident location than previous systems, emergency services are provided that encourage autonomous information transmission by individuals. This is helping to further strengthen and enhance the emergency service capabilities built by citizens and local governments.

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1. Introduction

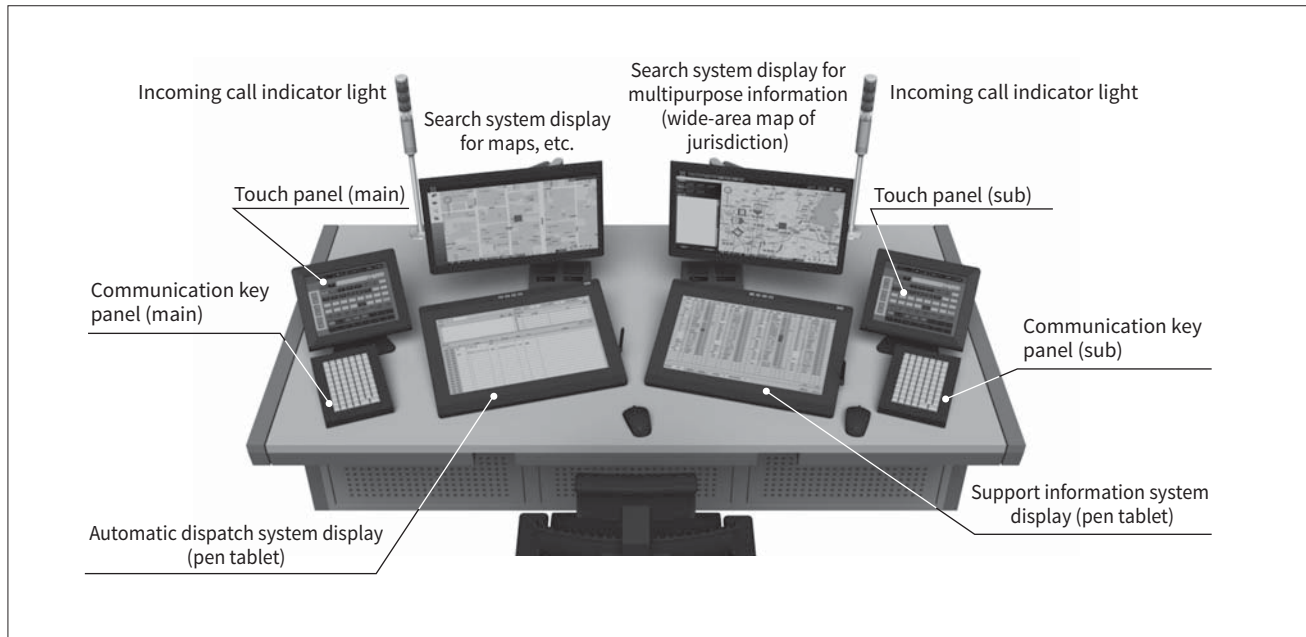
The entire country of Japan is at risk of various natural disasters due to its geographical location. In recent years, concerns have grown about the risk of natural disasters due to the effects of climate change caused by global warming, and of potential earthquakes occurring in the Nankai Trough or under the Tokyo metropolitan area⁽¹⁾. In response, local governments are predicting future demand for emergency services based on the characteristics of their localities to strengthen and enhance the emergency services that will be required in the future.

In addition to these concerns about natural disasters, other social needs include the response to the aging population, increased use of universal designs, and services for the various international sporting events that will be held soon in Japan. Therefore, systems must be prepared that can handle emergency calls from a wide range of people, including the elderly, disabled people, and international tourists.

In response to these challenges, Hitachi is developing various solutions that provide more advanced functionality for emergency service command and control systems. Since April 2018, Hitachi has been developing services that utilize smartphones to encourage autonomous information transmission by individuals. Looking further to the future

Figure 1 — Configuration of Hitachi’s Command Desk

One of the main systems for supporting the command and control operations of command and control staff. Each emergency service command and control center is equipped with multiple command desks according to the size of the population under its jurisdiction.



and toward realizing the vision of the “Super Smart Society” promoted by the Cabinet Office of Japan, Hitachi is developing new solutions that utilize artificial intelligence (AI), which is gaining attention as a key technology for the future⁽²⁾.

