RECOMMENDATION ITU-R BT.1774*

Use of satellite and terrestrial broadcast infrastructures for public warning, disaster mitigation and relief

(Question ITU-R 118/6)

(2006)

Scope

This Recommendation provides characteristics of satellite and terrestrial broadcasting systems used for disaster mitigation and relief operations. Detailed descriptions of these systems are also given in Annex 1 as guidance.

The ITU Radiocommunication Assembly,

considering

a) the recent natural tragedies due for example, to earthquakes and their consequences, alongside the possible role of communications in public warning, disaster mitigation and relief;

b) that all administrations recognize the need to organize information dealing with public warning, disaster mitigation and relief;

c) that in cases, when the "wired" or "wireless" telecommunication infrastructure is significantly or completely destroyed by a disaster, broadcasting services can often still be employed for public warning, disaster mitigation and relief operation;

d) that broadcast frequency bands are largely globally harmonized and could be used for disseminating public alert messages and advice to large sections of the population;

e) that broadcast frequency bands could be used for coordination of relief activities by disseminating information from relief planning teams to the population and provide information on the well-being of individuals, especially from the affected area;

f) that within the terrestrial broadcasting infrastructure there are a number of systems offering communication services that allow global or regional coverage;

g) that users of the broadcasting services are expected to be using both portable and fixed terminals for emergency services, especially in sparsely populated, uninhabited or remote areas;

h) that within the broadcasting services there is a great and growing need to determine standard international routing procedures for emergency traffic;

j) that many administrations have already established emergency communication traffic procedures including means for secure control of their utilization;

k) that distress, emergency, safety and other communications are defined in the Radio Regulations (RR);

* This Recommendation should be brought to the attention of Telecommunication Standardization Study Groups 9 and 16 and Telecommunication Development Study Group 2.

l) that individual broadcasters will always have their own security control over their programme material and their network;

m) that many stations operating in the broadcasting service can operate without externally provided power for some time (up to weeks),

n) that sound and television broadcasting organisations have developed techniques often referred to as "electronic news gathering" for the dissemination of information in programmes called "news bulletins" to inform the public of the extent of disasters and the recovery efforts being undertaken,

recognizing

a) that the broadcasting infrastructure is actually used to reach several billion people in a short period of time;

b) that in some countries, such alert systems such as the emergency warning system (EWS) or emergency alert broadcasting have been implemented in which broadcasting stations are connected to governmental or international organizations which issue disaster forecasts;

c) that a single transmitter operating in the LF, MF and HF frequency bands as well as space stations of the BSS cover large service areas;

d) that the RR foresee provisions by means of which BSS feeder links subject to Appendix 30A can be converted into FSS links (e.g. for VSAT operations in an emergency area);

e) that in some cases, a broadcasting station has its own seismometers in the country, analyses the seismic intensities, and voluntarily issues precautions to the public through broadcasts;

f) that ITU-R has established studies into spectrum usage and users requirements for terrestrial electronic news gathering in Radiocommunication Study Group 6,

recommends

1 that responsible agencies should prepare procedures and routines to send information on public warning, disaster mitigation and relief to transmitting or network distribution centres in accordance with agreed technical signal protocols;

2 that broadcast transmitters and receivers should be equipped to receive material prepared by the responsible agencies;

3 that systems for transmission and reception should include the possibility for forcing suitably equipped and suitably primed receivers (whether switched on or in standby mode) to present programme material for disaster mitigation and relief without intervention from the listener or viewer; so that all citizens can become informed of a possible disaster within the shortest possible period of time; with a robust mechanism against abuse of this feature;

4 that for *recommends* 1-3, public warning systems on broadcasting as given in Annex 1 should be considered;

5 that in case of public warning, disaster mitigation and relief, broadcasting transmitters should disseminate information advising at a local, national level and/or, potentially, even across national borders as appropriate;

6 that administrations should coordinate where possible with sound and television broadcasting organizations the application of electronic news gathering resources in the disaster area to maximize the potential for using the information gathered in a timely and coordinated fashion to assist the disaster mitigation and relief efforts.

Annex 1

Public warning systems on broadcasting

1 Introduction

This Annex presents an overview of public warning systems in the broadcasting service.

2 Outline of public warning systems on broadcasting

Broadcasters have two functions in disaster management. One is gathering or receiving information from disaster radiocommunication networks connected to administrative organizations. The exclusive line connected to the administrative organizations is preferably to be used for urgent alerts and such information as earthquake and tsunami data. The other function is delivering information to the general public. Some municipalities in some countries may have a multicasting system to outdoor receivers with loudspeakers in their own disaster radiocommunication network. However, it may be difficult to hear the sound indoors, especially in bad weather such as storms or heavy rain. Therefore, disaster alerts and information via broadcasting is useful for disaster mitigation.

3 EWS for analogue broadcasting

The system should use relatively simple equipment and ensure stable operations. In an emergency, the EWS control signal, which is an analogue signal, replaces the programme signal (radio and TV sound), automatically activating the receivers equipped with EWS function even when they are sleeping.

The EWS control signal can be used for alarm sound to draw the attention of listeners/viewers to emergency broadcasting programmes. Broadcasters operating TV and radio can transmit the EWS control signal. The EWS control signal includes an area code as well as a time code, keeping the receiver protected from intentional fake control signals.

4 EWS for digital broadcasting

In digital broadcasting, the EWS control signal is transmitted by multiplexing with broadcast wave. It automatically activates the receivers equipped with the EWS function when they are sleeping. The EWS control signal should be robust against the abuse of this feature. It is foreseen that the receiving function of digital broadcasting will be installed in mobile terminals such as cellular phones. It is effective to send emergency information to such mobile terminals. Therefore, such mobile terminals are desired to be equipped with the EWS function for digital broadcasting.

Appendix 1

Examples of public warning systems on broadcasting

1 Introduction

This Appendix presents a system overview and the current status of public warning systems on broadcasting in some countries/regions.

2 Japan

This section describes the present state of public warning systems on broadcasting in Japan. This system is called the emergency warning system (EWS).

2.1 Disaster management system

This section provides some information on the disaster management system in Japan for the public warning system on broadcasting.

