Digital Mobile Telecommunication System for Local Government

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Abstract

The “Digital Mobile Telecommunication System for Local Government” is intended to be used for rescue and recovery activities upon occurrence of disasters and to be utilized for transmission of administrative information in ordinary days. This paper reports the development result of this system.

Keywords

mobile communication system, mobile terminal, position information
disaster prevention information, IP network

1. Introduction

The Digital Mobile Telecommunication System for Local Government was institutionalized by the Ministry of Internal Affairs and Communications in 2001 and its technical requirements are specified in standard T79 of ARIB (Association of Radio Industries and Businesses). Since then, it is built up and operated as the disaster prevention administration radio system in local governments.

For development of this system, NEC aimed for a universal design so that the terminal that is directly touched by the end user would be operable like a mobile phone as much as possible and designed the system to transmit not only voice but also images and data showing the devastated situation so as to accommodate various needs on disaster prevention operations of the local government.

The system overview, features and application examples are covered in the next section onward. With the system having advantages of both mobile phone system that will increasingly evolve and escalate and the disaster prevention radio system that ensures accurate communication upon occurrence of disasters, technical development will be proceeded for easier-to-use products. Further in the future, development of the radio system will be proceeded to flexibly support the increasingly advancing social infrastructure system through application of software radio technologies.

2. System Overview

(1) Overall Configuration

This system is a digital mobile communication system, which communicates in TDM/TDMA mode using the 260MHz band frequency.

The 260MHz band is a frequency band allotted by the Ministry of Internal Affairs and Communications to this system; 260 to 266MHz is used for uplink (from the mobile station to the base station), and 269 to 275MHz for downlink (from the base station to the mobile station) in units of 25kHz. For the communication channel, one carrier is allotted to a pair of uplink and downlink (with a difference of 9MHz).

In TDM/TDMA mode, a frequency is time-divided by a 40mS frame and the frame is divided by 4 with a 10mS slot. Thus, quadruple communication (equivalent to 4 mobile machines) is allowed for one carrier. The modulation mode is $\pi/4$-shift QPSK and the transmission speed is 32kbps.

Services to be provided by this system are duplex communication, simplex communication, group communication, broadcast communication, controlled duplex communication, controlled group communication, dedicated channel communication, PBX communication, short message, mail, GPS communication, image transmission, FAX communication and data communication, and are configured with the control console, administration unit, position/image management unit, line control unit, base station radio unit, mobile station, PBX, data terminal, remote control unit, and facsimile (**Fig. 1**).

(2) Control Console

The control console for operating and controlling the entire system can issue commands to each mobile station and manage communication using functions such as talk monitoring, talk interruption, and forced disconnection.

The control console consists of the factory computer and handset. Operation can be performed with a set of the main

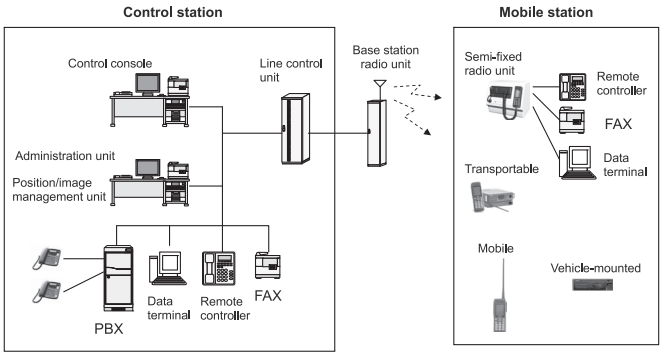

Fig. 1 System configuration.

control console and multiple sub control consoles.

(3) Administration Unit

The administration unit collectively manages the system set values, configuration information, and monitoring information. The administrator can create and change data and deliver data to each unit. Further, the administration unit consists of highly reliable servers so that the system status monitoring data can be always collected and the failure/communication status can be displayed on the menu screen.

(4) Position/Image Management Unit

The position/image management unit can receive the image information from mobile stations and position information via GPS and display them on the map.

(5) Line Control Unit

The line control unit is connected to the control console, administration unit and base station radio unit to control communication between mobile stations, between mobile stations and the control console, and between mobile stations and position/image management unit. By connecting the PBX, facsimile and data terminal, PBX communication, facsimile communication and data communication are enabled.

(6) Base Station Radio Unit

The base station radio unit is connected to the line control unit via a private line or LAN to relay radio communication between mobile stations and between mobile stations and the control station. In the event of a failure on the line control unit, the base station radio unit can be disconnected from the line control unit using the manual switch. Then, the base station radio unit alone can relay radio communication between mobile stations.

The base station radio unit consists of the base frame and expansion frame, each of which can implement up to 4 sending/receiving units. If the system is being configured with the base frame alone, up to 4 carriers can be sent. Depending on the setup, up to two of four sending/receiving units can be prepared as standby machines. Further, a function that moves the control carrier to another frequency by the substitute frequency function is available if interfering wave is detected on the sending/receiving unit that sends the control carrier.

