International Telecommunication Union

ITU-R

Radiocommunication Sector of ITU

Recommendation ITU-R BT.1774-1
(04/2007)

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

BT Series
Broadcasting service (television)

International Telecommunication Union

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SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
V	Vocabulary and related subjects

Note: *This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

Electronic Publication
Geneva, 2010

RECOMMENDATION ITU-R BT.1774-1*

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

(Question ITU-R 118/6)

(2006-2007)

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);

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);

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

n) that sound and television broadcasting organizations 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 to 3, public warning systems on broadcasting as given in Annex 1 may be considered;

5 that for *recommends* 1 to 4, public warning system control signals for analogue broadcasting as given in Annex 2 may also be considered by administrations implementing a public warning system;

6 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;

7 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 Emergency warning system 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, automatically activates the receivers equipped with EWS function even when they are standby.

Depending on its characteristics, the EWS control signal might also be used for alarm sound to draw the attention of listeners/viewers to emergency broadcasting programme. Broadcasters operating TV and radio can transmit the EWS control signal. The EWS control signal could include an area code as well as a time code, keeping the receiver protected from intentional fake control signals.

For a specific EWS for analogue broadcasting, a related control signal as described in Annex 2 is recommended to be used for automatic activation of receivers compliant with the systems described in Appendix 1 to Annex 1 for public warning, disaster mitigation and relief.

4 Emergency warning system 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
to Annex 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.

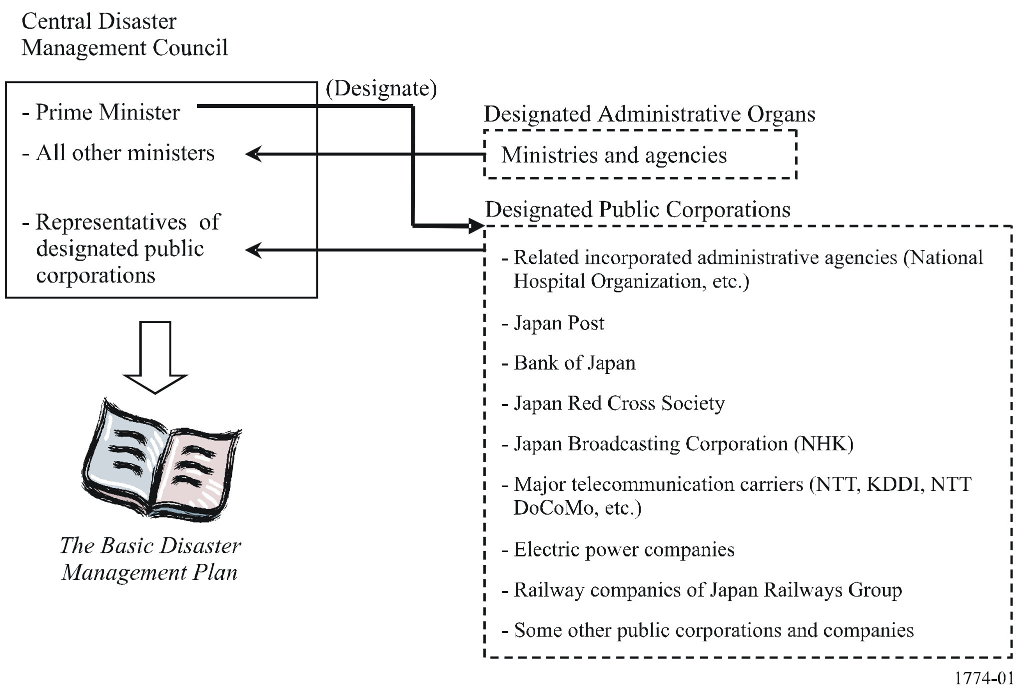
2.1.1 Disaster management plans

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)

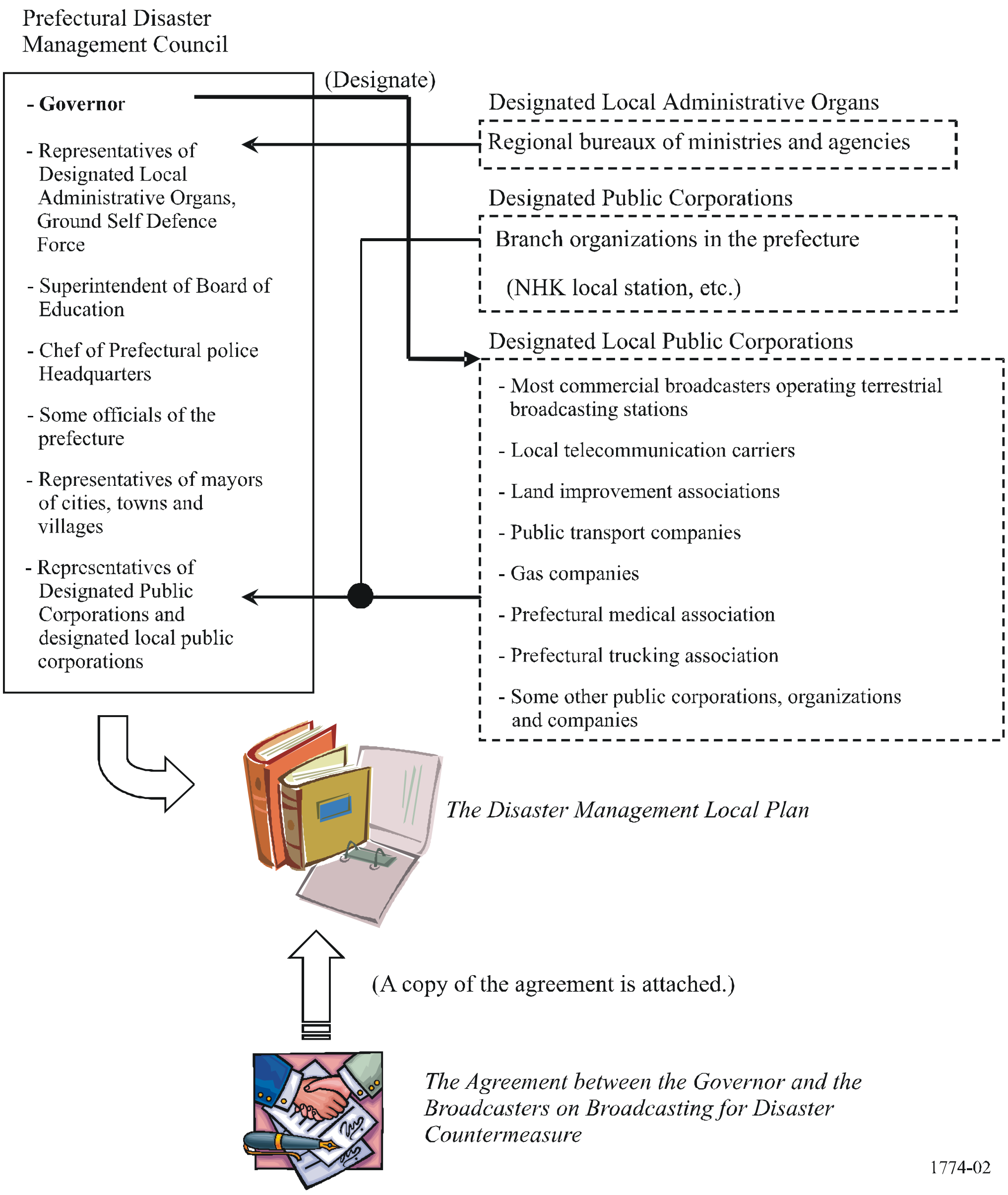


On the prefectural level, the Prefectural Disaster Management Council is organized with the representatives of designated public corporations and designated local public corporations. The Council formulates the disaster management local plan, and promotes execution of the Plan (Fig. 2).