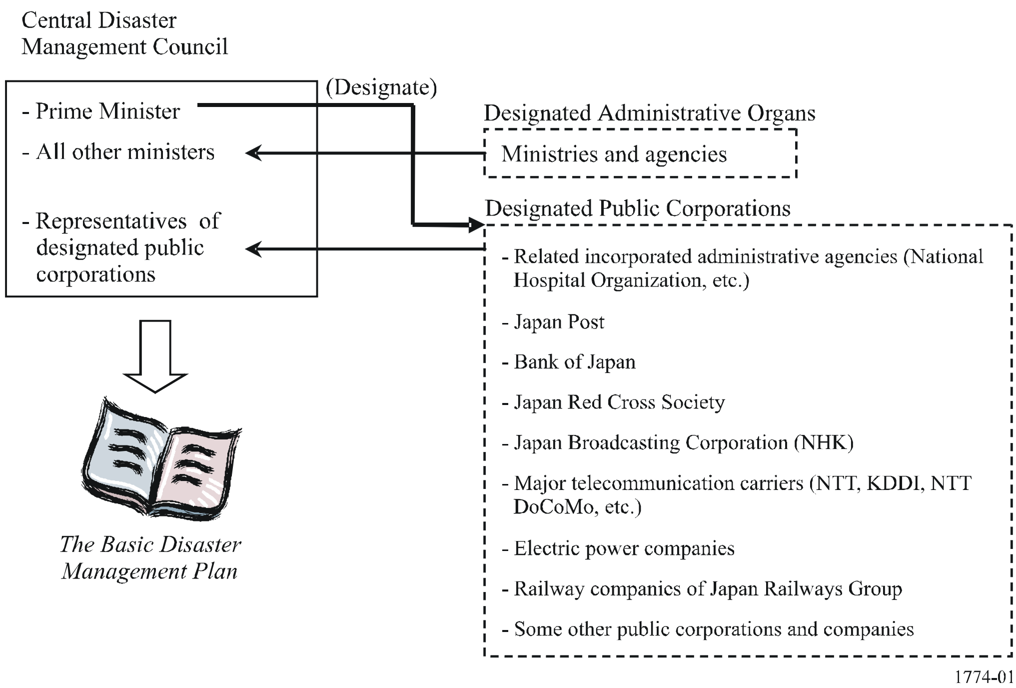
2.1.1 Disaster management plans

The disaster management system is specified in the disaster countermeasures basic act. The prime minister designated Japan broadcasting corporation (NHK) as the designated public corporation and the governor of each prefecture designated most commercial broadcasters operating terrestrial broadcasting stations as designated local public corporations.

On the national level, the Central Disaster Management Council is organized with the representatives of designated public corporations. The Council formulates the basic disaster management plan as the national master plan, and promotes execution of the plan (Fig. 1):

FIGURE 1

The structure of disaster management (national level)

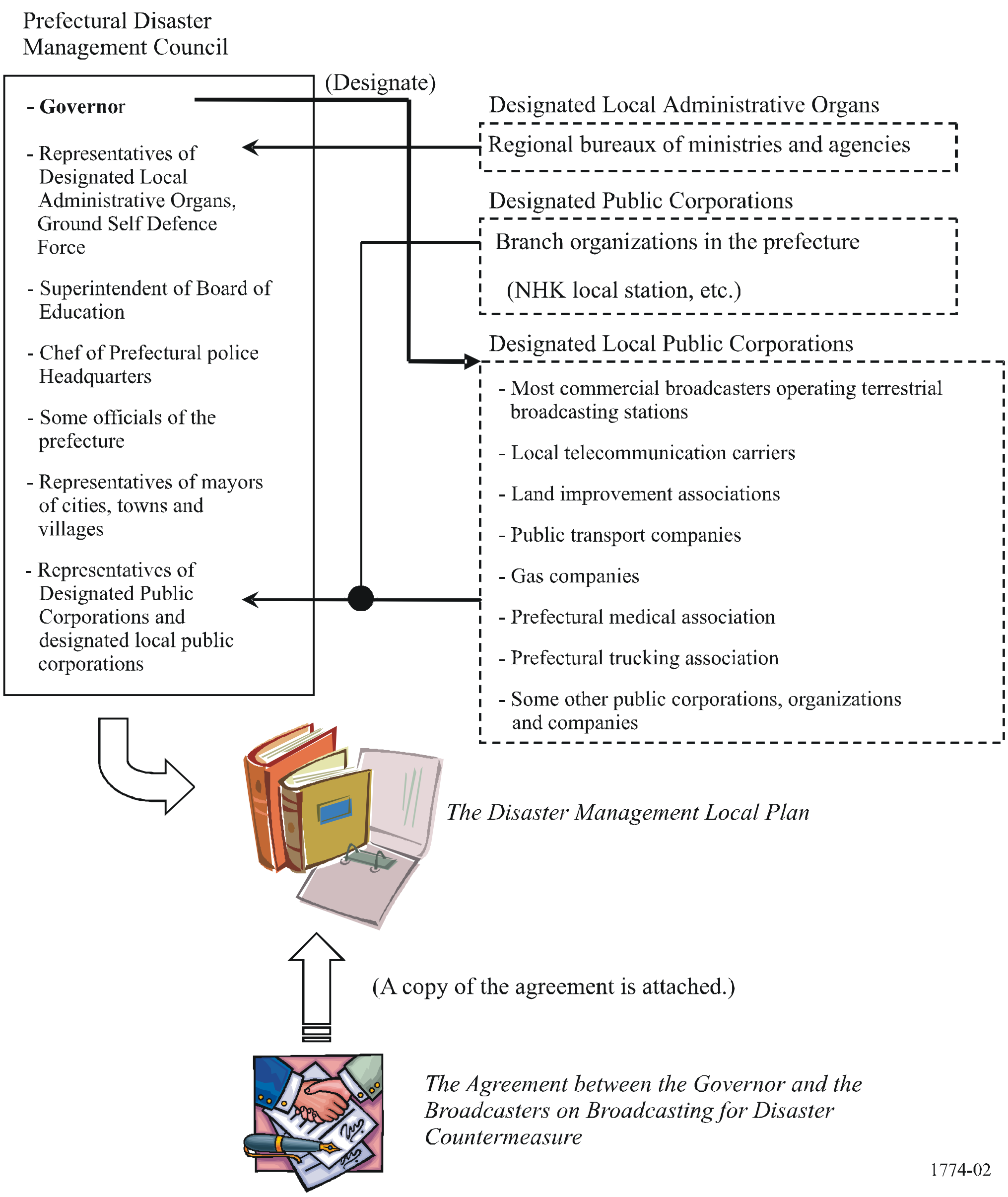


On the prefectural level, the Prefectural Disaster Management Council is organized with the representatives of designated public corporations and designated local public corporations. The Council formulates the disaster management local plan, and promotes execution of the Plan (Fig. 2).

