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Framework of disaster management for disaster relief systems

ITU-T E.100-series Recommendations – Supplement 1

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Supplement 1 to ITU-T E.100-series Recommendations

Framework of disaster management for disaster relief systems

Summary

Information and communication technologies (ICT) provide crucial services and systems for our daily lives as well as in emergency and disaster situations. Disaster relief systems that are used during and after disasters provide people with timely and useful information that is used for rescue, evacuation, safety confirmation and even for life sustainability.

Supplement 1 to ITU-T E.100-series Recommendations provides the high-level category of disaster relief (DR) systems including early warning systems as well as identifies the services and systems that need common specifications or requirements. It also describes new study area of disaster relief systems, which includes newly produced ITU-T Recommendations, and its requirements.

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FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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1 Scope

This Supplement describes the high-level category of disaster relief (DR) systems including early warning systems, identifies the services and systems that need common specifications, and describes their requirements progressively towards the next steps in standardization. It should be noted that the service descriptions in the Supplement are designed to identify common service elements, and to help derive the requirements that will result in fundamental network capabilities.

The framework of disaster management for network resilience and recovery (NRR) are described in [b-ITU-T L-sup.35].

2 References

[ITU-T E.108] Recommendation ITU-T E.108 (2016), *Requirement for a disaster relief mobile message service*.

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[3GPP TS 44.018] Technical Specification 3GPP TS 45.018 version 15.4.0 (2018), *3rd Generation Partnership Project: Technical Specification Group Radio Access Network*; *Mobile radio interface layer 3 specification; GSM/EDGE Radio Resource Control (RRC) protocol (Release 15)*.

[3GPP TS 45.002] Technical Specification 3GPP TS 45.002 version v16.0.0 (2019), *3rd Generation Partnership Project: Technical Specification Group Radio Access Network; GSM/EDGE Multiplexing and multiple access on the radio path (Release 16)*.

[3GPP2 C.R1001] 3GPP2 C.R1001-G v1.0 (2009), *3rd Generation Partnership Project 2: Administration of Parameter Value Assignments for cdma2000 Spread Spectrum Standards (Release G).*

[3GPP2 C.S0005] 3GPP2 C.S0005-F v1.0 (r 2012*), 3rd Generation Partnership Project 2: Upper Layer (Layer 3) Signaling Standard for cdma2000 Spread Spectrum Systems*.

[3GPP2 C.S0015] 3GPP2 C.S0015-C v1.0 (2012), *3rd Generation Partnership Project 2: Short Message Service (SMS) for Wideband Spread Spectrum Systems*.

3 Definitions

3.1 Terms defined elsewhere

This Supplement uses the following terms defined elsewhere:

3.1.1 broadband PPDR radiocommunications [b-ITU-R M.2377-1]: Broadband applications enable an entirely new level of functionality, with additional capacity to support higher data speeds and higher image resolution. It should be noted that the demand for multimedia capabilities (several simultaneous wideband and/or broadband applications running in parallel) puts a huge demand for very-high bit rates on a wireless system.

Broadband applications provide voice, high-speed data, high-quality, digital, real-time video and multimedia (indicative data rates are in the range of 1-100 Mbit/s) with channel bandwidths dependent on the use of spectrally efficient technologies.

Examples of possible applications include:

– high-resolution video communications from wireless clip-on cameras to a vehicle-mounted computer, used during traffic stops or responses to other incidents, or for video surveillance of security entry points such as airports with automatic detection based on reference images, hazardous material or other relevant parameters;

– remote monitoring of patients and remote, real-time video views that demand high bit rates. The demand for capacity can easily be envisioned during rescue operations following a major disaster.

Broadband applications are considered capable to cover functionalities provided by narrowband and wideband applications.

3.1.2 business continuity plan [ITU-T E.119]: A plan that enables businesses to continue to operate even during a disaster. The plans are made before a disaster and are used by public organizations mainly to save the lives of victims.

3.1.3 disaster relief [ITU-T E.108]: Information or action to be effective for reduction and suppression of a serious disruption of the functioning society. The disruption may be caused by accidents, natural phenomena or human activity, and results in a significant widespread threat to human life, health, property or the environment.

3.1.4 disaster relief system [ITU-T E.108]: A system that provides disaster relief (response) services to related parties, which include affected victims, rescue workers and systems.

3.1.5 e-health [ITU-T X.1092]: E-health is the transfer of health resources and health care by electronic means.

3.1.6 public protection and disaster relief (PPDR) [b-ITU-R M.2377-1]: The term Public Protection and Disaster Relief (PPDR) is defined in Resolution 646 (Rev.WRC-15) as a combination of two key areas of emergency response activity:

– Public protection (PP) radiocommunication: Radiocommunications used by agencies and organizations responsible for dealing with maintenance of law and order, protection of life and property, and emergency situations.

– Disaster relief (DR) radiocommunication: Radiocommunications used by agencies and organizations dealing with a serious disruption in the functioning of society, posing a significant, widespread threat to human life, health, property or the environment, whether caused by accident, nature or human activity, and whether suddenly or as a result of complex, long-term processes.

3.1.7 digital signage [ITU-T H.780]: A system that sends information, advertising and other messages to electronic devices (e.g., displays, speakers) in accordance with the time of day and the location of the display, or the actions of audience. Contents and their relevant information such as display schedules, are delivered over networks.

3.1.8 safety confirmation [ITU-T E.119]: Information about the safety of users who might be affected by a disaster to be collected and managed at more than one site, and to be reported to specified person.

3.2 Terms defined in this Supplement

This Supplement defines the following terms:

3.2.1 dedicated systems: Systems for disaster relief and early warning that have been designed, implemented and operated only for dedicated purpose.

3.2.2 disaster [based on, b-UNISDR terminology]: A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources

3.2.3 disaster relief for general public: A notification to the general public of the latest disaster relief information.

3.2.4 disaster relief for individual: A notification to individual persons of the latest disaster relief information and/or collect the latest situation of the individuals.

3.2.5 disaster message board system: A type of disaster relief system that enables people to input text messages into a network-based message board facility for delivery to or retrieval by other people.