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)

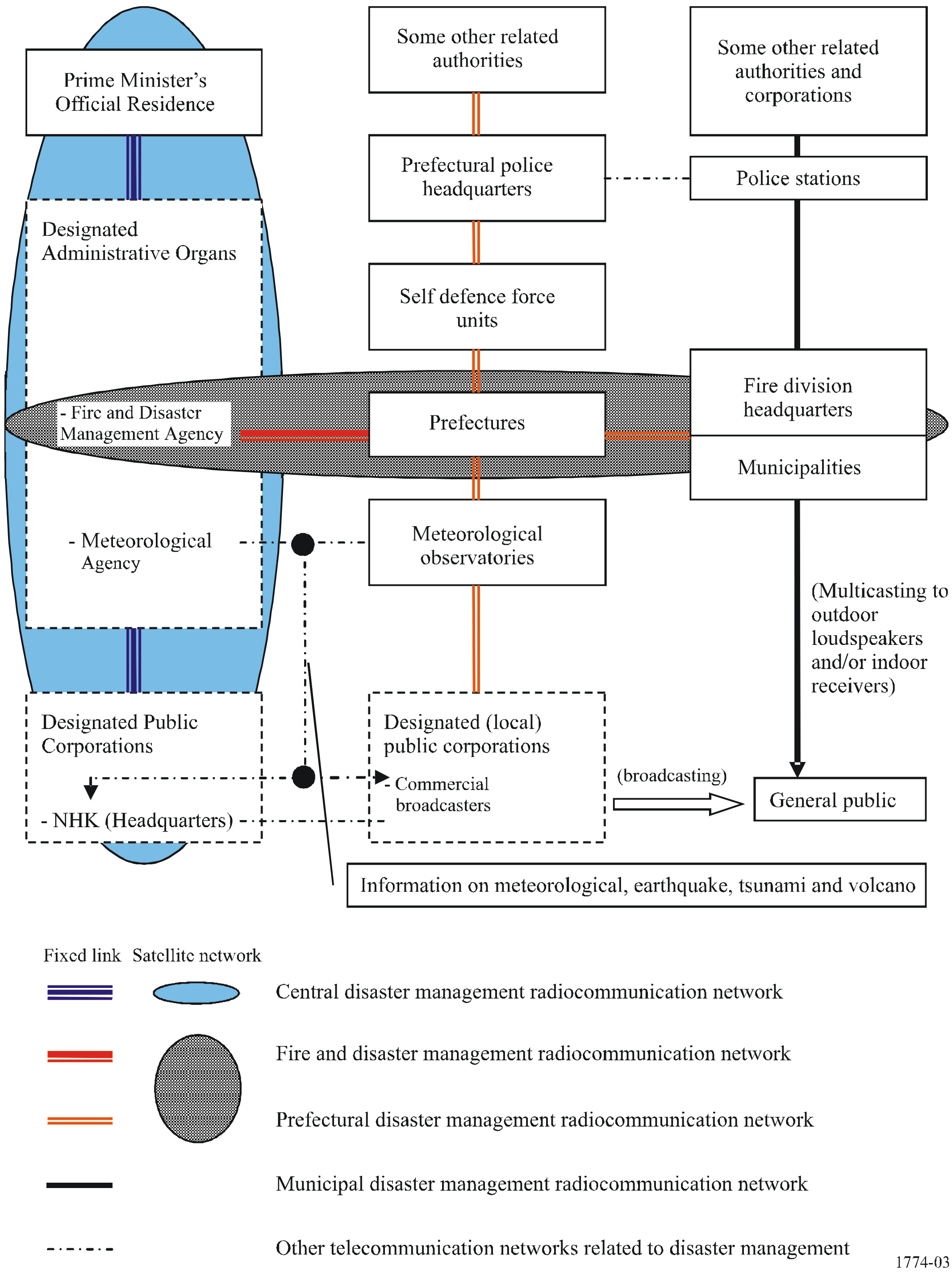


2.1.2 Telecommunication networks for disaster management

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.

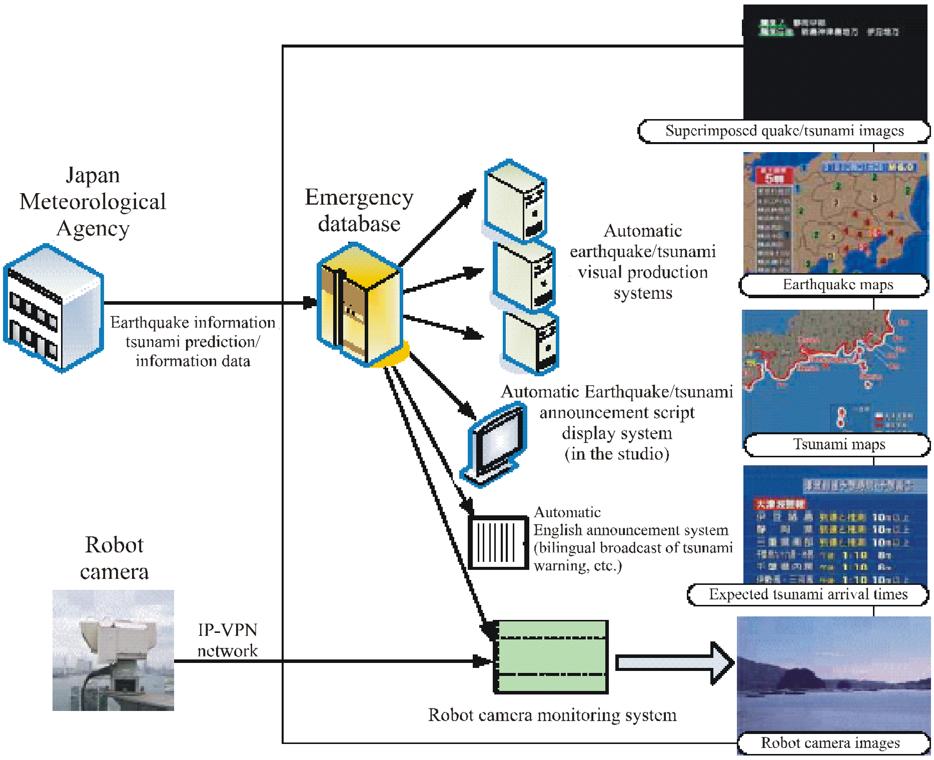
2.2.2.2 Emergency console

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



1774-04

FIGURE 5

Emergency console

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2.3 EWS over analogue broadcasting