The disaster management local plan consists of several volumes, such as "Earthquake disaster countermeasures", "Storm and flood countermeasures", "Volcano disaster countermeasures". The Plan is also used as the manual of disaster management. Therefore, the copy of the agreement between the governor and the broadcasters on broadcasting for disaster countermeasures is attached to the Plan. The procedure for broadcast request by the governor or the mayors to the broadcasters is specified by the agreement and would be reflected to the Plan.

FIGURE 2

The structure of disaster management (prefectural level)

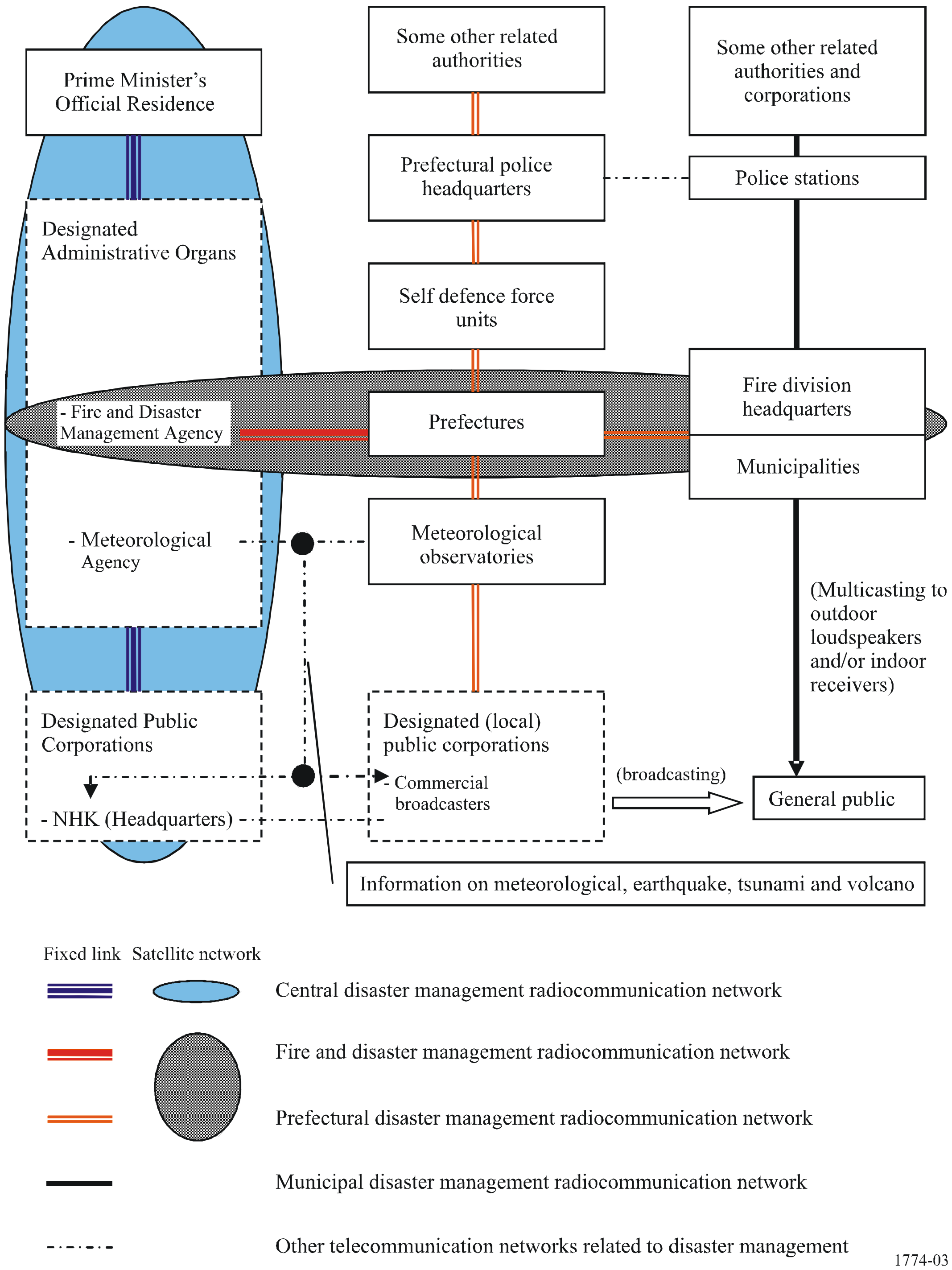


2.1.2 Telecommunication networks for disaster management

In the case of an emergency, the traffic of public switched telephone networks would be increased and it would be difficult to connect to the destinations. Wired telecommunication lines would suffer from some disasters. Therefore, it is very important to ensure an independent radiocommunication network for disaster management. Figure 3 shows disaster radiocommunication networks and related telecommunication networks in Japan. Disaster radiocommunication networks are established in the three layers of national, prefectural and municipal.

FIGURE 3

Disaster management radiocommunication and related network



Broadcasters have two functions in the networks. One of them is gathering information. For this purpose, disaster radiocommunication networks connected to administrative organs are used. In addition, the exclusive line from the meteorological agency is also used for urgent alert and such information as earthquake and tsunami data.

The other function is delivering information to the general public. Many municipalities have a multicasting system to outdoor receivers with loudspeakers in their own disaster radio-communication network. However, it is difficult to hear the sound indoors, especially in bad weather such as storms or heavy rain. Though a few municipalities lend indoor receivers to its residents, it is expensive. Therefore, disaster alert and information via broadcasting is also useful for disaster mitigation.

2.1.3 Disaster management drills

Disaster management drills are conducted in order to confirm and verify that the disaster management system of each organization is capable of smoothly carrying out the required activities should a disaster occur. On 1 September, disaster management day (the day in 1923, Great Kanto Earthquake occurred), the government and related disaster management organizations mutually cooperate to hold wide-ranging, large-scale disaster management drills throughout Japan. Additionally, in each region, drills based on past disasters are conducted year-round.