3.2.6 disaster relief guidance system: A disaster relief system that provides location information about 1) the current location of the user, 2) user-specified sites (e.g., his or her home or office), and

3) other sites (e.g., evacuation shelters, hospitals, stations, and public facilities), and route information that guides the user to these sites.

3.2.7 disaster voice delivery system: A type of disaster relief system that enables people to input packetized voice messages on to network facilities for delivery to or retrieval by other people.

3.2.8 early warning system [based on, b-UNISDR terminology]: The set of capacities needed to generate and disseminate timely and meaningful warning notification to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss.

3.2.9 m-health: A sub-category of e-health that uses mobile devices to collect health data, deliver healthcare information to practitioners and patients, for the real-time monitoring of patient vital signs, and the direct provision of care.

3.2.10 preparedness [based on, b-UNISDR terminology]: The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions.

3.2.11 prevention: The outright avoidance of adverse impacts of hazards and related disasters.

3.2.12 privacy policy statement: A document that describes some or all of the ways of gathering, using, disclosing and managing privacy related information and the related objectives.

3.2.13 safety confirmation and message broadcast system: A type of disaster relief system that confirms the safety of people in public agencies or discrete groups and broadcasts messages to them regarding their relief activities.

3.2.14 shared systems: Systems that are commonly used for both normal and urgent services such as disaster relief and early warning.

4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

BCP	Business Continuity Plan
CMAS	Commercial Mobile Alert System
DISS	Disaster Information Sharing System
DR	Disaster Relief
DRS	Disaster Relief Systems
DS	Digital Signage
ETWS	Earthquake Tsunami Warning Systems
EU-ALERT	European Public Warning System
EWS	Early Warning Systems
GNSS	Global Navigation Satellite System
HPLMN	Home Public Land Mobile Network
ICT	Information and Communication Technologies
IMT	International Mobile Telecommunications
IP	Internet Protocol
MNO	Mobile Network Operator

NRR	Network Resilience and Recovery
PLMN	Public Land Mobile Network
PP	Public Protection
PPDR	Public Protection and Disaster Relief
PTSD	Post Traumatic Stress Disorder
PWS	Public Warning System
SDO	Standard Development Organization
SNS	Social Networking Service
SVG	Scale Vector Graphics
TV	Television
TVCML	Television Common Mark-up Language
VPLMN	Visited Public Land Mobile Network

5 Conventions

None.

6 Overview of early warning and disaster relief system

An early warning system is a system that can deliver warning notifications of an imminent disaster or describe the possible effects of a disaster that has occurred to people suffering from the disaster.

A disaster relief system is a system that can provide information or support designed to reduce or suppress any serious disruption to the functioning of society. The disruption may be caused by accidents, natural phenomena or human activity, and results in a significant widespread threat to human life, health, property or the environment.

The systems in practice generally include features for both early warning and disaster relief systems (DRS) along with the timeframe. The systems can be used to assist preparedness and prevention before a disaster, for rescue and evacuation assistance during a disaster, and for safety confirmation and life sustainability after a disaster.

6.1 Direction for new services and systems

This clause identifies several factors to be taken into account when the new disaster relief services and systems are designed.

1) Use of a wide variety of terminals and communication channels

To date, radio and TV broadcasting, amateur radio and fixed phones are mainly been used for disaster relief systems. Recently, mobile communication and digital signage (DS) have also been developed and are widely used throughout the world. These new technologies must be recognized as new terminals and communication channels for delivering urgent information in a timely way to a large number of people. They also have great potential for providing area-specific or user-specific information, which is really needed by the people involved in the disaster. Providing interactive channels is another of their features that provides assistance during times of disaster.

New types of early warning and disaster relief systems with mobile terminals and digital signage must be investigated.

2) Handling of voice call congestion and alternative communication modes

Voice call congestion is a well-known problem in the event of certain types of disasters (e.g., earthquakes) and it remains difficult to manage using the public telephone network with both fixed and mobile terminals. In several previous cases, operators have regulated voice calls to avoid switching system failure resulting from a sudden increase in the number of voice calls. This regulation is another cause of call failures, which causes frustration to users.

IP-based technologies are capable of mitigating the congestion or providing other communication means (e.g., Internet protocol (IP) telephony, voice-based messaging, text messaging, e-mail, social networking service (SNS)). Their use for communication during disasters must be investigated.

3) Intelligent information gathering and distribution for individuals

Different types of ICT devices (e.g., sensors, video surveillance, and personal cameras in cell phones and smartphones) are being embedded everywhere, which make previously unknown information available when responding to a disaster. Accessible roads are shown in collected vehicle records, for example. Videos taken by individuals are expected to reveal the exact nature of any damage and this can help to create an up-to-date map. Big-data processing will assist us to identify key parameters from the information and advice on subsequent actions.

Innovative ways of information gathering and distribution will help both the authorities and individuals to execute evacuation plans.

It should be noted that information is not always helpful if it is not easy to understand. Too much information as well as confusing or unreliable (including obsolete) information should be avoided.

4) Refugee support including health care

After a serious disaster refugees need to stay in a shelter where the environment is entirely different from that of ordinary day-to-day life. Each refugee should be treated as a member of the community. They must be supplied with food and goods minimizing waste as much as possible, with the use of ICT systems to contribute to this kind of community operation (i.e., membership management) and resource management (i.e., supply chain management).

People who have experienced disasters are liable to suffer from conditions related to physical and mental distress such as post-traumatic stress disorder (PTSD). For prevention and assistance, disaster victims should be provided with a physical and mental health care program at an early stage. They may remain in evacuation shelters or their homes where no expertise health care service is available.

In these situations, e-health or m-health are expected to support the health-care program. E-health-care systems, especially m-health, should be investigated.

5) Consideration of accessibility

It should be noted that the systems must be helpful for people with disabilities such as visual and hearing impairments. It was reported that during the East Japan Earthquake and subsequent tsunami in 2011 that the death rate for people with disabilities was twice that for those without disabilities [b-Earthquake].

It is also recommended that the systems be applicable for foreigners including visitors, who may have limited knowledge about the site and difficulties in understanding the local language.

Early warning and disaster relief systems with multi-modal expressions are important for people with disabilities. It is also important that the information be provided in a widely used language, namely English. (See [ITU-T F.790])

6) Public authority and enterprise support

During disasters, public authorities and their rescue teams play a crucial role in providing warnings and evacuation instructions, and in undertaking rescue operations. The latest ICTs should contribute to this area.