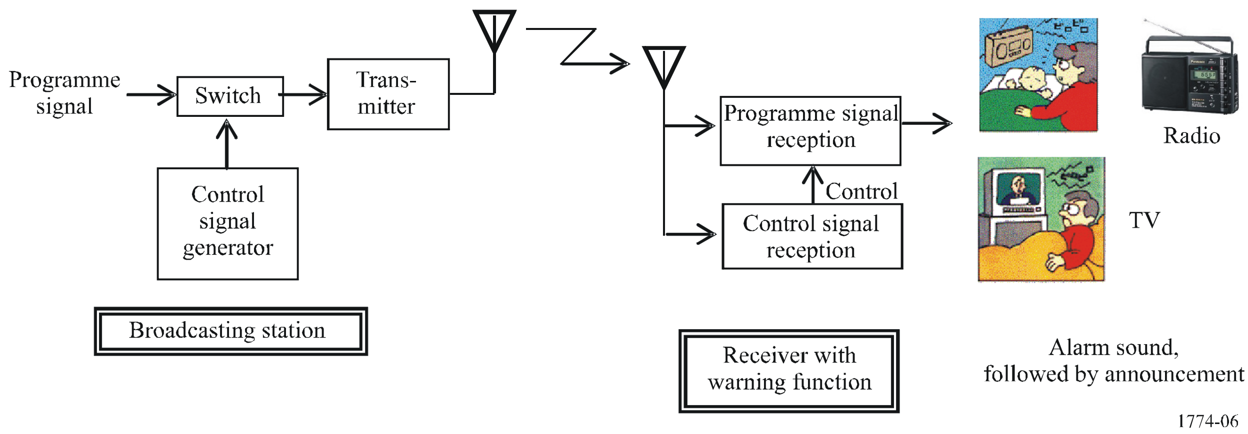
2.3.1 Overview

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

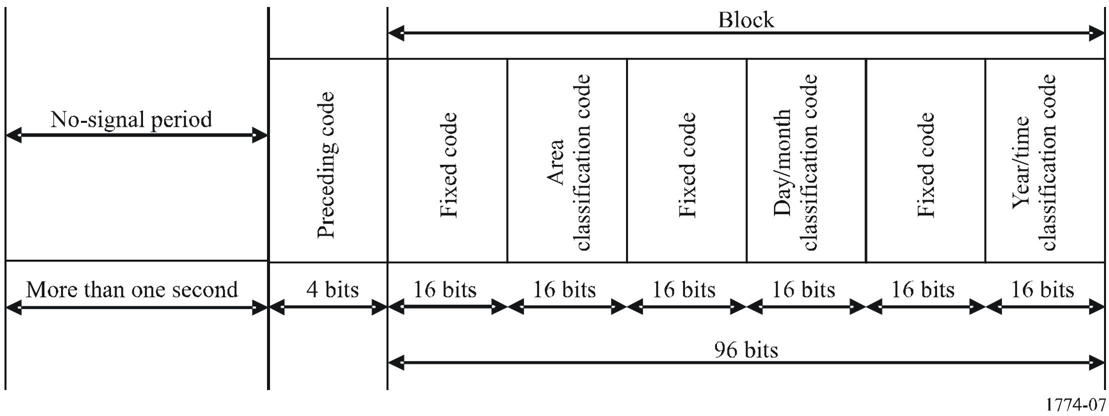
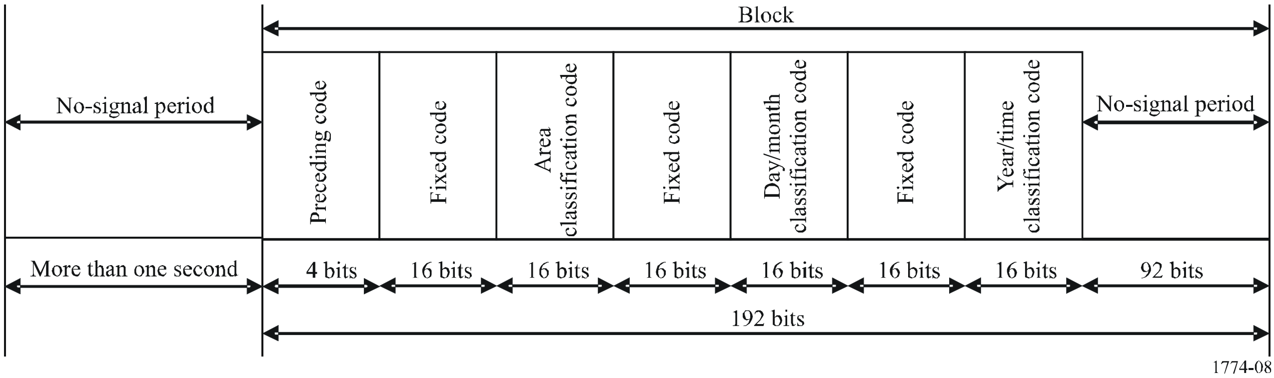


FIGURE 8

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.

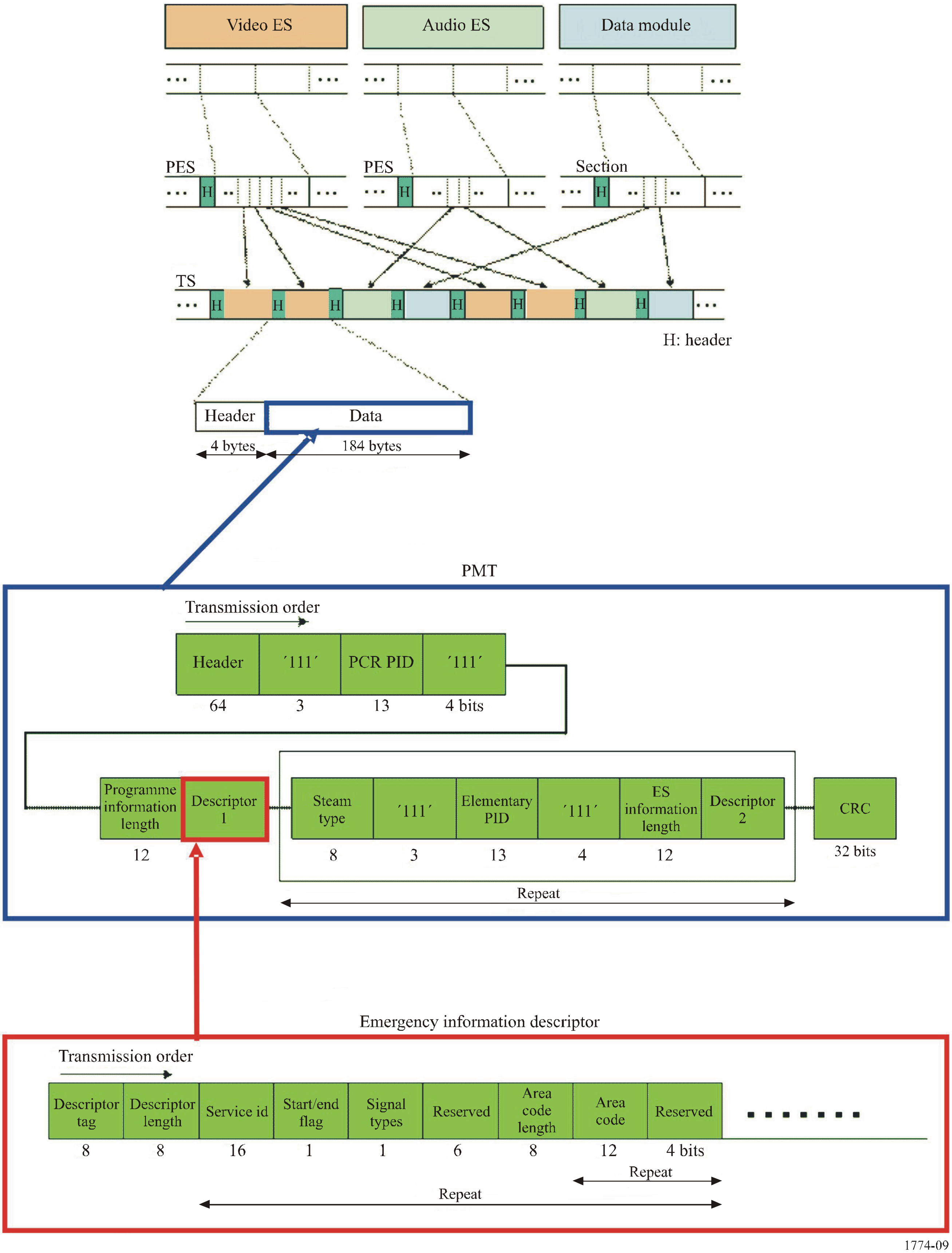
Fundamentally, the operation when the EWS signal is received is established by the product specification of each manufacturer.