Broadcasters participate in the training activities of these national and regional disaster management drills in addition to the training within each organization.

2.2 Earthquake and tsunami warning broadcasting

2.2.1 Gathering information

2.2.1.1 Japan meteorological agency's quick reports on earthquake and tsunami

Japan, an archipelago that lies on several active seismic faults, has experienced numerous earthquakes in the past that have left many people dead. The 1993 earthquake off the south-western part of Hokkaido created a massive tsunami that struck the island of Okushiri in just 5 min, killing 202 people and leaving 28 people missing, and severely damaging property. It was after this incident that the Meteorological Agency began studying a system to quickly issue a tsunami warning in the event of an earthquake.

In March 1995, the agency launched a system capable of the following:

– About 2 min after an earthquake, issuing emergency quake intensity (quake intensity of a particular zone viewed as a two-dimensional plane, with the entire country divided into about 150 zones (currently 180)).

– About 3 min after the quake, issuing a tsunami warning.

– About 5 min after the quake, issuing individual quake intensity (at about 3 700 points across the country where seismographs are installed, including those managed by municipalities).

Under this system, the agency increases the number of seismographs to improve the accuracy of quake intensity measurement and tsunami warnings. First, the emergency quake intensity gives preliminary information about the earthquake, enabling the agency to quickly assess whether a tsunami warning should be issued or not. Next, the individual quake intensity is issued.

The new system is thus designed primarily to speed up the process of issuing a tsunami warning. Furthermore, as the tsunami danger area is divided into 66 zones, the agency can issue a tsunami warning with greater accuracy. In addition to its domestic quake observation network that crisscrossed the country, the agency uses information provided by the incorporated research institutions for seismology (IRIS) and the pacific tsunami warning center (PTWC) in Hawaii to issue a tsunami warning in the event of an earthquake in the seabed of the pacific ocean.

2.2.1.2 Broadcaster's own network of seismographs

The seismic data from the Meteorological Agency reaches NHK about 2 min after an earthquake. Other than this seismic observation network operated by the agency, NHK has its own seismographs installed at 72 points across the country, from which it gathers seismic data about 20 s to 1 min after an earthquake. With this data, NHK can immediately prepare to broadcast the seismic data from the agency upon arrival. If the quake intensity is estimated to exceed the danger level, NHK begins broadcasting seismic information ahead of the agency. The commercial broadcasters also measure seismic intensity data and use its emergency broadcasting operation as well as NHK.

2.2.1.3 Robot cameras

NHK has about 440 robot cameras stationed across the country. Those installed along coastlines are the first to warn the public of the most imminent tsunami danger. Although of low image quality, the pictures recorded by these 440 robot cameras are stored for 12 h in a robot camera monitoring system. The system automatically picks robot cameras of the most affected areas, and displays the images at the moment when the quake occurred. With these automatically produced quake/tsunami information images, robot cameras, and monitoring system, NHK is the first to provide accurate information on earthquakes and tsunami immediately after they occur.

The commercial broadcasters also set robot cameras and use them in a breaking report of the earthquake as well as NHK.

2.2.2 Delivery information

2.2.2.1 Earthquake and tsunami warning broadcasting system

The Meteorological Agency had modified and upgraded its earthquake and tsunami warning system from 1995 till 1999, and NHK followed by renewing its tsunami warning broadcasting system. Earthquake and tsunami data issued by the agency are first transmitted to NHK over data lines. At NHK, its computers will then automatically produce a variety of visual information including "superimposed quake/tsunami images", "earthquake maps", "tsunami maps", and "expected tsunami arrival times". Scripts to be read by an announcer on air will also be automatically produced by an announcement script display system based on data provided by the agency. Upon receiving seismic data from the agency, NHK will immediately begin broadcasting quake/tsunami programmes with the latest information (Fig. 4).

The commercial broadcasters also construct the system that can promptly broadcast latest information on the earthquake and the tidal wave as well as NHK.

2.2.2.2 Emergency console

In 1992, the NHK News Centre installed an "emergency console" (Fig. 5) to further speed up the broadcasting of earthquakes and other emergency news programmes. This console makes it far simpler and quicker to make changes in prearranged programmes as such changes are necessary to broadcast emergency news.

If a tsunami warning is issued, NHK will broadcast an emergency warning to warn the public of possible dangers. The moment it receives a tsunami warning from the Meteorological Agency, NHK uses the console to complete preparations for emergency broadcasting through all of its 13 media (terrestrial television, radio, satellite broadcasting) outlets. Upon pressing only one button of the console, emergency news programmes will be aired automatically.

FIGURE 4

The earthquake and tsunami warning broadcasting system

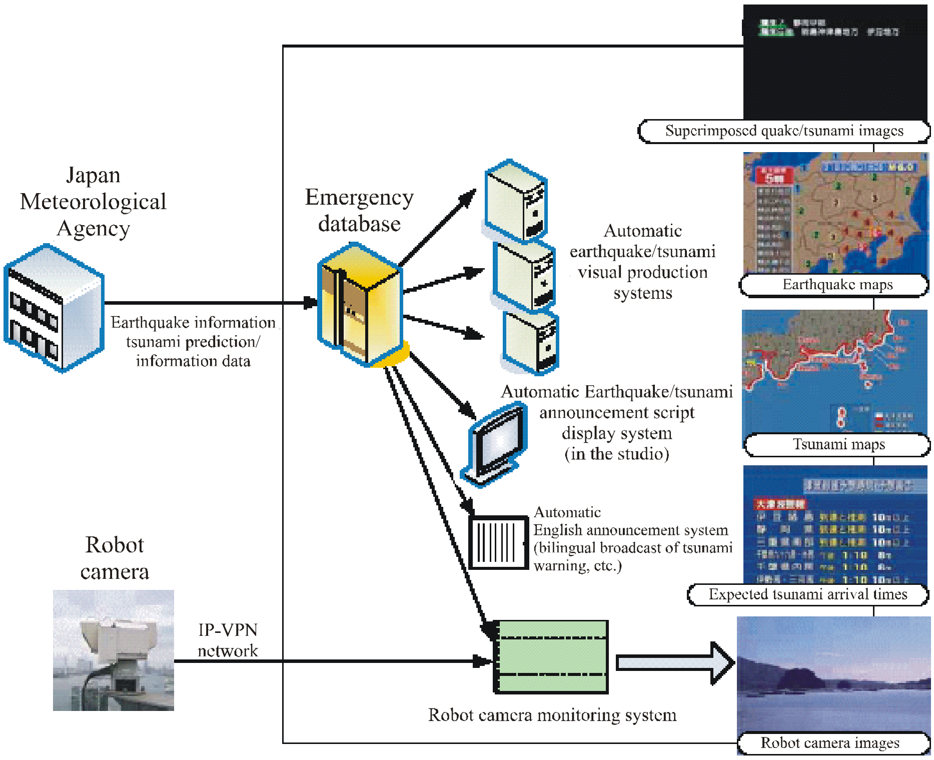


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FIGURE 5

Emergency console

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2.3 EWS over analogue broadcasting