In addition to individuals, enterprises should be protected against disasters. Companies are responsible for taking care of their employees' safety and maintaining their business. In particular, factories and manufacturers must manage goods and resources (including energy, electricity, and fuel) even during a disaster. Fierce business competition may have led to optimized production lines, but this may not be sustainable during an unexpected disaster and any resultant damage to the usual supply chain. ICT including a DR system is a necessity for business continuity.

7) Security and privacy

The data dealt with in a disaster relief system often contains private information. It is recommended that privacy protection be considered. Although it is difficult to consider system security if the systems must be developed and launched rapidly during/after disaster, any reduction in security protection is prohibited. This means that information to be protected must be classified as such, and that a privacy policy statement must be published before a disaster occurs.

In addition, during the East Japan Earthquake, some refugees moved frequently from one evacuation site to another. Staff sometimes recorded information on behalf of information owner which resulted in incorrect data finding its way into the system. Thus, we must consider the resistance of data to human errors.

A consideration of the availability of data and services is also recommended because public safety confirmation services received a large number of safety confirmation requests over a very short period during the East Japan Earthquake.

Confidential information about individuals such as private contact information should be managed securely and dealt with according to the permissions given by individuals in advance. It is recommended that a privacy policy statement be drawn up and published before a disaster.

Data integrity is recommended even if data are stored in several data centres and updated frequently. The source of the data should be identified (e.g., who, when and why) to allow traceability and confirmation.

6.2 Landscape of early warning and disaster relief systems

This clause examines existing and emerging early warning and disaster relief systems to identify new study areas for development.

6.2.1 System categorization

Four viewpoints are introduced with which to categorize the systems.

1) Timing, when the service or system is applicable or effective at the time of the disaster

1) Before disaster
2) During disaster
3) After disaster

2) Notification flow direction

1) Public agency to general public (victims)
2) Public agency to public agency
3) Public agency to people within the agency
4) Public agency to individual (victims)

5) Individual to public agency

6) Individual to individual (victims)

3) System technology

1) TV broadcasting

2) Radio broadcasting

3) Fixed radio communication

4) Digital signage

5) Satellite fixed land (i.e., fixed-site access to satellite)

6) Satellite vehicle (i.e., mobile-site access to satellite)

7) Fixed/mobile phone

8) Mobile broadcast

9) Mobile phone

10) Amateur radio

NOTE – Other disaster relief systems using Internet and broadband technologies need further study.

4) Shared or dedicated system

Some systems are designed, implemented, and operational only in disaster situations and are not used in normal situations. One example is a fixed radio emergency communication system implemented among local governments categorized as dedicated systems. The other systems are commonly shared during both disasters and in normal situations. One example is TV broadcasting categorized as shared systems.

6.2.2 Landscape of systems and services

Considering the above classification, the landscape of these systems is shown in Table 1.

Table 1 – System landscape for early warning and disaster relief

<table>
<tr><th>Timing</th><th>Before disaster
(for preparedness, prevention)</th><th colspan="2">At and during disaster
(for rescue, evacuation)</th><th>After disaster
(for safety confirmation, life sustainability)</th></tr>
<tr><th>Type of notification
Flow direction of notification</th><th>Early warning</th><th colspan="3">Disaster relief</th></tr>
<tr><td rowspan="4">Public agency to general public[1)]</td><td colspan="4">TV broadcasting including hybridcast – Shared</td></tr>
<tr><td colspan="4">Radio broadcasting – Shared</td></tr>
<tr><td colspan="4">Digital signage (new) – Shared</td></tr>
<tr><td colspan="4">Fixed radio communications – Dedicated</td></tr>
<tr><td rowspan="3">Public agency to public agency</td><td colspan="4">Fixed radio communication – Dedicated</td></tr>
<tr><td colspan="4">Satellite with fixed land station – Dedicated</td></tr>
<tr><td colspan="3">–</td><td>Satellite with mobile land station – Dedicated</td></tr>
<tr><td rowspan="3">Public agency to people within the agency</td><td></td><td colspan="3">Mobile phone – Dedicated</td></tr>
<tr><td></td><td colspan="3">Fixed phone – Dedicated</td></tr>
<tr><td></td><td colspan="3">Safety confirmation and message broadcast (new)</td></tr>
</table>

Table 1 – System landscape for early warning and disaster relief

Timing	Before disaster (for preparedness, prevention)	At and during disaster (for rescue, evacuation)	After disaster (for safety confirmation, life sustainability)
Public agency to Individual[2)]	Mobile broadcast to phone (new) – shared		
	Disaster information sharing system (new) – Shared		
		Disaster relief guidance (new)-Dedicated	
Individual to Public Agency	–	Mobile phone– Shared	
	–	Fixed phone–Shared	
	–	Amateur radio[3)] – Shared	
Individual to Individual	–	Mobile phone– Shared	
	–	Fixed phone– Shared	
	–		Disaster message board (new) – Dedicated
	–		Disaster voice delivery (new) – Dedicated
NOTE 1 – (New) means a new NRR measure which needs study for standardization.			
NOTE 2 – Pubic agency-to-general public and public agency-to-individual are distinguished in the sense that the former assumes a large audience and recipients receive general information, whereas the latter assumes that a number of recipients with the same characteristics receive information specifically applicable or useful to them.			

6.2.3 PPDR radiocommunication systems

Some of the radiocommunication services described in the above clause, which are mainly provided by public agency, are categorized as public protection for disaster relief (PPDR). A number of studies of PPDR radiocommunications have been carried out within ITU-R. [b-ITU-R M.2377-1] defines the PPDR objectives and requirements for the implementation of future advanced solutions to satisfy the operational needs of PPDR organizations. Specifically, the report addresses:

– the categorization of operational, technical and functional objectives and requirements relating to PPDR systems;
– the use of PPDR systems, not only in terms of generic capabilities, but also as they vary according to narrowband, wideband and broadband capabilities;
– the development of mobile broadband PPDR services and applications enabled by the evolution of advanced broadband technologies;
– the efficient and economical use of the radio spectrum; and
– the needs of developing countries.