This article presents an overview of the multi-function command and control system (for emergency services) provided by Hitachi, and describes the development of new solutions for emergency services to keep citizens safe, utilizing the latest technologies such as smartphones and AI.

2. Hitachi’s Multi-function Command and Control System

An emergency service command and control system is responsible for command tasks such as identifying disaster locations and organizing dispatch teams, and control tasks such as managing dispatched vehicles and providing disaster support information. These operations start when an emergency call is received.

For many years, Hitachi has been promoting the development of emergency service command and

control systems that keep citizens safe. However, the Great East Japan Earthquake in 2011 caused large-scale damage that exceeded previous expectations. In response, Hitachi started studying how to provide even more advanced functionality for emergency service command and control systems.

This section describes Hitachi’s multi-function command and control system, which provides new functions for supporting increasingly complex emergency services, and reliable central command systems, which can deal even with unexpected failures.

2.1 New Features for Supporting Increasingly Complex Emergency Services

As disasters in recent years have become more diverse and large scale, the tasks that must be performed by command and control staff and by the teams dispatched to the disaster zone are becoming more complex every year. To support the complex work required of the command and control staff, Hitachi has updated the configuration of the command desk to four screens, including pen tablets that support handwritten input (see **Figure 1**). In addition, Hitachi is providing new smart devices to dispatch teams for use at disaster sites. The three main features of these devices are as follows.

^{*} “a society that is capable of providing the necessary goods and services to the people who need them at the required time and in just the right amount; a society that is able to respond precisely to a wide variety of social needs; a society in which all kinds of people can readily obtain high-quality services, overcome differences of age, gender, region and language, and live vigorous, comfortable lives”

(1) Enhanced information gathering through utilization of pen tablets

As the types of callers and call information become more diversified, there is a need for multiple command and control staff to complement each other in information gathering tasks to improve accuracy. Therefore, in addition to the conventional audio monitoring of emergency call information, Hitachi's command system also utilizes pen tablets to provide an environment where memos, including diagrams of a victim's injuries or maps of a disaster zone, can be shared visually among the command and control staff. Additional information can also be entered in the memos in real time from other command desks to help improve information gathering tasks.

(2) Optimization of dispatch plans according to activity status through utilization of wide-area maps

When a large-scale disaster occurs, almost all the rescue vehicles follow complex commands across the entire area of jurisdiction. The command and control staff must be able to assess the conditions in real time and to change the dispatch plan flexibly according to the conditions on the scene. Therefore, in addition to maps centered on the disaster zone as in conventional systems, Hitachi provides an environment in which a wide-area map is always displayed. This makes it easy to gain an overall view of the dispatch status, and the position and traveling direction of vehicles across the

entire area of jurisdiction. This supports command and control staff in understanding the status of activities when multiple disasters occur simultaneously, enabling them to make an appropriate dispatch plan.

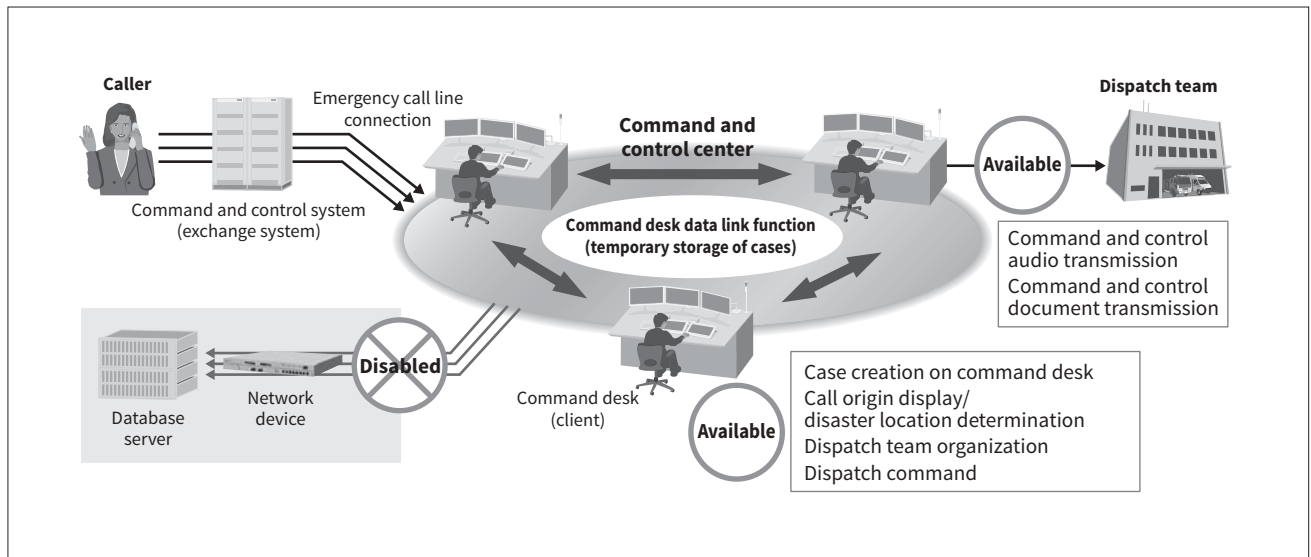
(3) Making onsite work more efficient through utilization of tablets