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

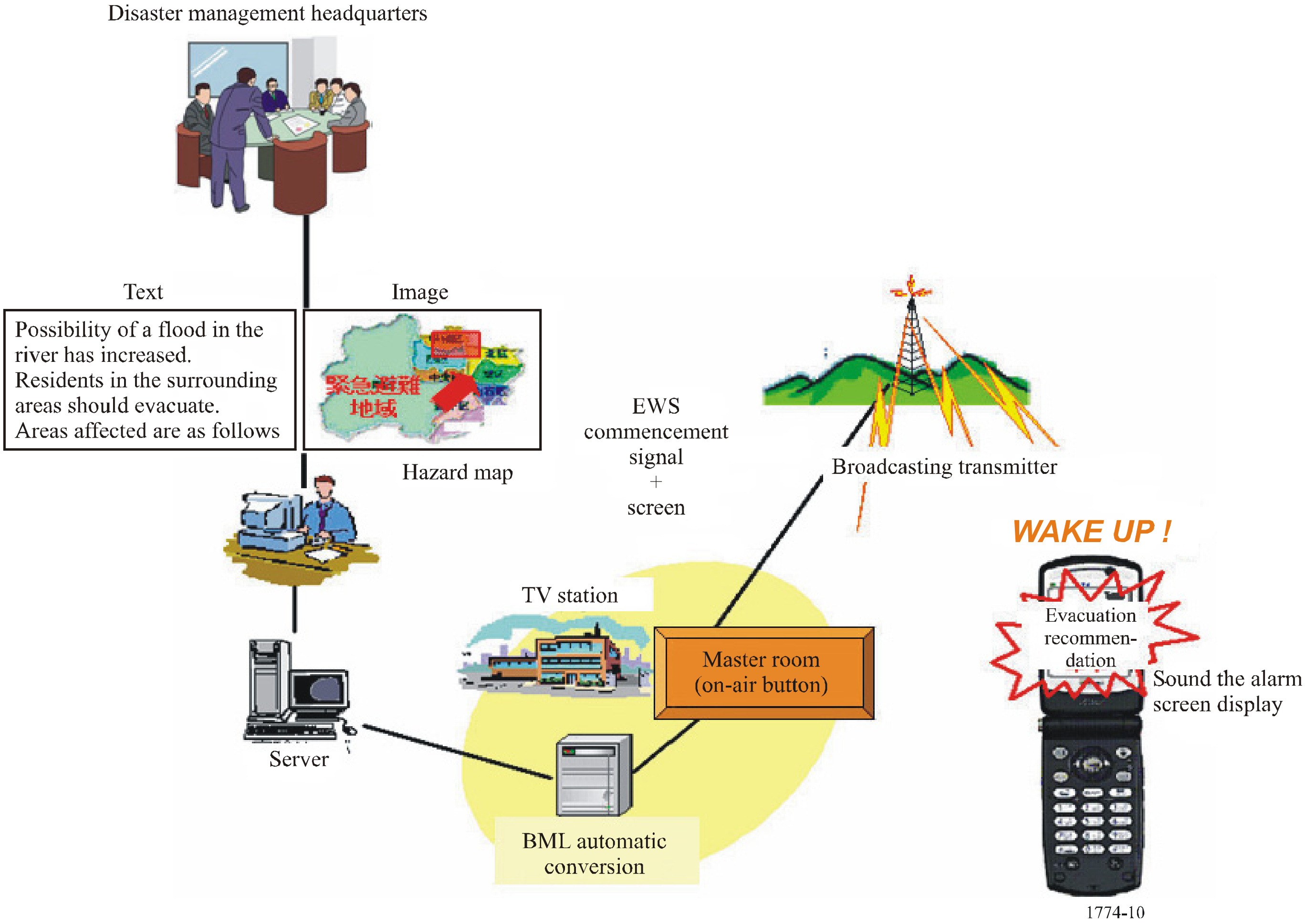


Figure 11 shows handheld receiver activation using EWS signals for digital terrestrial broadcasting.

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

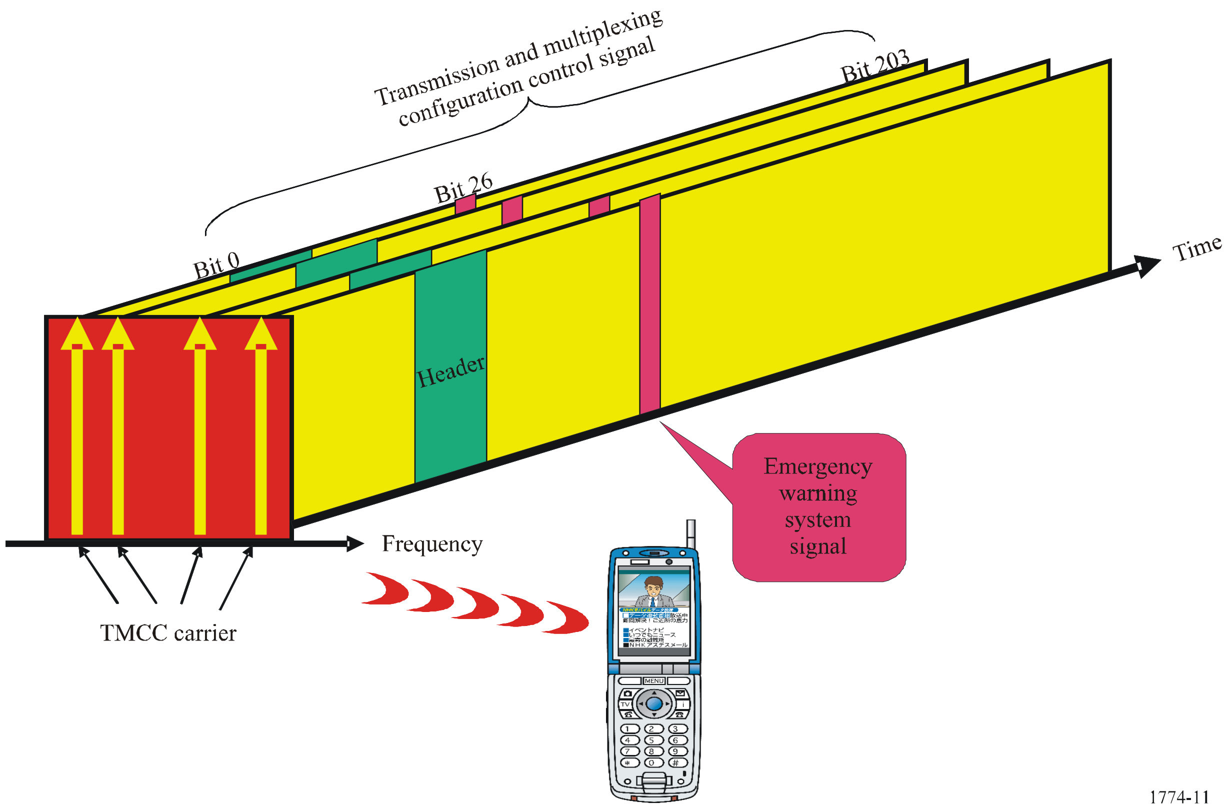
– monitors only the EWS signals by limiting time slots.

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/).

3 Republic of Korea

This section presents an overview and the current status of public warning systems on broadcasting in the Republic of Korea.

3.1 Public warning systems for analogue broadcasting

3.1.1 Specification for television auto alarm broadcasting

In order to deliver emergency information to the public without interrupting the main programme, the standard employs the closed-caption feature. The message is inserted in the 284 synchronous signal with amplitude-modulated binary NRZ pulse. The clock uses 503 496.32 Hz, i.e. 32 times horizontal frequency. The data rate is about 60 bit/s. During an emergency, the TV set is automatically turned on with a loud alarm sound. A description of the emergency is presented at the bottom of the TV screen. Table 1 is the message format.