Also, [b-ITU-R M.2291] addresses the current and possible future use of international mobile telecommunications (IMT) in support of broadband PPDR radiocommunications. The report further provides examples for deploying IMT for PPDR radiocommunications, case studies and scenarios of IMT systems to support broadband PPDR applications such as data and video.

6.3 New study areas for disaster relief including early warning

This clause describes potential new study areas for further investigation.

As shown in Table 1, there are a variety of early warning and disaster relief systems. Most of these systems have already been developed, implemented and standardized. However, the mobile and digital signage systems are two main systems that must be newly developed and standardized.

6.3.1 Early warning system

To date, TV and radio broadcasting systems have been used to provide the general public with early warnings. A dedicated radio communication system is also used by local governments. The specifications of those systems have been developed and standardized by ITU-R, ITU-D and other standard development organizations (SDOs). Recently, a system for sending an early warning to an individual mobile terminal has been in development and some mobile network operators (MNO) have already provided it. ITU-T is a suitable body for studying and standardizing the early warning systems (EWS) for mobile terminals.

In addition, a system for transmitting an early warning to a digital signage terminal is a new ITU-T study area.

The specific new study areas being investigated by ITU-T are:

1) Warning system with mobile terminals

In case of a disaster, mobile networks may be heavily congested by individual voice calls. If the mobile system distributes notifications through mobile broadcast technology, which is independent from or less affected by voice calls, the warning notification can reach multiple mobile terminals simultaneously within the areas affected by such disasters as earthquakes. The recipients of the notification will be made aware of the potential disaster and can prepare for it.

2) Warning system with digital signage

Digital signage (DS) is a kind of information delivery display that shows TV programmes, local news, local public information, advertising and other messages. The display is normally installed in public and semi-public areas, including railway stations, retail outlets, hotels, restaurants, and corporate buildings.

When warning information is received from prediction agencies, the warning system can deliver early notification to the DS installed in local public and semi-public areas.

6.3.2 Disaster relief system

The current practise for information distribution is via TV and radio broadcasting systems that have been used to distribute information to the general public for disaster relief. Dedicated radio and satellite communication systems are used by local governments. Amateur radio is also utilized. Those systems have already been developed and standardized by ITU-R and other SDOs.

The use of mobile terminals for notifying relief information is currently under development and several mobile operators have already provided some services. It should also be noted that most people (including victims) keep their mobile phones with them when escaping from danger and the mobile phone penetration ratio is greater than that of fixed telephones.

When it comes to networks and systems, disaster relief systems must operate even when voice traffic is severely congested. In contrast to the traditional voice traffic over a circuit switched network, and according to several past experiences, IP packet traffic may not be heavily congested even after a disaster. Therefore, an IP-based mobile system can be effective.

Additionally, some systems are required to operate without being connected to core networks. ITU-T is therefore a potential standardization body for studying disaster relief systems that distribute information to mobile terminals. In addition, the use of digital signage for digital relief systems is a new study area for ITU-T. The specific new study areas established by ITU-T are:

1) Disaster message board system

After a disaster, it is customary for people to enquire about the conditions and the wellbeing of their family, relatives, and friends using the telephone network. However, they may fail to make contact due to severe voice traffic congestion. IP packet traffic is less congested than voice traffic therefore with an IP messaged-based mobile service, victims can easily inform their friends and family members of their safety or the extent of casualty.

A user, i.e., a victim, places his or her text message on the message board of the system and the messages are delivered to their friends and family members.

2) Disaster voice delivery system

Some people prefer live voice-based communication when confirming the condition of their family, relatives, and friends. Voice-based calls are easy for the elderly to make. Traditional circuit switched networks may suffer from congestion, whereas IP packet networks are not generally heavily congested even after a disaster. If part of a victim's voice call is packetized and sent as a notification message, it can be efficiently transmitted to their friends and family members through IP networks. This kind of packetized voice service allows friends and family members to confirm the safety and the casualty of victims.

A user, i.e., a victim, uploads his or her voice message to the server of the system and the message is delivered to friends and family members.

3) Disaster relief guidance system

During and after a disaster, victims may need to go to hospitals and temporary evacuation shelters at unknown locations. After a disaster (e.g., an earthquake), people working in offices will want to go home and their usual public transportation service may have stopped operating. As a result, they may have to travel on foot through long and unfamiliar routes, some of which may be impassable due to the disaster.

In such cases, the victim first identifies his or her terminal location by global navigation satellite system (GNSS) and selects the target location (e.g., shelter, hospital or home). Then, the terminal can provide a graphical representation of the route to the location.

A disaster relief guidance system that provides geographical evacuation guidance to those involved in a disaster by showing them a map with key locations and an available route (even if the network connectivity is limited, intermittent, or lost) should be investigated.

4) Disaster relief system with digital signage

Digital signage is normally installed in public and semi-public areas (such as railway stations, hotels and corporate buildings) and is a powerful way of delivering real-time disaster-related information to the general public. However, the network may suffer from a capacity shortage and traffic congestion due to network failures or a sudden increase in traffic. To guarantee communication even in the event of a disaster, a disaster relief system with DS that can cope with the amount of information, the use of pre-stored graphics, and new technologies (e.g., scale vector graphics (SVG)) should be investigated.

5) Safety confirmation and message broadcast system

During and after a disaster, public agencies, such as local governments, fire departments, hospitals and telecommunication companies, want to confirm the safety of their staff immediately and to continue as far as possible with their work, which may include saving people's lives in the devastated areas. To continue with their work, they must dispatch available staff to target areas as soon as possible.

A safety confirmation and broadcast message service should be investigated. It should be able to collect information about the safety of the people working for the agency and broadcast messages to them from the agency to formulate a business continuity plan (BCP).

6) Disaster information sharing system

The speed and accuracy of conveying disaster information before and after the disaster event is crucial for the protection of residents. It is important to send out the disaster-related information quickly and accurately to the people in the concerned area so that they can be alert to the disaster and be aware of the instructions given by disaster-related agencies. When a disaster occurred, information providers, such as local governments or ministries, provide disaster information to various media outlets, which may take time to convey the information. The disaster information sharing system (DISS) gathers disaster information issued by information providers in a centralized fashion. This allows simultaneous distribution to various media outlets such as cell phones, TV and radio. Using various methods enables the speedy and accurate dissemination of information to save as many residents as possible in affected areas.