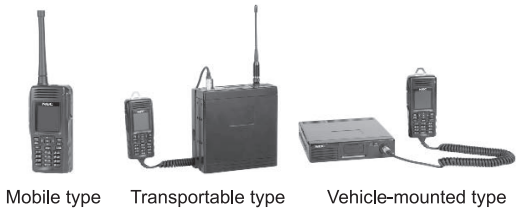

Photo 1 Mobile station walkie-talkie.

(7) Remote Controller

The remote controller can be used as a communication terminal by connecting it to the line control unit, base station radio unit, or fixed radio unit.

(8) Mobile Station

Three types of mobile stations are available. They are the mobile walkie-talkie, the transportable walkie-talkie, and the vehicle-mounted walkie-talkie (**Photo 1**). Each walkie-talkie has functions such as voice communication (individual communication, group communication, broadcast communication, control communication, etc.) to the control station and mobile stations, non-voice communication (mail, position information registration, etc.), emergency call, and support communication. By connecting to the fixed station expansion unit, the transportable walkie-talkie can perform PBX communication, facsimile communication and data communication as the semi-fixed station.

On the assumption of the use upon occurrence of disasters, the mobile walkie-talkie is equipped with a waterproof function. The operating screen is a color LCD and has operability similar to a mobile phone through the use of a graphical interface.

The mobile walkie-talkie contains a built-in camera on the rear, so the picture taken in the field of the disaster can be immediately sent to the control station.

3. System Features

(1) Image Transmission

The picture taken in the field of the disaster can be immediately and easily sent to the control station (**Photo 2**). Since the walkie-talkie contains a camera, users do not have to carry peripherals such as the digital camera and notebook PC. Thus, mobility in the field of the disaster can be enhanced.

The image data picked up with the mobile walkie-talkie can be stored in and browsed on the local terminal. It can also be sent to the position/image management unit for browsing on the management unit. Image data can be also browsed on the remote PC connected to the position/image management unit via the network.

The mobile walkie-talkie supports the TDMA communication mode using one slot as well as the communication mode using multiple slots to reduce the image transmission time.

(2) Position Information Transmission

To support the needs of collecting the position information of the mobile station walkie-talkie, grasping the status of the field activities, and conducting adequate field activities, the transportable walkie-talkie contains a GPS unit (The GPS unit can be optionally attached to the outside of the mobile walkie-talkie). The position information of the walkie-talkie measured using the GPS unit is sent to the position/image management unit for e.g. mapping display on the map (**Fig. 2**). Consequently, the GPS unit can be utilized for grasping the walkie-talkie position status and managing the moving state of the vehicle mounted with the transportable walkie-talkie. By adding the position information to the picture taken by the afore-mentioned camera contained in mobile walkie-talkie, the location where the picture was taken can be checked when the image is being browsed on the position/image management unit.

(3) Data Transmission

With the Digital Mobile Telecommunication System for Local Government, voice communication and fixed phrase short messages specified as standard as well as data transmission (non-voice data) applications are available. In addition to the afore-mentioned data transmission functions such as image transmission and position information, data transmission functions using the mail function (free-form message transmission), facsimile transmission function, and data terminal are supported. For the facsimile transmission function, communication between the facsimile in the control station and the facsimile connected to the semi-fixed radio unit and communication with the facsimile connected via the PBX in the control station are available. Further, by utilizing the facsimile transmission function, broadcast facsimile transmission from the facsimile in the control station and group facsimile transmission from the semi-fixed station as well as individual facsimile transmission are supported.

(4) Supporting the IP Network

Most traditional systems used the analog or digital private line between the equipment in the control station and the equipment in the base station. However, the information highway built up with an optical network and private micro radio systems often use the IP network recently, so the components of this system support the IP network. As a result, the system can be built up while the IP network is being uti-

Photo 2 Picture taken with the mobile walkie-talkie.

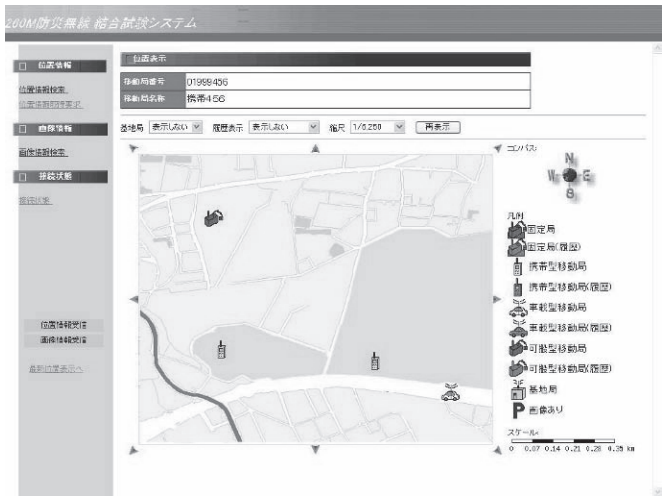

Fig. 2 Position information mapping display on the position/image management unit.

lized to the maximum extent possible and the system's total installation cost can be reduced.