TABLE 1

Emergency message format for analogue TV

Control code	Start code		Date and time		Test		Number of area		Area1		Area2		....	AreaN	
Hex	1D37	1D37			xx	xx	xx	xx	xx/xx/xx/xx	xx/xx/xx/xx	xx/xx/xx/xx	xx/xx/xx/xx	....	xx/xx/xx/xx	xx/xx/xx/xx
Size in Byte	2	2	6	6	1	1	1	1	8	8	8	8	....	8	8

Control code	GroupId		Start of event code		Event code		Severity		Start of closed-caption		Text	Presentation time		End code	
Hex	xx	xx	1D3B	1D3B	xx	xx	xx	xx	1D39	1D39		1D3A	1D3A	1D38	1D38
Size in Byte	1	1	2	2	1	1	1	1	2	2	variable	2	2	2	2

3.1.2 Specification for FM radio alarm broadcasting

This specification employs radio data system (RDS) radio text (RD) feature to delivery the emergency message without interruption of the main programme. After differential encoding of the message, it is inserted in the amplitude modulated auxiliary subcarrier, which is the third harmonic (57 kHz) of baseband pilot signal. The data rate is about 1 187.5 bit/s. The main function is similar to the analogue TV standard, except that the message is presented with audio, using optional text-to-speech system, instead of closed-caption text. Table 2 illustrates the message format.

TABLE 2

Emergency message format for FM radio

Control code	Start code	Date and time	Duration	Number of Area	Area1	...	AreaN	Event code	Checksum	Presentation time	Text	End of presentation	End code
Hex	24		xx	xx	xx/xx/xx/xx	...	xx/xx/xx/xx	01 - FF		02		03	40
Size in Byte	1	5	1	1	4	...	4	1	1	1	variable	1	1

3.2 Public warning systems for digital broadcasting

3.2.1 Automatic emergency alert service (AEAS) for terrestrial digital multimedia broadcasting (T-DMB)

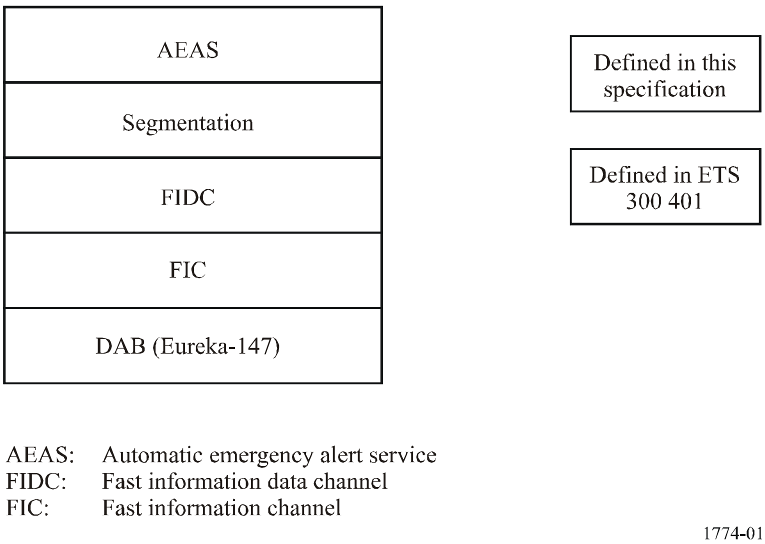
3.2.1.1 Overview

The T-DMB provides mobile and personal service to the general public. Some receivers are combined with cellular phone and some are installed in an automobile usually with a navigating device. The T-DMB is believed to be ideal for the emergency alert with automatic activation. Since 2005, we have been developing a standard for the automatic emergency alert service (AEAS) to protect lives and properties of people using terrestrial digital multimedia broadcasting (T-DMB) system (Report ITU-R BT.2049). The current standard is in its final draft status. A trial AEAS system is scheduled to test by the end of 2006.

The standard specifies the following: definition of emergency message, i.e. AEAS message; the signalling and delivery method of the AEAS message using T-DMB; and functional requirements of T-DMB AEAS transmitting system and the AEAS receiver. The AEAS message format is designed to be short with essential information for swift delivery. In serious situation, detailed information, such as event descriptions and evacuation instructions in text or in other multimedia format, will be followed in other services. The AEAS message format provides fields for the short text message and/or the external links. The AEAS provides targeted service according to the location of the receiver. Figure 12 illustrates the protocols stack necessary for the delivery of AEAS.

FIGURE 12

Protocol stack for the automatic emergency alert service



3.2.1.2 AEAS message format

An AEAS message contains information associated with an event, e.g. natural disasters and incidents. Table 3 illustrates the structure of the AEAS message.

TABLE 3

AEAS message format

EventCode	Severity	d&t	tGeocode	nGeocode	rfu	Geocodes	Desc&Link
3 bytes	2 bits	28 bits	3 bits	4 bits	3 bits	variable	variable

The following are the syntax and semantics of each field:

– *EventCode*: This field shall contain the event code which is defined in Annex 1 of the standard. The major portions of the EventCode are quoted from USA's FCC Rule 47 Part 11.

– *Severity*: This 2-bit field shall indicate the severity of the event, as in Table 4:

TABLE 4

Severity

Severity	Semantics
00	"Unknown" – Severity unknown
01	"Moderate" – Possible threat to life or property
10	"Severe" – Significant threat to life or property
11	"Extreme" – Extraordinary threat to life or property

– *d&t (date and time)*: This 28-bit field shall indicate the date and time when the emergency information is announced by an originator. The first 17 bits shall be the modified Julian data and the next 11 bits shall be the UTC code (short form), which is defined in ETS 300 401 v1.4.1 section 8.1.3.1.

– *tGeocode (Geocode type)*: This 3-bit field shall indicate the type of the geocode used in the message.

TABLE 5

Geocode type

Geocode type	Semantics
000	The whole territory of the Republic of Korea
001	Define by the ROK Government
010	Korean Regional Code. The target is general public
011-011	Rfa

An AEAS message shall include only one type of Geocode. When tGeocode is 000, nGeocode shall be set to 0000 and no Geocode shall be included in the message.

– *Geocodes*: This field shall include one or more geographic codes delineating the affected area of the AEAS message. The type and the number of geocodes are defined in tGeocode and nGeocode fields, respectively. The length of the geocode shall be fixed and defined implicitly. For example, the length of Korean Regional Code is fixed to 10 bytes.

– *Desc&Link*: This variable length field shall present short human readable text and external link associated with the AEAS message. The text includes description of the event and instruction for targeted recipients. The external link shall be surrounded by double quotes (“). The external field may be used for any additional information for the message, for example, uniform resource identifier (URI) for web or other DMB services. The URI shall be full and absolute.

3.2.1.3 AEAS message segmentation

An AEAS message shall be delivered via FIDC (FIG 5/2). The AEAS message shall be segmented into several FIGs. The data field of an FIG shall contain one and only one segment of the AEAS message. For this purpose, 2-byte segment header shall be used, as shown in Table 6.

TABLE 6

Segment header fields

Current	**nSegment**	**AEASId**
4 bits	4 bits	8 bits

– *Current (n)*: This 4-bit field shall be the (n + 1)th sequence number of the current segment.

– *nSegment (m)*: This 4-bit field shall be the total number of segments of the AEAS. The total number is (m + 1). Since an FIG can accommodate at most 26 bytes of AEAS message, therefore, the maximum size of an AEAS message is 26 bytes/FIG × 16FIG = 416 bytes.