7 Requirements for new early warning systems

7.1 Lead time for early warning

As early warnings are used to assist preparedness for and the prevention of disasters, the timing of such warnings is very important. There are many types of disasters including earthquakes, droughts, floods, fires, hurricanes, wars and terrorism. The required lead time depends on the type of disaster. Some examples of lead times for natural disasters are shown below.

1) **Seconds** for earthquakes
2) **Minutes** for tornadoes and tsunami
3) **Hours to days** for volcanic eruptions
4) **Hours to weeks** for hurricanes
5) **Weeks to months** for droughts
6) **Years or even decades** for slow-onset threats (such as El Nino, climate change, etc.)

In general, an early warning system consists of two parts. A specialized agency first detects or predicts a disaster and identifies the affected or potentially damaged areas. The agency then transfers the warning information to the distribution systems. The distribution systems (e.g., public telecommunication network and broadcasting systems) decide on the distribution areas after receiving information about the affected or potentially damaged areas and distribute the warning information to the relevant terminals.

The operators of the distribution system for early warning systems should take the lead time requirement into account.

7.2 Early warning system for mobile terminals

The mobile terminal is the key receiver of early warnings because people always carry it with them and its penetration ratio is higher than that of traditional fixed telephones. Even when mobile traffic is severely congested, the warning notification must reach multiple mobile terminals simultaneously within the areas affected by the disaster. If the early warning is delivered through a broadcasting channel that is different from the individual communication channel, it reaches multiple terminals without interference from other voice and e-mail traffic. Figure 1 shows an example of a tsunami mobile warning system.

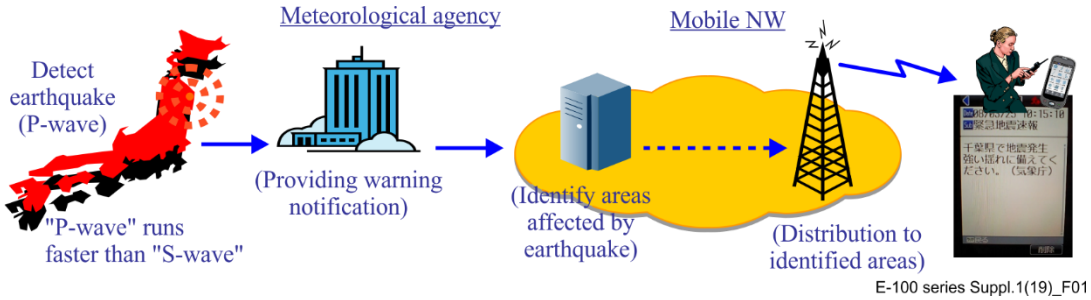

Figure 1 – Tsunami Mobile Early Warning System Japan

The mobile terminal broadcast channels for early warning use have already been specified. For broadcast technologies, 3GPP specifies [TS 22.268], [TS 22.368, [TS 23 041], [TS 25 304], [TS 25.331], [TS 36 304], [TS 36 331], [TS 45.002] and [TS 44.018]. 3GPP2 specifies [C.S0005], [C.S0015] and [C.R1001].

The 3GPP early warning system is called the public warning system (PWS) and is categorized into three subsystems; earthquake tsunami warning system (ETWS), commercial mobile alert system (CMAS) and European public warning system (EU-ALERT).

The relationship between PWS and ETWS is shown in Figure 2.

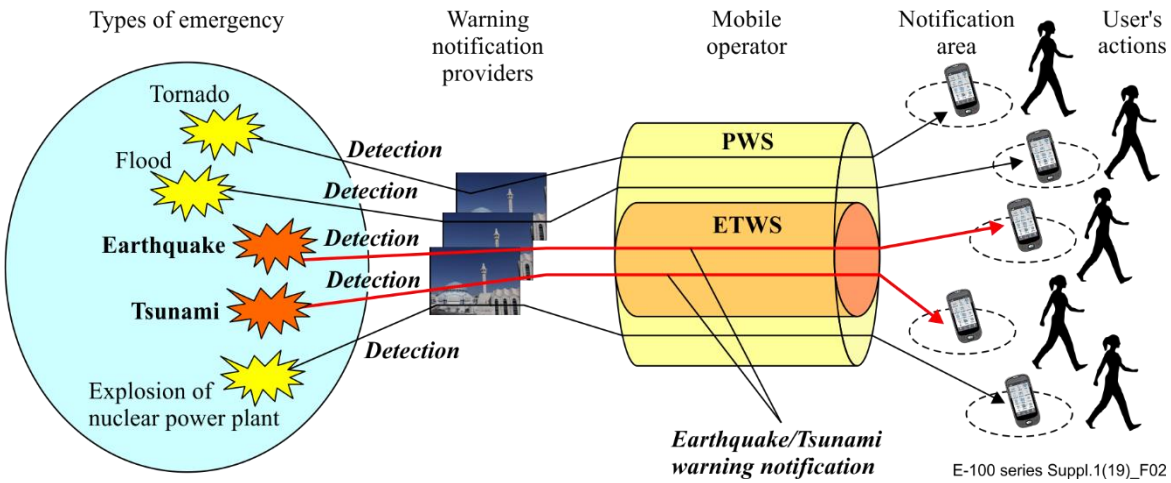

Figure 2 – Relationship between PWS and ETWS

As of 2013, ETWS has been implemented and operates throughout Japan, CMAS has been used on a trial basis in the USA, and EU-Alert has been used in the Netherlands. At present, these systems are actually operated separately in each region or country. Frequent overseas travellers may ask to receive early warning notification via their mobile terminals even when they are abroad.

It is recommended that mobile early warning should be available and compatible in different countries and regions.

The TS 22.268/ 3GPP technical specification states that:

1) It should be possible for mobile terminals that are enabled for warning notifications in the home public land mobile network (HPLMN) to receive warning notifications from a visited public land mobile network (VPLMN) supporting PWS when roaming.

2) A mobile terminal that does not support the PWS requirements of the VPLMN's PWS service may not receive warning notifications from that VPLMN.

3) The PWS offered by a PLMN may be subject to PWS regional regulatory requirements.