Conventional means of sharing information between command and control staff and dispatch teams include an automatic vehicle monitoring system (AVM), which is permanently installed in the vehicle. However, there is growing need for light and mobile devices to enable more efficient activity at the scene. To address this need, Hitachi has newly adopted tablet devices to support use cases such as a command team controlling an accident site after a large-scale fire occurs, or a rescue team transporting victims or providing emergency aid. These tablets enable the command team to visually assess conditions such as the locations of the dispatched teams, routes for entering the disaster zone, and fire hydrant situation. Rescue teams can share the conditions of victims with the command team and enter the information required for accurate and fast transportation or emergency aid.

Thanks to these new features, Hitachi's multi-function command and control system provides support for complex emergency services.

Figure 2 — Overview of Autonomous Decentralized Processing Method

Even when communication between the server and the command and command desk is abnormal, the "command desk data link function" that stores data between command desks for a certain period of time enables tasks to continue as normal on each individual command desk.



2.2

Reliable Central Command Systems Able to Deal with Unexpected Failures

Each emergency service command and control center installs multiple units of the previously described command desks according to the size of the population under its jurisdiction. This provides an environment for effectively performing command and control tasks in response to emergency calls from citizens. The command systems that perform the central command functions for operational support are equipped with an automatic dispatch system and search systems for maps, etc. (hereafter “clients”). Communication control processing between each client and the database server must be highly reliable. Therefore, preventive measures are usually taken to prepare for hardware failures, such as providing redundancy for the database server and installing multiple clients.

To ensure even better reliability, Hitachi has updated the communication control processing method to protect against abnormalities in the communication network between the server and the clients. This new method includes a “command desk data link function” where, in addition to the data shared between command desks when registering to each client, data is also sent to other command desks so that each client stores data from the other clients for a certain period of time. This provides for autonomous decentralized processing where tasks can continue as normal on each individual client. Furthermore, during periods when communication has stopped, data is integrated automatically on the server from the data stored on each client, which minimizes the time required for data recovery (see **Figure 2**).

In this way, Hitachi’s multi-function command and control system has developed into a resilient system that can maintain emergency service capabilities even in the case of large-scale disasters that exceed conventional expectations.

3. Development of New Emergency Services for Safer Cities

Emergency service command and control centers need to deal with calls from a wide range of people, including the elderly, disabled people, and international

visitors. Emergency calls received via communication other than landlines are also rapidly increasing, and dealing with these is an urgent task. Furthermore, there is a need to prepare for large-scale disasters that may occur again in the near future.

This section describes new services that Hitachi has developed in response to these trends. These include a video emergency call support service using smartphones that was launched in April 2018, and new services for strengthening local emergency service capabilities, which will be launched in the future.

3.1

Realization of Video Emergency Calls Using Smartphones

Approximately 40% of the emergency calls made in the last five years in the Tokyo metropolitan area were made from cellular phones or smartphones⁽³⁾. The smartphones that made most of the emergency calls are equipped with a camera and global positioning system (GPS) functions, as well as traditional voice call functions. As such, video emergency calls can be made that are faster and clearer than ever before.