– *AEASId*: This Id enables an AEAS receiver to assemble an AEAS message from FIG segments. In addition, the Id prevents the AEAS receiver from presenting duplicate AEAS messages. Since, during an emergency, an AEAS message will be emitted repeatedly, the AEAS receiver should always remember the AEASId that has been presented. However, if the AEASId is managed by a local authority, a mobile receiver can face with problematic situations: the same AEAS message has different AEASId, or two different AEAS messages have the same AEASId. In order to avoid these situations, the AEASId shall be nationally managed by a central authority, so that identical emergency information should always have a same AEASId nationwide.

TABLE 7

AEASId fields

OriginL (Originator level)	**MsgId (Message Id)**
3 bits	5 bits

– *OriginL (Originator level)*: this 3-bit field shall indicate the originator group of the AEAS message. It represents three levels of government, i.e. national, state and local governments.

TABLE 8

List of originator level

OriginL	Description
000	National Government (NEMA, KMA, etc.)
001	Large city, Province
010	Small city, County
100~111	Rfa

– *MsgId*: this 5-bit, modulo-32 counter shall be incremented by one for each successive AEAS message.

3.2.1.4 Delivery of AEAS message

AEAS messages and the associated signalling are encoded in the fast information data channel (FIDC), specifically in Extension 2 of FIG type 5 (FIG 5/2). Figure 13 shows the structure of the FIG 5/2.

The following definitions apply to the flags D1 and D2:

D1: This 1-bit flag shall be reserved for future use of the Type 5 field.

D2: This 1-bit flag shall signal whether the Type 5 field contains AEAS message or just padding.

0: padding.

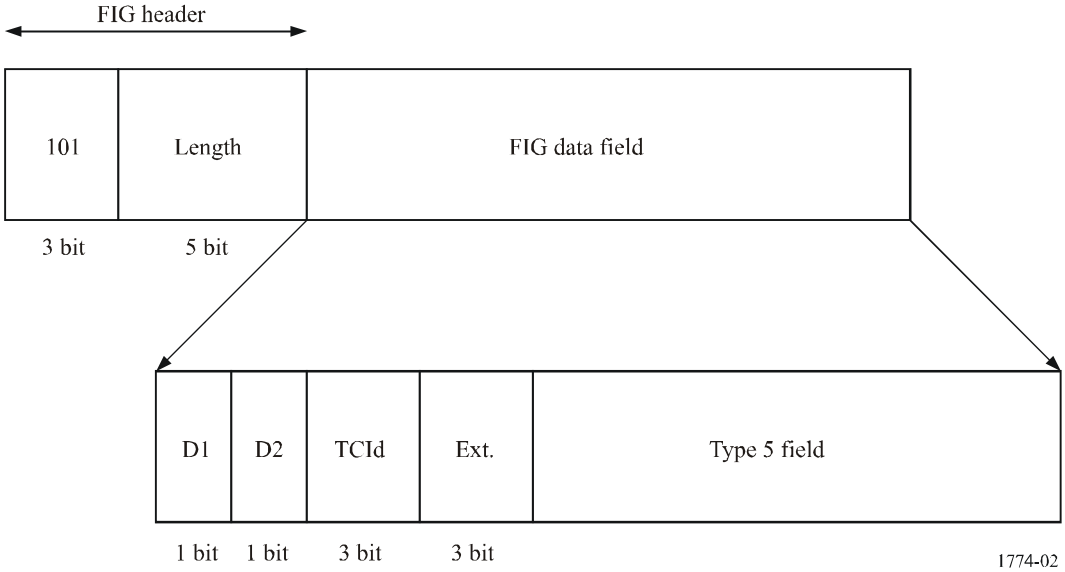
1: presence of AEAS message.

The TCId shall be 000.

When there is no emergency, the padding message with D2 = 0 shall be transmitted every 0.5 second or less. The size of padding is 29 bytes, so that the FIG with the padding message can occupy a whole fast information block (FIB). The padding message signals the presence of AEAS service in the current ensemble. It also guarantees the necessary bandwidth for immediate insertion of the AEAS message. Signalling of AEAS with multiplex configuration information (MCI) shall not be used. When emergency information arrives from the management office, associated AEAS messages shall be generated and emitted immediately. The AEAS message has the highest priority over other broadcasting services. During the emergency, the AEAS message shall continue to be emitted repeatedly. When a receiver receives the AEAS message, it shall immediately present the emergency information with highest priority over other services.

FIGURE 13

Structure of FIG Type 5



Annex 2

Common emergency warning system control signal for analogue broadcasting

1 Introduction

The EWS described in this Annex enables a public warning to be made in the case of emergency due to disasters etc. through analogue radio and/or analogue TV sound channels. As analogue broadcasting is one of the most widespread broadcasting services, it is quite effective to make the public warning using this method.

The control signal in this EWS for public warning shall activate sleeping receivers. Automatic activation of the receivers requires keeping a part of the receiver circuit alive to monitor the emission of a control signal.

2 Audible baseband EWS control signal

In an emergency, the EWS control signal replaces the programme signal (analogue radio and/or analogue TV sound), to automatically activate receivers equipped with the EWS function, even when they are on stand by. The employment of analogue sound in this EWS has the feature of very low power consumption by the receiver when monitoring the signal. The sound of the EWS control signal is used as an alarm sound as well to draw the attention of all the listeners/viewers to the emergency broadcasting programmes that follow the EWS control signal.

The EWS control signal is an FSK modulated signal that employs two audio frequencies, 640 Hz and 1 024 Hz, and is capable of transmitting 64 bit/s data. It is preferable that the modulation level for the EWS control signal is about 80% in order to detect the EWS control signal reliably. The EWS control signal comprises two kinds of signals; a start signal and an end signal. An audible start signal denotes the beginning of the emergency warning broadcasting programme and activates equipped receivers. An audible end signal denotes the end of the emergency warning broadcasting programme, and the activated receiver returns to its original state.

2.1 Start signal

The structure of the start signal is shown in Fig. 12. The start signal comprises an unmodulated signal period, preceding code, fixed code and arbitrary code. The unmodulated signal period allows the EWS control signal to be clearly distinguished from the broadcasted program by silence. The preceding code can be used as an indication as to whether the signal is a start signal or end signal. The fixed code is the most important code in the EWS control signal. The fixed code has the following two functions: 1. Receiver activation, 2. Timing reference for the arbitrary code. The arbitrary code carries additional information such as the time or location of the event. BLOCK-S as shown in Fig. 14 comprises fixed and arbitrary codes and should be transmitted repeatedly – at least four times. This multiple transmission of the fixed codes prevents mis-activation of receivers and also ensures activation of receivers in a poor reception environment.