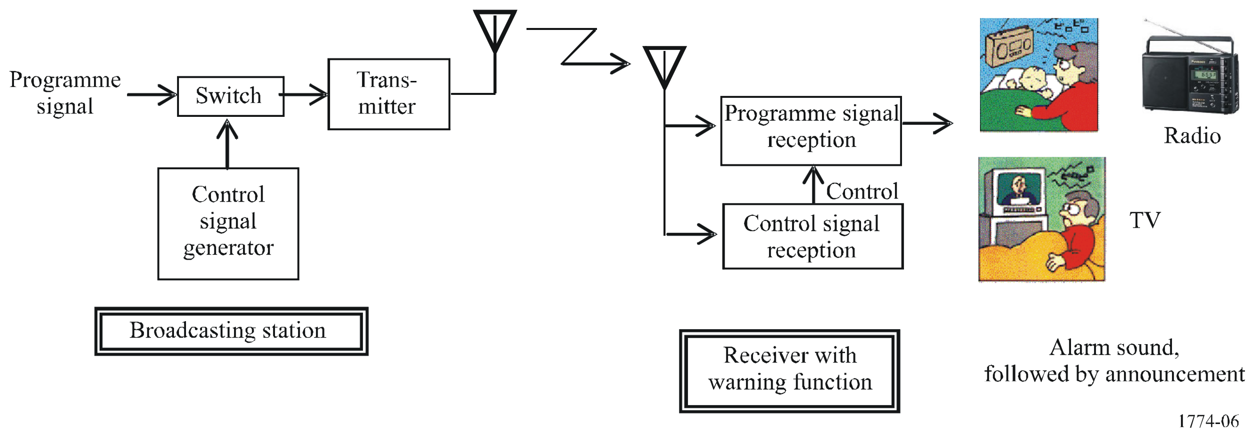
2.3.1 Overview

The emergency warning system developed by NHK Science and Technical Research Laboratories (NHK STRL) in the 1980s, promptly and effectively conveys to the public emergency notices such as tsunami warnings. It works through conventional broadcasting systems by automatically actuating warning receivers. This service has been in operation since 1985 in Japan.

The composition of a typical emergency warning system is shown in Fig. 6. In an emergency, the control signal replaces the programme signal (radio and TV sound), automatically activating the warning receivers even when they are switched off. The control signal is composed of two frequencies near 1 kHz and set at a level higher than the normal programme signal. The control signal is also used for the warning sound. The system uses relatively simple equipment to ensure stable operations.

FIGURE 6

Composition of emergency warning system for analogue broadcastings



The warning receiver issues a special alarm sound, a demodulated control signal, to draw the attention of listeners/viewers to emergency broadcasting programmes. At NHK, the control signal can be transmitted through satellite TV, terrestrial TV, MF radio and FM radio. Many commercial broadcasters operating terrestrial TV and MF radio can also transmit the control signal. The control signal includes an area code as well as a time code, keeping the warning receiver shielded from intentional fake control signals.

In Japan, several types of warning receivers have been commercially produced. NHK and many commercial broadcasters periodically transmit test control signals in emergency warning broadcasting on the first day of each month.

2.3.2 Operation of EWS

Broadcasters operate EWS only in the following cases:

		Start signal	Area code
(1)	Large-scale earthquake warning statement is declared by Meteorological Agency	Category I	Nationwide
(2)	Including broadcasting of evacuation order is requested by governor of prefecture	Category I	Prefecture or wide area
(3)	Tsunami warning is declared by Meteorological Agency	Category II	Nationwide, prefecture or wide area

Category I activates all EWS receivers in the service area. Category II activates only the relevant EWS receivers.

In cases (1) and (2), broadcasters will transmit the Category I start signal. In case (3), as inland users do not need to evacuate, broadcasters will transmit the Category II start signal.

After the emergency warning message, broadcasters will transmit the end signal to turn off EWS receivers.

2.3.3 Specification and configuration of EWS signal

The modulation method of the EWS signal is the frequency shift keying (FSK) method with a space frequency of 640 Hz and a mark frequency of 1 024 Hz. The allowable frequency deviation is plus or minus ten parts per million in each case. The transmission speed of the EWS signal is at 64 bits per second and this deviation is ten parts per million. Signal distortion is below 5%. The configurations of the Category I start signal and Category II start signal are shown in Fig. 7, and that of the end signal is shown in Fig. 8.