To facilitate the use of early warning in different countries and regions, the key elements for establishing roaming capabilities are message identification and language. These matters are studied by ITU-T under ITU-T SG 2 and include the selection of message identifiers for land mobile alerting broadcast capabilities and for civil purposes and land mobile alerting broadcast capabilities for civic purposes.

7.3 Early warning system using digital signage

Requirements need further study.

Relevant studies are available in [ITU-T H.780] on "Digital signage: Service requirements and IPTV-based architecture", and [ITU-T H.785.0] on "Digital signage: Requirements of disaster information services".

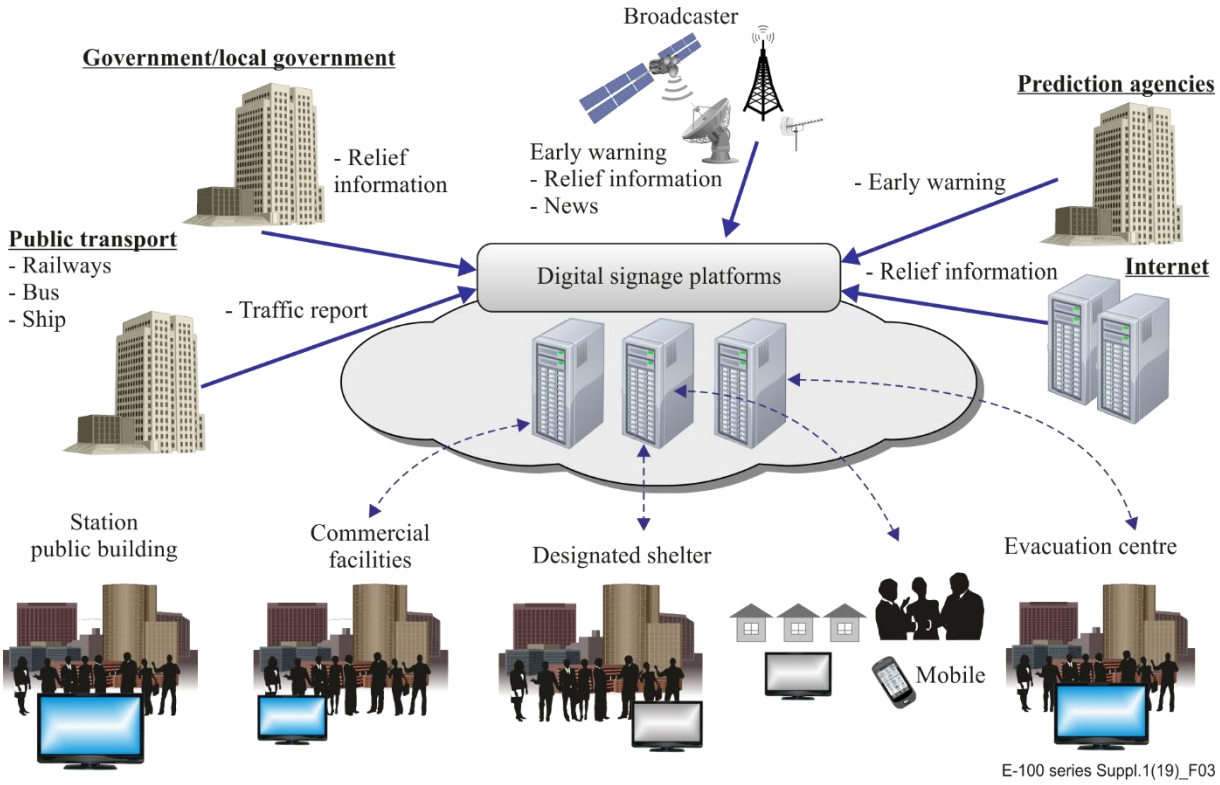

Figure 3 – Digital signage system for disaster relief and early warning

8 Requirements for new disaster relief systems

Disaster relief notification is important and should be effective in relation to rescue, evacuation, safety confirmation, and life sustainability, for example. Clause 6.3.2, introduced five new disaster relief systems, that is, "Disaster message board system", "Disaster voice delivery system", "Disaster relief guidance system", "Disaster relief by digital signage system" and "Safety confirmation and message broadcast system". The key factor is mobility, because most victims escape from danger with their mobile phones. This clause describes the requirements for these five systems.

8.1 Disaster message board system

The requirements for disaster message board service are detailed in [ITU-T E.108].

8.2 Disaster voice delivery system

The requirements for disaster voice delivery service are detailed in [ITU-T E.108].

8.3 Disaster relief guidance system

In the event of a disaster, victims may want to go to evacuation shelters, hospitals or their homes. However, they do not normally know the locations of these shelters and hospitals, and public transportation may have been disrupted. Therefore, they will want to know the route to take when walking to these destinations. The disaster relief guidance service can provide a graphic showing the route to these destinations via the display of a mobile terminal.

The requirements for disaster relief guidance system are detailed in Appendix I.

8.4 Disaster relief by digital signage system

As shown in Figure 3 in clause 7.3, a DS platform aggregates disaster relief information from multiple sources and delivers the information to various DS terminals. Details of the information should be processed according to the requests or needs of the recipients. For example, the refugees may request information about the nearest evacuation point as soon as possible.

DS services usually use rich content such as high-definition video carried through fixed or wireless networks. During or after a disaster the network capacity may be reduced due to partial failure or traffic congestion. Therefore, alteration of the data format or the data itself should be considered in advance (e.g., the replacement of large size data with small size data, the use of pre-stored graphics or representations such as scale vector graphics (SVG)).

In addition to a one-way delivery function (push mode), DS is required to distribute or retrieve disaster relief information such as safety confirmation or dedicated news in response to requests from victims or refugees (pull mode).

Furthermore, DS must meet the accessibility requirement for people with disabilities such as the hearing and visually impaired, and even by foreigners (e.g., a narration function for the visually impaired or a sign language function for the hearing impaired, and a translation or multi-language function for foreign visitors).

The requirements of disaster relief for digital signage is under study in ITU-T and are detailed in [ITU-T H.780] and [ITU-T H.785.0].

8.5 Safety confirmation and message broadcast system

To allow business to continue even in the event of a disaster, the safety confirmation and broadcast message service realized by using cloud computing is suitable for confirming the safety of public agency staff and dispatching available staff to undertake required work.