The specification of each code is as follows:

– The unmodulated signal period lasts more than one second

– The preceding code for the start signal is “1100”

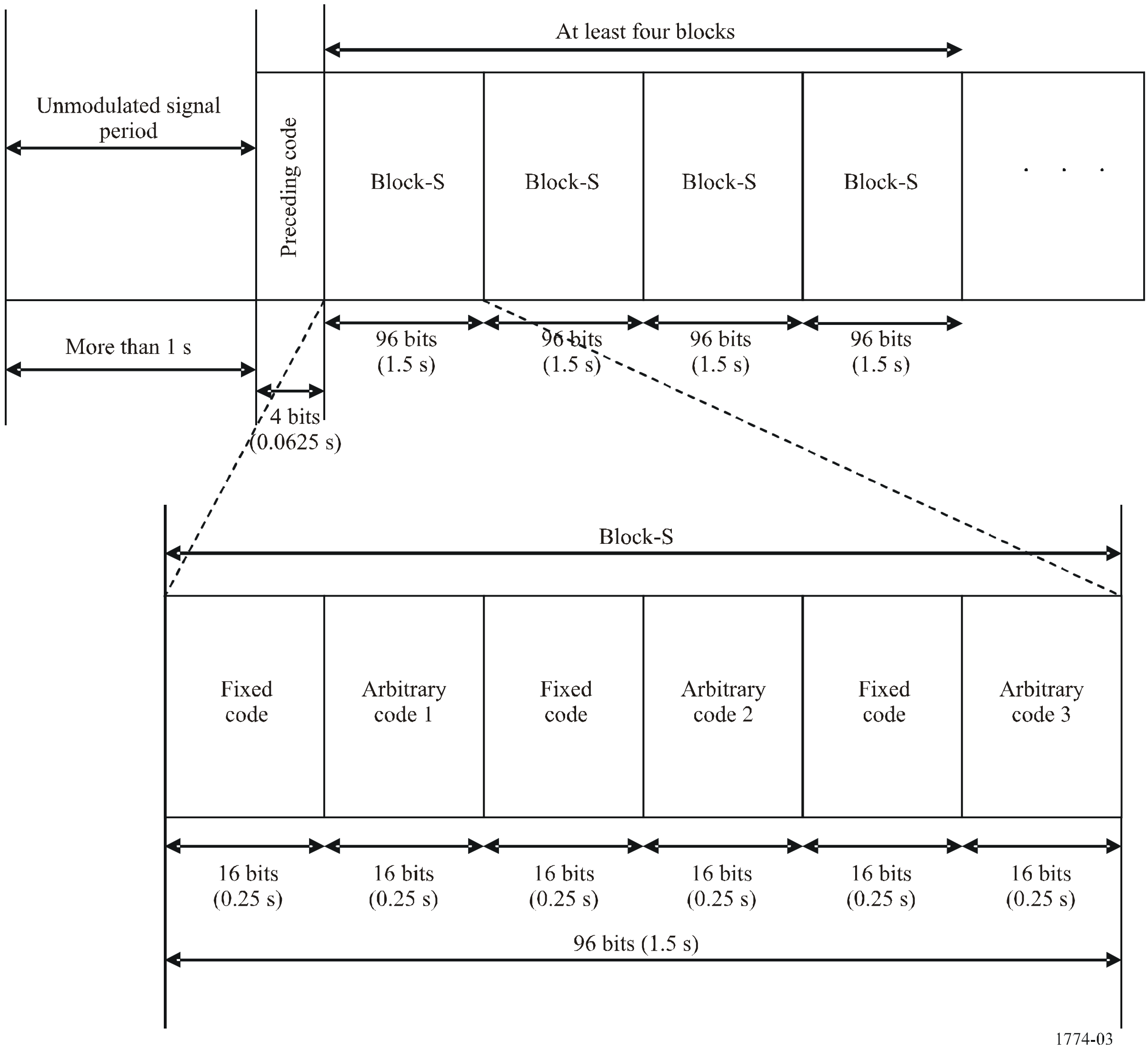
– The fixed code is a 16 bit code word that starts with “00” and ends with “01”

– The arbitrary code is a 16 bit code word that starts with “01” or “10”, and ends with “00” or “11”. The remaining 12 bits can be any bit patterns with consideration of proper and stable receiver operation.

The starting and ending two bits of the fixed and arbitrary codes are set so that the same bit pattern of fixed and arbitrary codes never appears.

FIGURE 14

Structure of start signal



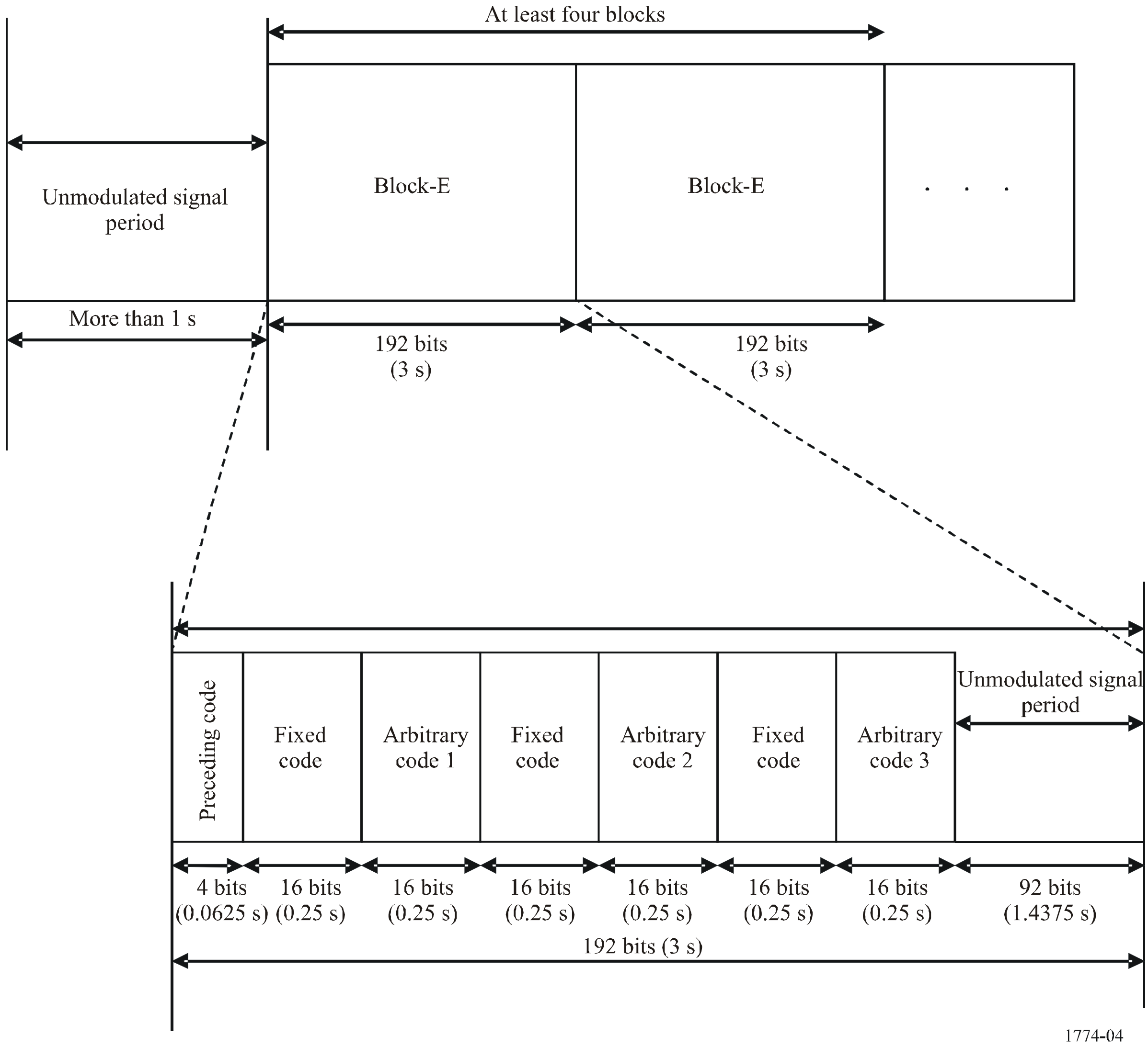
2.2 End signal

An end signal informs the receivers of the end of the emergency broadcasting programme. The activated receiver returns to its original state after receiving the end signal. The structure of the end signal shown in Fig. 15 is similar to that of the start signal. The fixed code employed in the end signal is identical to that in the start signal. The preceding code of the end signal is "0011".

In preparation for an actual emergency, it is important to test the automatic activation of the receivers with regularly scheduled (for example once a month) test broadcasts that include the EWS control signal. In such test broadcasts, it is necessary for the receivers to turn off at the end of the test. If the receiver is not turned off, the power source of portable receivers will be discharged, and the battery might be empty when an actual disaster occurs. The end signal can be used for the purpose of preventing such a situation. Transmission of the end signal is optional.