By focusing on these innovations, Hitachi developed video emergency call technology that shares video and positioning information with the emergency service command and control center via the caller’s smartphone, and launched a video emergency call service. The caller connects to the emergency service command and control center via a dedicated app that users install on their smartphones in advance or via a uniform resource locator (URL) sent from the emergency service command and control center. This service enables the sharing of video information from a disaster site, and provides an environment in which conditions such as injuries or the status of the disaster zone can be shared visually between the caller and the command and control staff.

Hitachi is also planning future services for third-party call functions to strengthen the response to a wider range of callers. These functions will provide interpreters for emergency calls from international visitors who cannot speak Japanese or persons who find it difficult to make voice calls. This will make it easier for the command and control staff to obtain information from callers (see **Figure 3** and **Figure 4**).

Figure 3 — Comparison of Status Before and After Deployment of Video Emergency Call Service

After service deployment, the caller and the command and control staff can share information more accurately.

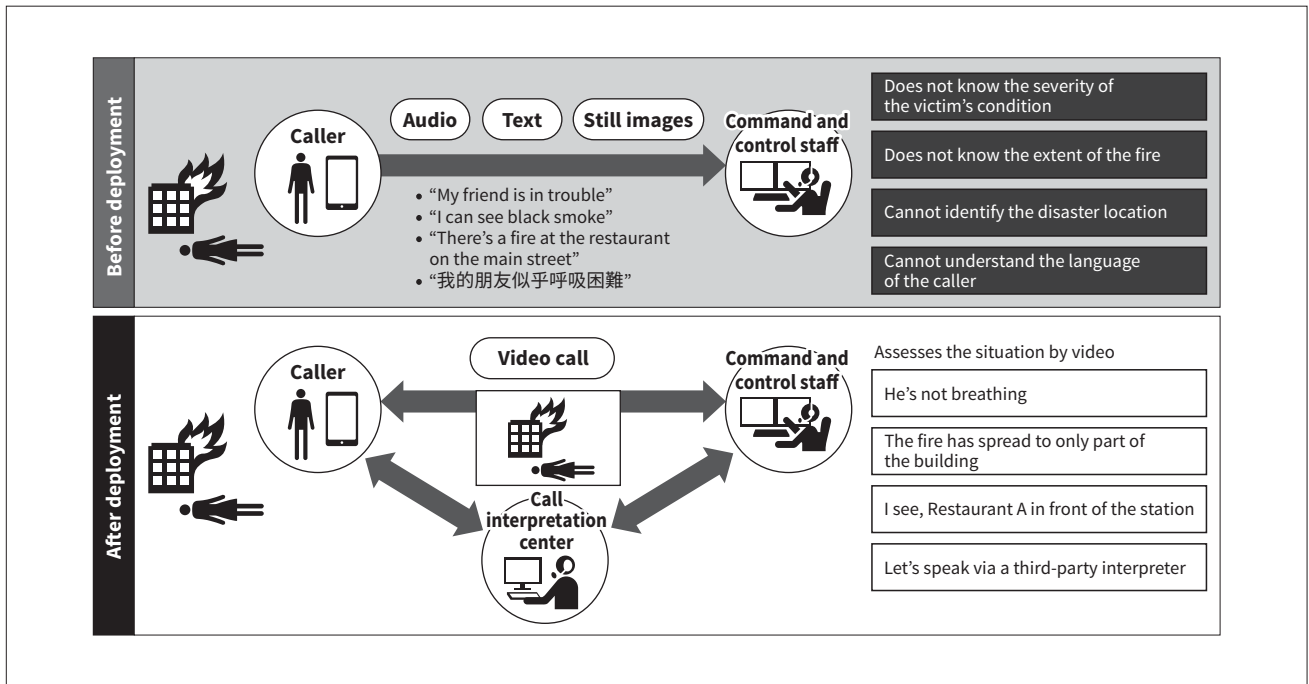
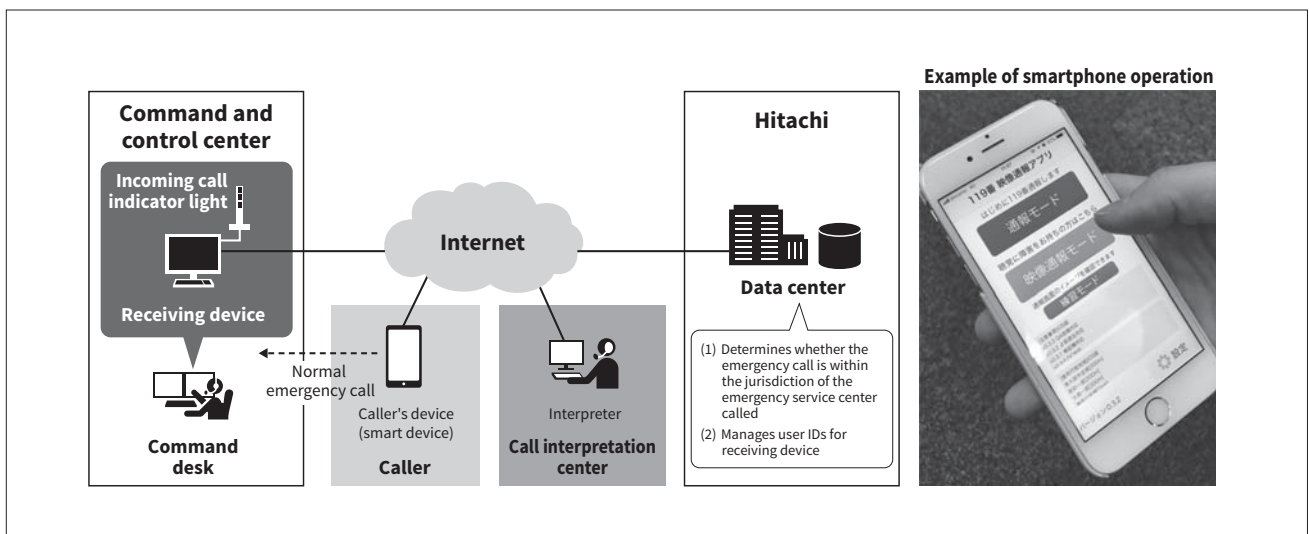