FIGURE 7

The configurations of Category I start signal and Category II start signal

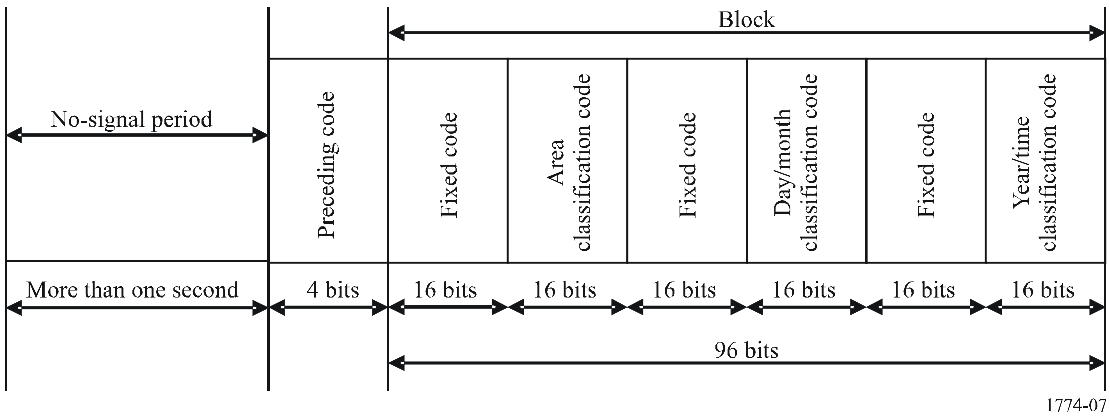
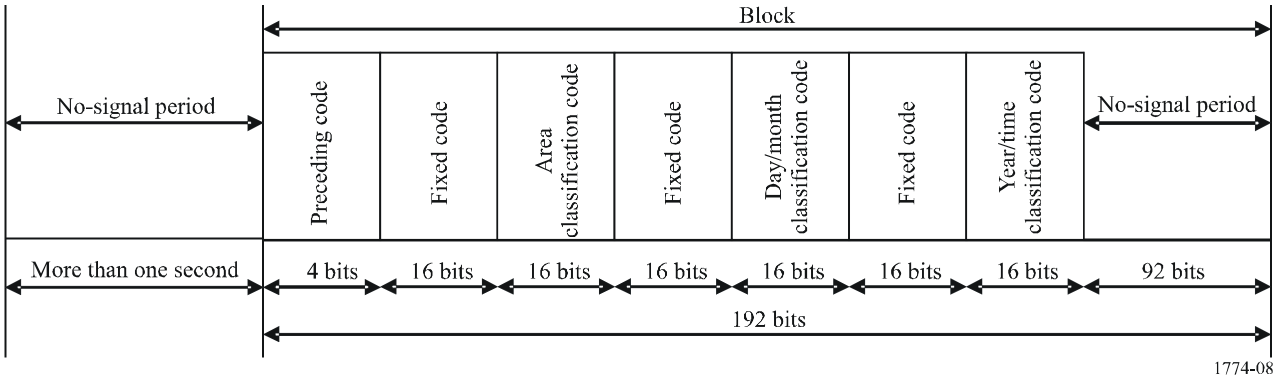


FIGURE 8

The configurations of end signal



Notes for Figs. 7 and 8:

1 Fixed code: The fixed code consists of a 16-bit code inherent in the EWS signal. It is used for extracting the EWS signals from sound signals. Furthermore, it is used for distinguishing between the Category I start signal and the Category II start signal.

2 Area classification code: The area classification code is for operating a receiver in restricted regional areas. The purpose of this code is to avoid triggering receivers other than the relevant receivers by anomalous propagation of broadcasts.

3 Year/month/day/time classification code: The year/month/day/time classification code is used for transmitting real-time information for preventing operation of receivers by illegal radiowaves that are recorded and retransmitted after the EWS signals have been transmitted.

2.4 Digital emergency warning system (digital EWS)

This section introduces details regarding the digital emergency warning system (digital EWS) using digital broadcasting.

In digital broadcasting, the EWS signal is transmitted by multiplexing with the broadcast wave the same as for analogue broadcasting. Many existing TV receivers are able to receive the EWS signal. In the case of analogue TV receivers, these turn on automatically when the TV receiver detects the EWS signal, even if the switch is set to off, and the viewer can obtain the urgent information. However, digital TV receivers can receive this signal only when the switch of the TV receivers is turned on, under the current situation.

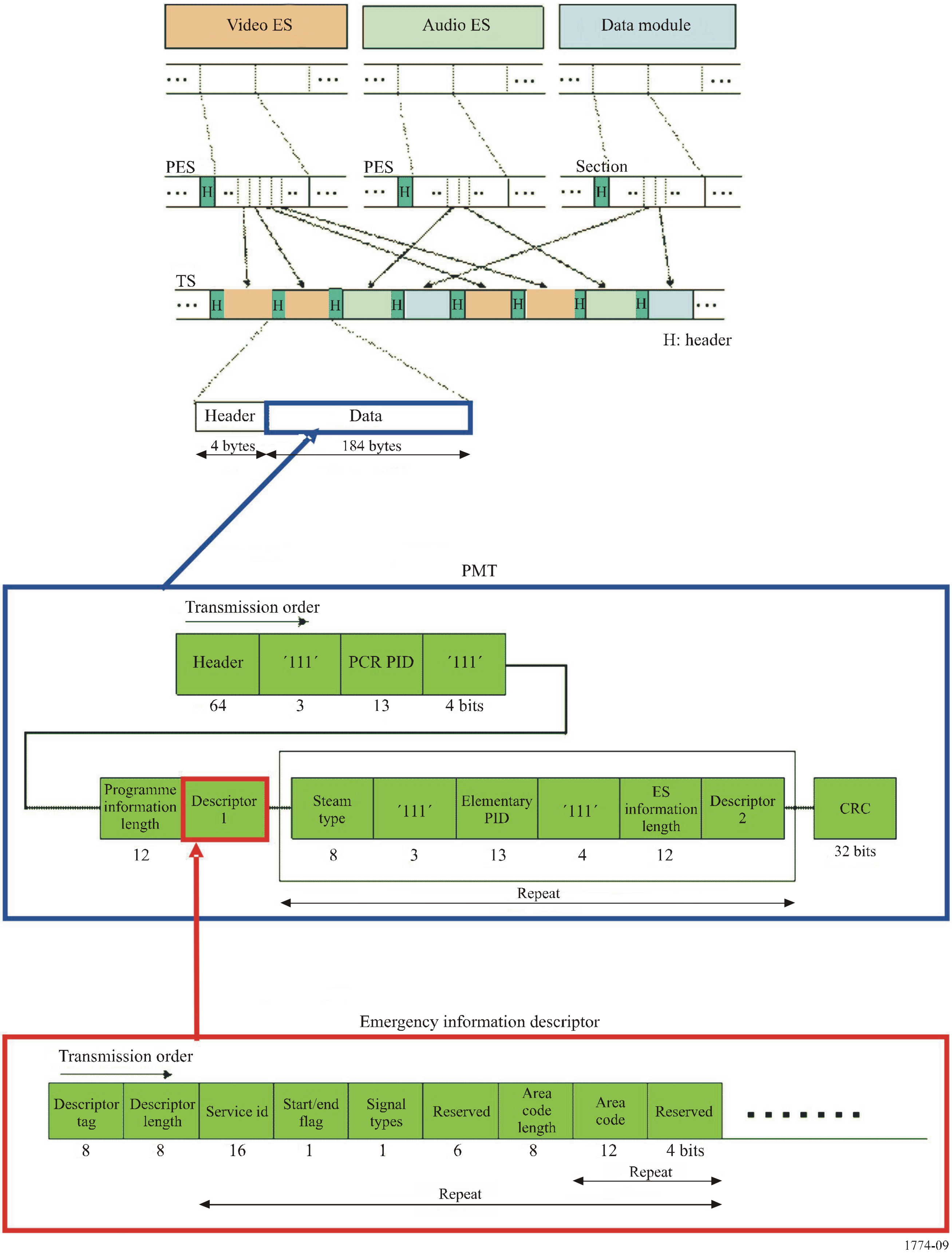
Fundamentally, the operation when the EWS signal is received is established by the product specification of each manufacturer.