FIGURE 15

Structure of end signal



2.3 Common fixed code

A massive disaster may affect many countries. Once such a disaster occurs, the emergency warning information should be distributed widely, even across national borders. Therefore a common EWS control signal is desirable. To detect the EWS control signal, an EWS receiver continuously calculates the cross-correlation between the given fixed code and the input signal. A high correlation value means the detection of the fixed code by the receiver. To avoid incorrect detection in this matter, the fixed code is desired to have the following features.

– The number of bits with values "1" and "0" is equal. A code that contains long continuous streams of "1" or "0" produces continuous 640 Hz or 1 024 Hz sound components. As these sound components may exist in some broadcasting programmes, such codes are not suitable for use as the fixed code.

– The bit pattern of this fixed code does not appear anywhere else within the combination of this code and any consecutive arbitrary code. If the bit pattern of this fixed code reappears, both the correct reference position and the false bit pattern position are detected as EWS reference positions by the receiver. If the detection of multiple reference positions may occur, this is not suitable for demodulation of the arbitrary codes.

The fixed codes shown in this Annex satisfy the features above. As the common fixed code, one of the codes listed in the Appendix should be selected. It is recommended to use the code "0010 0011 1110 0101" as the common fixed code of the EWS control signal for analogue broadcasting. The remaining codes can be used, for example, as regional fixed codes for a country or a region.

3 Specification for analogue television auto alarm broadcasting

In order to deliver emergency information to the public without interrupting the main programme, the standard employs the closed-caption feature. The message is inserted in the 284 synchronous signal with amplitude-modulated binary NRZ pulse. The clock uses 503 496.32 Hz, i.e. 32 times horizontal frequency. The data rate is about 60 bit/s. During emergency, the TV set is automatically turned on with loud alarm sound. Description of the emergency is presented at the bottom of TV screen. Table 9 is the message format, where each code in the format is transmitted twice. Figure 16 illustrates the signal structure for VBI (vertical blanking interval) line.

TABLE 9

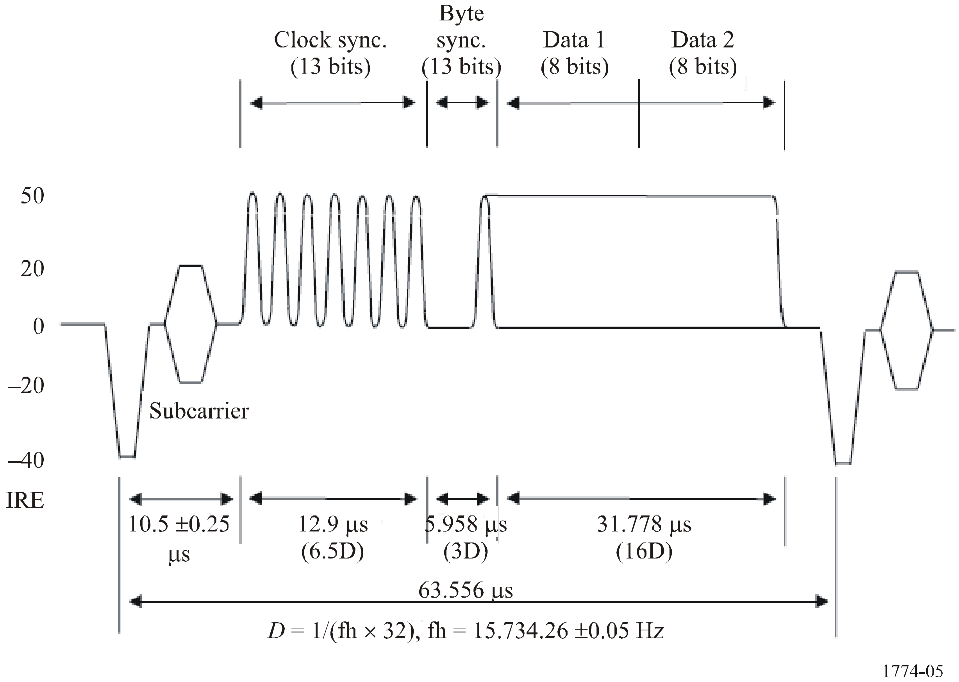
Emergency message format for analogue TV

Control code	Start code		Date and time		Test		Number of area		Area1		Area2		....	AreaN	
Hex	1D37	1D37			xx	xx	xx	xx					....		
Size in Byte	2	2	variable	variable	1	1	1	1	variable	variable	variable	variable	....	variable	variable

Control code	Group Id		Start of event code		Event code		Severity		Start of closed-caption		Text	Presentation time		End code	
Hex	xx	xx	1D3B	1D3B	xx	xx			1D39	1D39		1D3A	1D3A	1D38	1D38
Size in Byte	1	1	2	2	1	1	variable	variable	2	2	variable	2	2	2	2

FIGURE 16

Signal structure of VBI (vertical blanking interval) line



4 Specification for analogue FM radio alarm broadcasting

This specification employs radio data system (RDS) radio text (RT) feature to delivery the emergency message without interruption to the main programme. After differential encoding of the message, it is inserted in the amplitude modulated auxiliary subcarrier, which is the third harmonic (57 kHz) of baseband pilot signal. The data rate is about 1 187.5 bit/s. The main function is similar to the analogue TV standard, except that the message is presented with audio, using optional text-to-speech (TTS) system, instead of closed-caption text. Table 2 illustrates the message format.

TABLE 10

Emergency message format for FM radio

Control code	Start code	Date and time	Duration	Number of area	Area1	. . .	AreaN	Event code	Checksum	Presentation time	Text	End of presentation	End code
Hex	24			xx		. . .				02		03	40
Size in Byte	1	variable	variable	1	variable	. . .	variable	variable	variable	1	variable	1	1

Appendix 1
to Annex 2

Fixed code

Possible fixed codes with consideration of § 2.3, Annex 2, are listed in Table 11.

TABLE 11

List of fixed codes

No.	Fixed code
1	0010 0011 1110 0101
2	0000 1011 0011 1101
3	0000 1011 1100 1101
4	0000 1100 1011 1101
5	0000 1110 0110 1101
6	0000 1110 1011 1001
7	0000 1110 1110 1001
8	0000 1111 0011 0101
9	0000 1111 0101 1001
10	0000 1111 0110 0101
11	0001 0001 1110 1101
12	0001 0011 1110 0101
13	0001 0100 1110 1101
14	0001 0100 1111 1001
15	0001 0110 1110 0101
16	0001 1010 0111 1001
17	0001 1010 1110 1001
18	0001 1011 1100 0101
19	0001 1110 1100 0101
20	0001 1110 1101 0001
21	0001 1111 0010 0101
22	0001 1111 0010 1001
23	0010 0001 1101 1101
24	0010 0011 0101 1101
25	0010 0110 0011 1101
26	0010 0111 1001 0101
27	0010 0111 1100 0101
28	0011 0000 1011 1101
29	0011 0000 1111 0101
30	0011 0111 1000 0101
31	0011 1011 0000 1101

TABLE 11 (*end*)

No.	Fixed code
32	0011 1011 0100 0101
33	0011 1100 1000 1101
34	0011 1100 1001 0101
35	0011 1100 1010 1001
36	0011 1100 1011 0001
37	0011 1110 0010 0101
38	0011 1110 0010 1001
39	0011 1110 0100 0101
40	0011 1110 0101 0001

The code No. 1 in Table 11 "0010 0011 1110 0101" is recommended as the common fixed code of the EWS control signal for analogue broadcasting.