The requirements are detailed in [ITU-T E.119].

8.6 Disaster information sharing system

By using DISS, the information providers, such as local governments, can provide the common platform with the disaster information immediately when it is obtained so that the information collection can be performed effectively. The information is centrally managed at the common platform so that the information communicators can retrieve the necessary information from the common platform accurately and immediately and distribute the information to the residents through the media they operate.

The requirements are detailed in Appendix II.

Appendix I

Requirements for disaster relief guidance system

I.1 Introduction

In the event of a disaster, victims may want to go to go to evacuation shelters, hospitals or their homes. However, they do not normally know the locations of these shelters and hospitals and public transportation may have been disrupted. Therefore, they will want to know the route to take when walking to these destinations. The disaster relief guidance service can provide a graphic showing the route to these destinations via the display of a mobile terminal.

Most victims carry a mobile terminal such as a mobile phone, smart phone or tablet with them when escaping from a disaster. A mobile terminal with GNSS can identify the geographical position of a victim. If graphical route guidance to evacuation shelters, hospitals and their homes is shown on a display of a mobile terminal, a victim can easily and quickly understand the route.

It should be noted that the network capacity may be reduced during and after a disaster, and the local network in a disaster area might be isolated from the other main parts of the network. Moreover, radio access networks from base stations to mobile terminals may be out of service after a disaster. Therefore, this service must operate even with an isolated local network or when there are no radio signals from a mobile base station.

In addition to these points, a graphical map can be easily and quickly created even by non-IT experts such as local government staff and rescue teams, as the locations of evacuation shelters and dangerous locations must be updated in a timely manner depending on the situation.

I.2 Example procedures

When a victim starts the software for "Guidance service for disaster relief" in his mobile terminal, the terminal displays the map showing the site of evacuation shelters, hospitals and other relief locations. Once the victim has selected one of the locations, the terminal displays a graphical route showing directions to the selected location. The victim can then easily identify the walking route to the selected location.

The concept of "Guidance service for disaster relief" is shown in Figure I.1.

The key element of the service is the map, which consists of a base map and relief locations such as evacuation shelters and hospitals. The maps are stored in the terminal in advance, because the mobile terminal may not be able to access the map servers within a network due to network outage and heavy traffic congestion. The service must operate even when there are no radio signals from mobile base stations.

The map is regularly updated under normal conditions and it must also be capable of being easily and quickly updated after a disaster. The maps are stored in both a central server and local servers since the connection to the central server may be shut down after disasters.

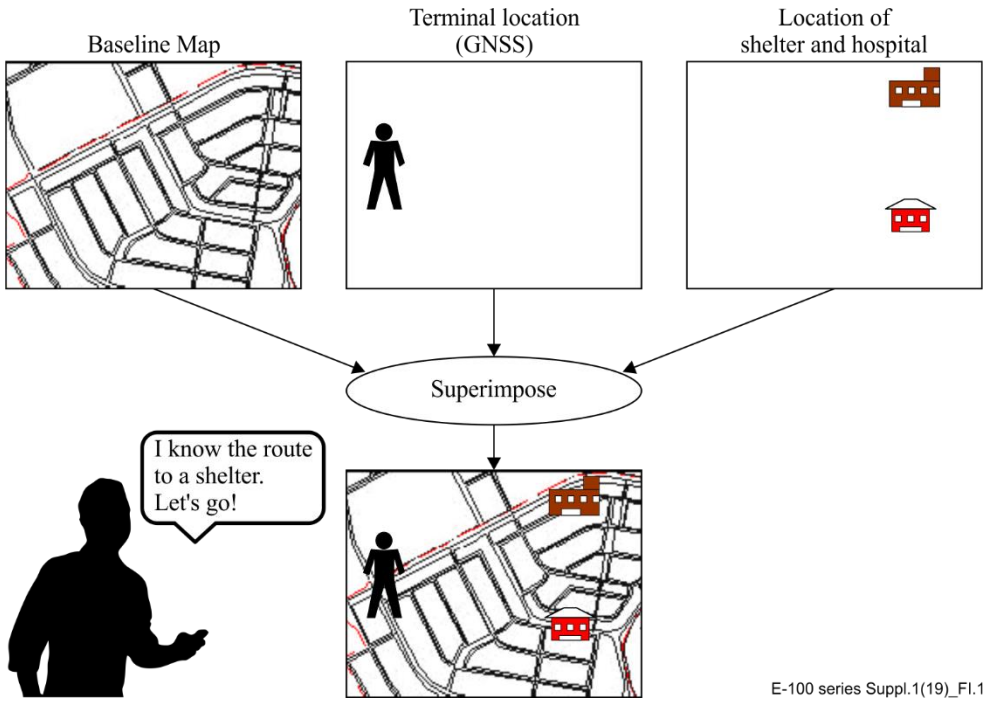

Figure I.1 – Guidance service for disaster relief

I.3 Requirements

Guidance service for disaster relief is required to provide the following basic functions.

I.3.1 Guidance map

A route guidance map is created by superimposing several maps/graphics and is stored in a central server within the network.

(1) Types of maps

– Baseline map;
– Location of evacuation shelter;
– Location of public service organization such as hospitals, local government offices;
– Location of dangerous/hazardous sites;
– Location of other relief sites.

(2) Superimposition

Some kinds of maps/graphics are superimposed to form a guidance map when the service is activated at a mobile terminal.

(3) Updating

Each map/graphic must be regularly updated.

After a disaster, it is particularly important that the locations of shelters and dangerous sites be quickly updated even by non-IT experts such as local governments and rescue teams.

(4) Uploading and downloading

Each map/graphic must be uploaded into a central server within a network.

It is recommended that some local servers also store each map/graphic in addition to their storage in a central server.

Each map/graphic must be capable of being downloaded into a mobile terminal when required. Automatic downloading is recommended when a map is updated.

(5) Map technology

Map technology is required to create various types of map in advance, and to enable non-IT experts to input the locations of emergency shelters and dangerous sites after a disaster. The maps should be stored and superimposed in a mobile terminal.

I.3.2 Geographical position of victims

A mobile terminal with GNSS must be able to identify its own geographical position. Its GNSS function is called stand-alone GNSS.