2.4.1 Technical specifications of digital EWS

The emergency information descriptor may be used only for ISDB-TSB recommended in Recommendation ITU-R BS.1114 (System F), ISDB-T recommended in Recommendation ITU-R BT.1306 (System C), broadcasting-satellite service (sound) system using the 2.6 GHz band recommended in Recommendation ITU-R BO.1130 (System E), and ISDB-S recommended in Recommendation ITU-R BO.1408. The emergency information descriptor for EWS is placed in the Descriptor 1 field of the programme map table (PMT), which is periodically placed in the transport stream (TS). The details of the emergency information descriptor is shown in Fig. 9.

FIGURE 9

Structures of TS, PMT and emergency information descriptor



Notes to Fig. 9:

1 ES (elementary stream): ES is encoded video and audio, etc.

2 PES (packetized elementary stream): PES is packetized ES in each significant unit.

3 TS (transport stream): TS is divided PES, and the size is 188 bytes including 32 bytes of the header.

4 PID (packet identifier): PID shows what the transmitted packet is.

5 CRC (cyclic redundancy check): CRC is a type of hash function used to produce a checksum, which is a small number of bits, from a large block of data, such as a packet of network traffic or a block of a computer file, in order to detect errors in transmission or storage.

6 Descriptor tag: The value of the descriptor tag shall be 0xFC, representing the emergency information descriptor.

7 Descriptor length: The descriptor length shall be a field that writes the number of data bytes following this field.

8 Service id: The service id shall be used to identify the broadcast programme number.

9 Start/end flag: The value of the start/end flag shall be '1' and '0', respectively, when transmission of emergency information signal starts (or is currently in progress) or when transmission ends.

10 Signal types: The value of the signal type must be '0' and '1', respectively, for Category I and II start signals.

11 Area code length: The area code length shall be a field that writes the number of data bytes following this field.

12 Area code: The area code shall be a field transmitting the area code.

2.4.2 Mobile and portable reception

In Japan, digital terrestrial television broadcasting for mobile and portable reception using one of 13 segments will be launched in early 2006. Digital EWS for mobile and portable reception is the same as described in § 5.1, but the actual receiver is under development.

In digital reception with a mobile terminal, such as cellular phone or PDA (portable digital assistant), the following effects are expected in the disaster prevention field:

– realize a congestion-free transmission path even in times of disaster;
– realize stable information transmission even in times of emergency or disaster, through start-up control;
– realize communication paths according to areas and targets.

2.4.3 Automatic activation of handheld receivers by EWS signals

Digital terrestrial broadcasting has an emergency warning mechanism similar to that of analogue broadcasting. Broadcasting differs from telecommunications in that it can send information to a large number of handheld receivers at the same time. The ability to activate handheld receivers to receive emergency information would lead to a reduction in the damage caused by a disaster. For this to be effective, a handheld receiver would have to be in the constant stand-by mode for the EWS signals, but if the power consumption were too high, it would be difficult to maintain stand-by for a long time.

To solve this problem, a low-power-consumption EWS signal stand-by circuit that can maintain stand-by for the digital terrestrial broadcasting EWS signals have been studied.