4. Application Examples

Introduction of the Digital Mobile Telecommunication System for Local Government has enabled image transmission, position information communication using GPS data and data communication in addition to voice communication. Thus, the scope of the system is greatly expanded.

(1) Collection of Disaster Prevention Information

The server of the disaster prevention information system is connected to the control station in this system and the disaster prevention information terminals (data terminals) connected to the fixed radio terminal are installed in multiple branches or shelters.

Information on the devastated area including the damage prompt report, evacuee information, and request for goods and personnel can be entered from the disaster prevention information terminal and sent to the disaster prevention information system via this system (**Fig. 3**).

Normally, disaster prevention information is transmitted using a high-speed optical network. If the optical network is damaged by a disaster, disaster prevention information can be collected by using this system via the temporarily installed disaster prevention information terminal.

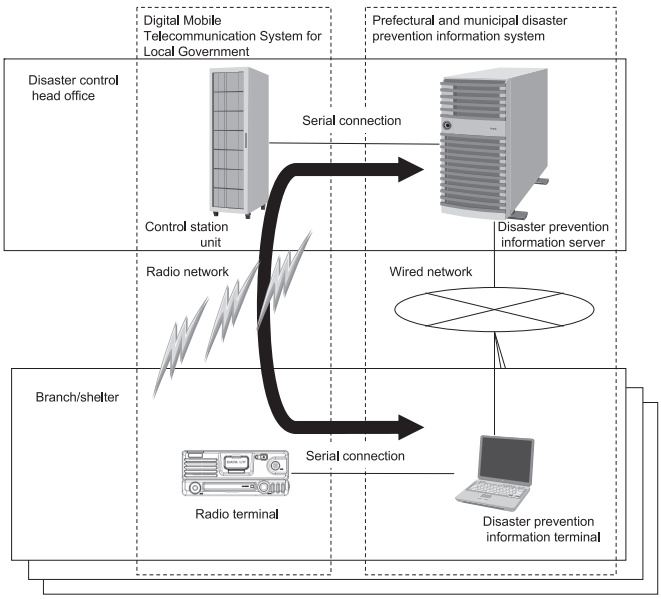

Fig. 3 Disaster prevention information collection function.

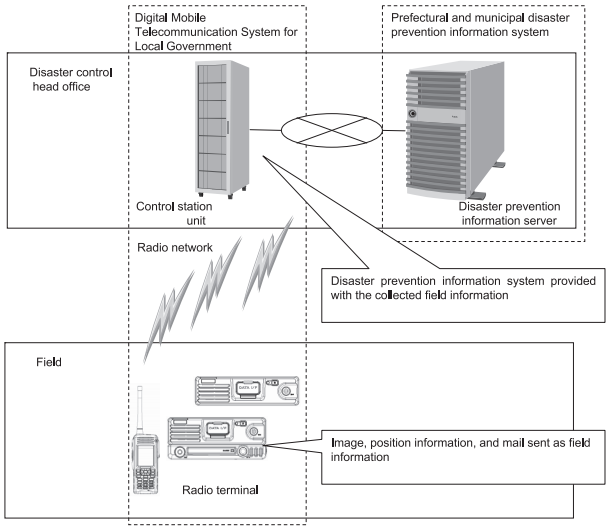

Fig. 4 Image information, position information, and mail transmitted from the mobile station.

(2) Image Information, Position Information, and Mail Transmitted from the Mobile Station

By connecting the server of the disaster prevention information system to the control station via LAN, image information, GPS information, and mail collected in the mobile station can be sent to the disaster prevention information system via this system (**Fig. 4**).

Further, if the disaster prevention information system has the map function, information on the field can be collected through one click by linking the image information, mail, etc. in advance on the map.

As described above, introduction of this system can enhance redundancy of the disaster prevention information system in the event of network failures through the use of voice communication as well as non-voice communication. Additionally, intuitive collection of field information is enabled through collaboration with the map system.

5. Conclusion

This paper reported the overview and development result of the Digital Mobile Telecommunication System for Local Government. The public mobile radio system is changing from

analog into digital. The system must be built up in consideration of cost-effectiveness including the installation cost as well as the long-time maintenance cost. For this purpose, we will utilize not only the software radio technology described above as well as the newest technologies including next generation network (NGN) technology and radio system broadband technology so as to develop the social infrastructure system that can contribute to security and safety.

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