Figure 4 — Example of Video Emergency Call Service

The caller is connected to the emergency service command and control center via Hitachi's data center.



3.2 Strengthening of Local Emergency Service Capabilities Using Smartphones

As described in the previous section about the video emergency call service, there are concerns in Japan about another large-scale earthquake disaster occurring in locations such as the Nankai Trough. As such, there is a need to strengthen systems such as support for evacuating survivors and providing emergency rescue and aid. In response, Hitachi has built

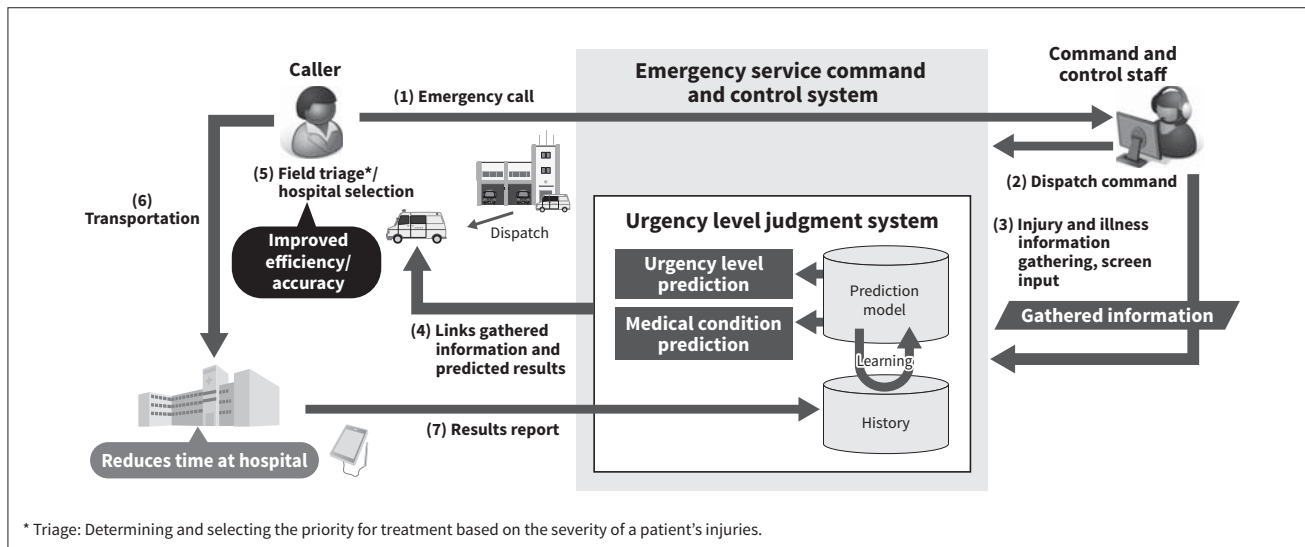
environments where information can be shared between individuals in dispatch teams and emergency organizations, which helps strengthen local emergency service capabilities. An overview of these services is described below.