FIGURE 10

A concept of digital EWS for mobile and portable reception

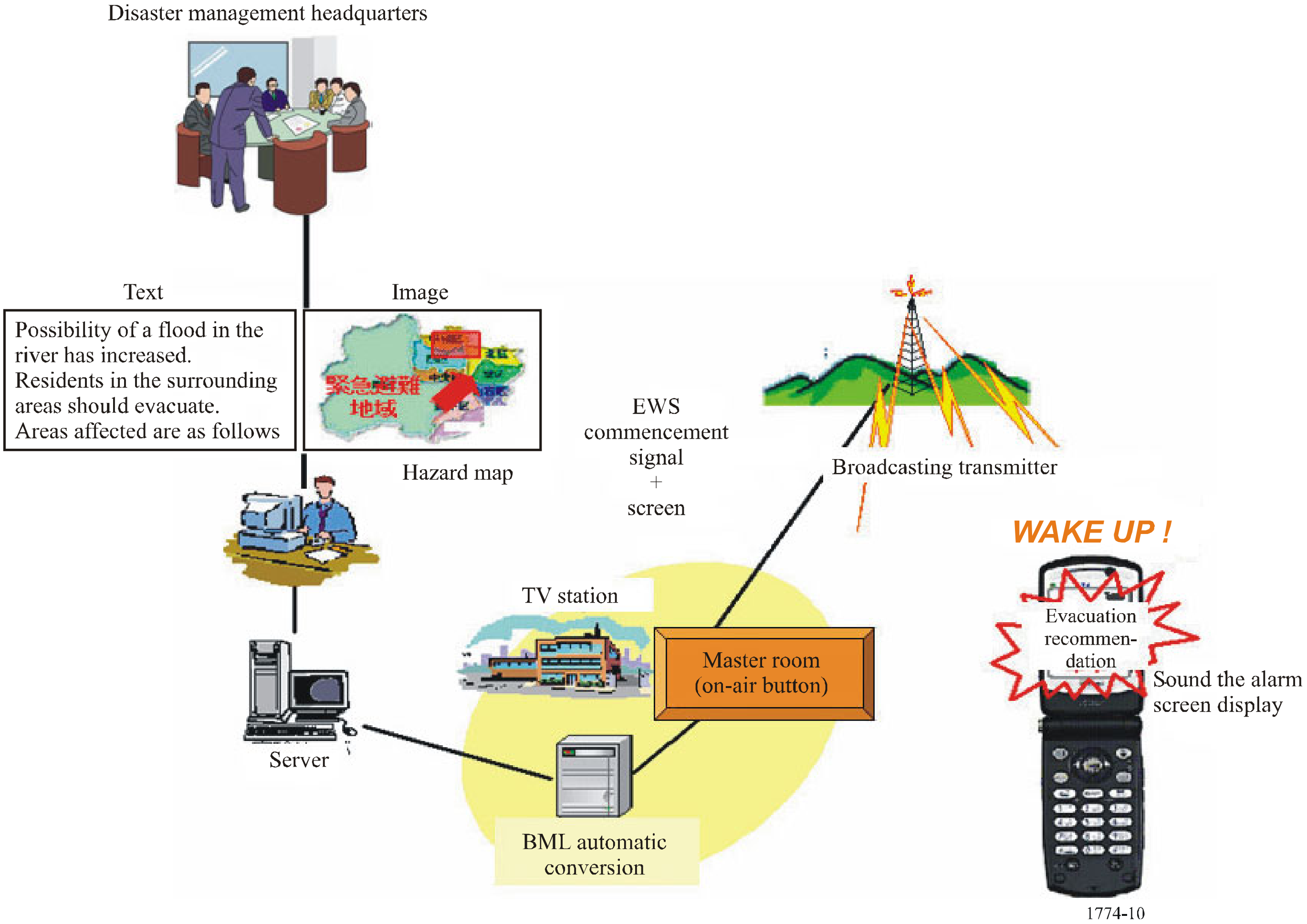


Figure 11 shows handheld receiver activation using EWS signals for digital terrestrial broadcasting.

An EWS signal is indicated by bit 26 of the transmission and multiplexing configuration control (TMCC) signals comprising 204 bits in System C of Recommendation ITU-R BT.1306. In the case of Mode 3 (number of carriers: 5 617), the number of TMCC carriers is 52 in total for 13 segments, or four carriers per segment. The TMCC signals modulated by differential binary phase shift keying (DBPSK) are transmitted at an interval of approximately 0.2 s.

To achieve remote activation, the EWS signals in one or more TMCC carriers are to be continuously monitored by each receiver. Furthermore, continuous monitoring shall be achieved without substantially shortening the stand-by time of handheld receivers. To reduce the power consumption, a dedicated stand-by algorithm is introduced that:

– extracts only TMCC carriers, and

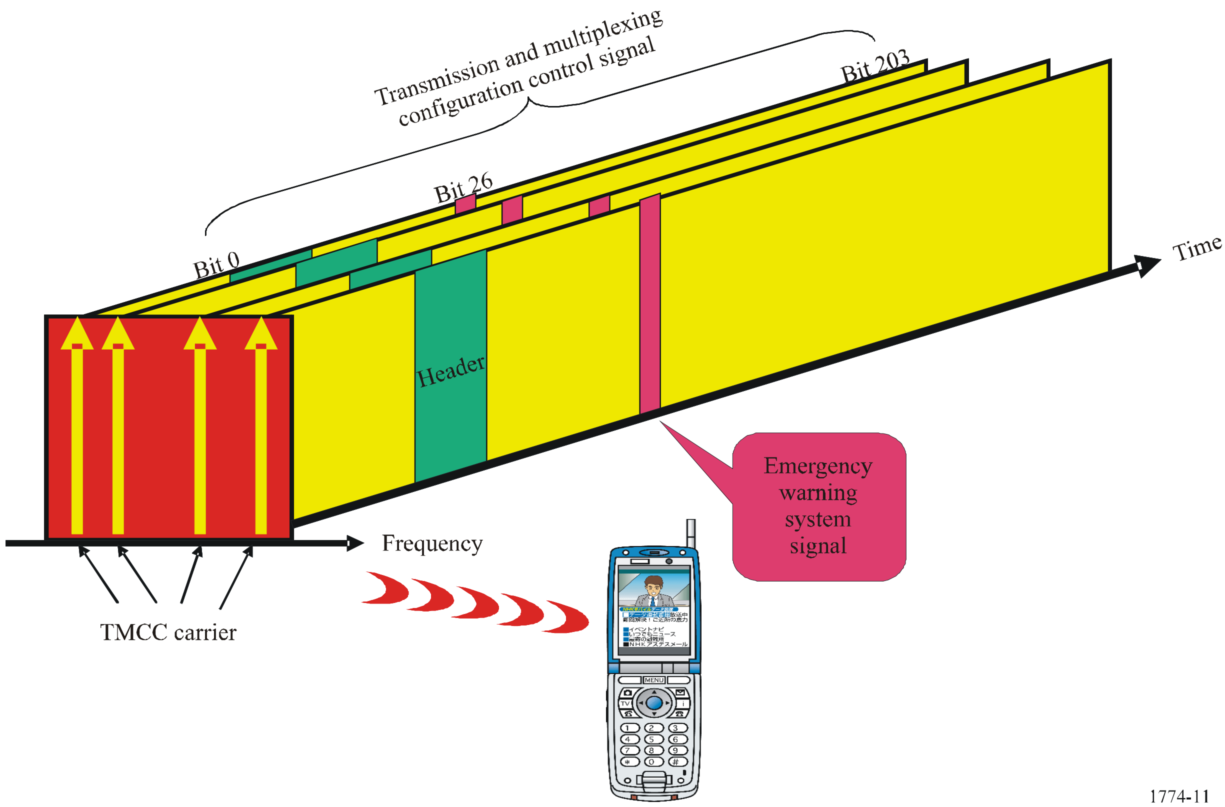
– monitors only the EWS signals by limiting time slots.

The function for EWS stand-by with very low power consumption has been verified.

The remote activation technique which uses the EWS signals in TMCC can also be applied to fixed receivers of System C of Recommendation ITU-R BT.1306.

FIGURE 11

Handheld receiver activation using EWS signals of digital terrestrial broadcasting



2.5 Bibliography (informative)

The information on the Emergency Warning System is available in the following references.

ARIB Standard, BTA R-001 Receiver for Emergency Warning System (EWS): (http://www.arib.or.jp/english/).

ARIB Standard, ARIB STD-B32 Video Coding, Audio Coding and Multiplexing Specifications for Digital Broadcasting: (http://www.arib.or.jp/english/)

ARIB Technical Report, ARIB TR-B14Operational Guidelines for Digital Terrestrial Television Broadcasting: (http://www.arib.or.jp/english/).