(1) Direct dispatch command for dispatch teams

Currently, dispatch teams receive instructions directly from the emergency service command and control center, and use multiple devices such as AVMs and transceivers to share positioning information and

Figure 5 — Future Vision for Emergency Operations Using AI Technology

AI supports command and control staff in providing accurate verbal guidance and transportation destination selection based on the urgency and medical condition of the victim. This improves the efficiency of life-saving operations.



rescue conditions. In the future, Hitachi will also provide an environment in which each team member can conduct their onsite activities with their smartphones to reduce total costs and increase work efficiency. Hitachi is also considering developing services suitable for the activities of emergency service organizations.

(2) Services linked with related organizations

Up to now, videos from disaster zones were mainly shared between emergency service personnel such as the command and control staff and the dispatch teams. However, by distributing a dedicated app, Hitachi will provide an environment in which videos also can be shared with governmental agencies, emergency service organizations, and medical institutions. This will provide the real-time support required at the site of a disaster or rescue, such as providing disaster zone videos from the emergency service organization or accurate life-saving instructions from doctors.

By providing new services like these, which support autonomous information transmission by individuals, Hitachi aims to strengthen local emergency service capabilities.

4. Improving Life-saving Efficiency Using AI

Due to the impact of the aging population in Japan, even though the frequency of emergency dispatch has increased 87% (2.2 million incidents) in the last 20

years, the number of emergency dispatch personnel has only increased slightly^{(1), (4)}. In this context, the Fire and Disaster Management Agency has established an urgency level judgment protocol to reduce unnecessary and non-urgent emergency dispatches. The plan was to deploy this protocol across the entire country, but so far it has not been widely adopted. This lack of adoption may be because the operating methods have not been clearly established and a certain effort is required to gain the necessary skills.

This section describes new solutions for overcoming these challenges by utilizing an AI that is being researched and developed by Hitachi.

4.1 Using AI to Determine a Victim's Medical Condition and Urgency Level

Command and control staff need to have the knowledge to accurately determine a victim's medical condition from the caller's description. However, while the number of emergency calls has increased, the number of personnel experienced in these tasks remains low. Therefore, it is difficult to accurately control rescue transportation tasks when there is a sudden rush of emergency calls, such as after a large-scale disaster or a mass food-poisoning incident.

To reduce the burden on command and control staff, Hitachi uses AI to support the determination of a victim's medical condition and urgency level based

on the gathered information. Specifically, the items that should be checked are displayed in a list on the screen of the command desk. As the command and control staff member gathers information according to these items and enters the data, the AI estimates the conditions from keywords and displays the urgency and medical condition of the victim.

This supports accurate verbal guidance and transportation destination selection without being solely reliant on the experience of the command and control staff, which should shorten the time required for emergency transportation (see **Figure 5**).

4.2

AI's Contribution to the Field of Emergency Services

Each emergency service command and control center must provide services specialized for their local characteristics to achieve even greater life-saving efficiency, and also to consider how best to conduct its operations.

The predictive accuracy of solutions utilizing AI improve through the continuous accumulation of operating history and learning. Therefore, there are high expectations for the effective use of AI in emergency transportation tasks, for which the workload burden is increasing even as it becomes more difficult to enhance emergency systems.

As such, Hitachi will continue to develop AI in emergency service solutions in the future as a vital part of realizing the vision of a "Super Smart Society."

5. Conclusions

This article has presented Hitachi's multi-function command and control system, which responds to complex and diverse emergency service demands, and has described the development of new solutions using smartphones and AI to help overcome the various challenges facing emergency services.

In the future, Hitachi will continue to pay close attention to the changing needs of society and develop a wide range of solutions that blend the latest technologies with Hitachi's core multi-function command and control system. In this way, Hitachi will help

strengthen and enhance the emergency service capabilities built by citizens and local governments.

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