I.3.3 Specification of evacuation shelter

At a terminal, a victim can specify a relief site such as an evacuation shelter or a hospital.

I.3.4 Route guidance

A terminal shows the route on a mobile terminal, which guides the victims to a specific site such as an evacuation shelter, a hospital or their home.

I.3.5 Route guidance to home

Information about the route from a pre-registered location to a user's home is created and stored in a terminal in advance. The pre-registered location is possibly a user's office or a station, as selected by the user. This function is an option.

I.3.6 Geographical direction

The mobile terminal should have a compass function. The direction can be identified by the geomagnetic function of the GNSS or by performing a calculation using the direction of the sun and the time.

I.3.7 Security

The system must be secured against malicious access.

I.3.8 Language

1) Local languages (required)
2) English (recommended as a lingua franca)
3) Other languages (optional)

Appendix II

Requirements for disaster information sharing system

This appendix introduces information about the requirements for disaster information sharing system supplied by [b-APT].

II.1 Introduction

This appendix provides three major requirements for the disaster information sharing system (DISS) and describes the practical case of the operations and usage of the DISS. The outline and applications of the DISS are also described.

II.1.1 Background

Alongside global warming, various kinds of natural disasters are occurring more frequently all over the world. Especially in the Asia-Pacific region, which is a disaster-prone area. Large scale natural disasters such as typhoons, floods, tidal waves, draughts, earthquakes, tsunamis, and volcanic eruptions occur frequently in this region.

II.1.2 Lessons learned from large scale disasters

Lessons learnt from large scale disasters proved that it is important to send out the disaster-related information as quickly as possible, with utmost urgency and as accurately as possible to the people in the concerned areas so that they can be alert to the disaster and aware of instructions given by disaster-related agencies.

II.1.2.1 Guarantee of information delivery

It is sometimes hard to hear the voice sound of the loudspeaker of municipal disaster management radio communication system in some areas due to weather conditions. Phonetic isolation also occurs in a car and building, shutting out outside sound. In such cases, mobile phone, TV and internet work well for information delivery.

II.1.2.2 Durability of information delivery

It is sometimes difficult to operate municipal disaster management radio communication systems because of severe damages caused by the earthquake and tsunami. In such cases, some local governments can use another communication means such as temporary FM broadcasting and internet website, etc.

II.1.2.3 Continuity of information delivery

It is sometimes hard to keep municipal disaster management radio communication system functional due to power outages and fuel shortages. In this case, remote control function should be introduced for the safety of the operator. In order to provide the solution for the mentioned necessity, this appendix describes the concept and requirements of the disaster information sharing system (DISS).

II.2 Purpose and function of DISS

Disaster information dissemination consists of the following three phases.

1) Information issuance;
2) Information transmission;
3) Information distribution.

Information providers are to issue the information and transmit it to communicators who would in turn distribute it to residents. From the lessons learned from past serious disasters, it is required to establish a system to disseminate the necessary information quickly and accurately to each resident living in the area hit by the disaster. The DISS has been introduced to satisfy such a necessity. In the following clauses, the concept of the DISS and the function of each part are described.

II.2.1 Basic concept and merits of DISS

This clause describes the basic concept of the DISS and the feature of the common platform, which is a key component of the DISS. It also describes the merits of introducing the DISS.

The DISS consists of the three parts, i.e., information providers, common platform and information communicators. In the DISS, the information providers can provide the common platform with the disaster information immediately when it is obtained so that the information collection can be performed effectively. The information is centrally managed at the common platform so that the information communicators can take the necessary information out of the common platform accurately and immediately, and distribute it to the residents through the media they operate.

Figure II.1 shows a basic concept of the DISS. The most important part of the system is the information sharing common platform, which transmits information related to local safety and security collectively to various media in a prompt and efficient way.

Figure II.2 shows the merit of the DISS' common platform. Without a common platform, information providers (e.g., local governments) and information communicators (e.g., broadcasters) need to create many one-to-one systems. On the other hand, with a common platform, information providers and information communicators can share the information simultaneously (see Figure II.1).

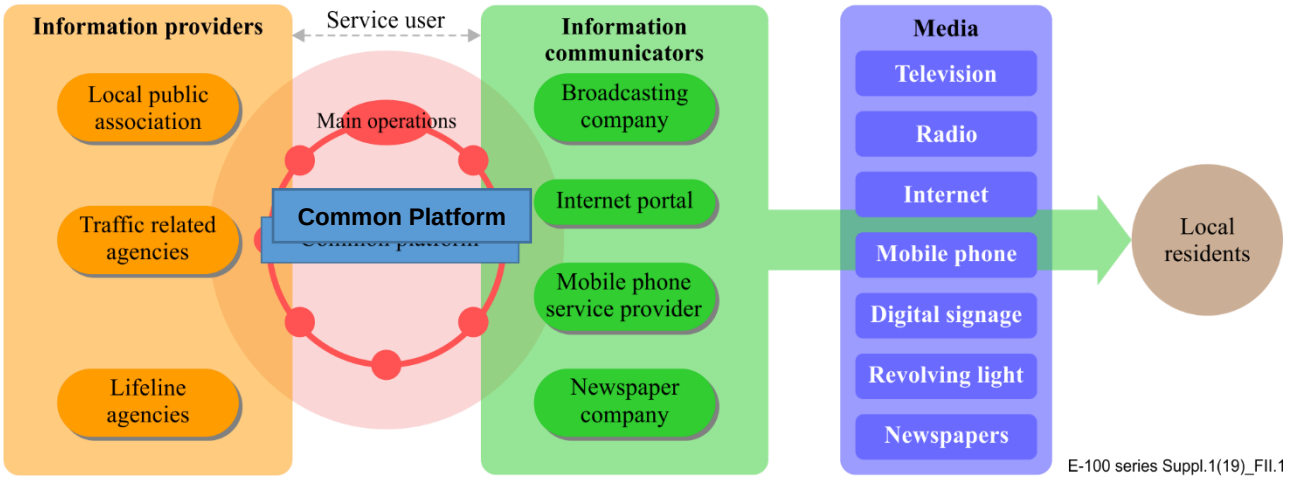

Figure II.1 – Basic concept of the DISS

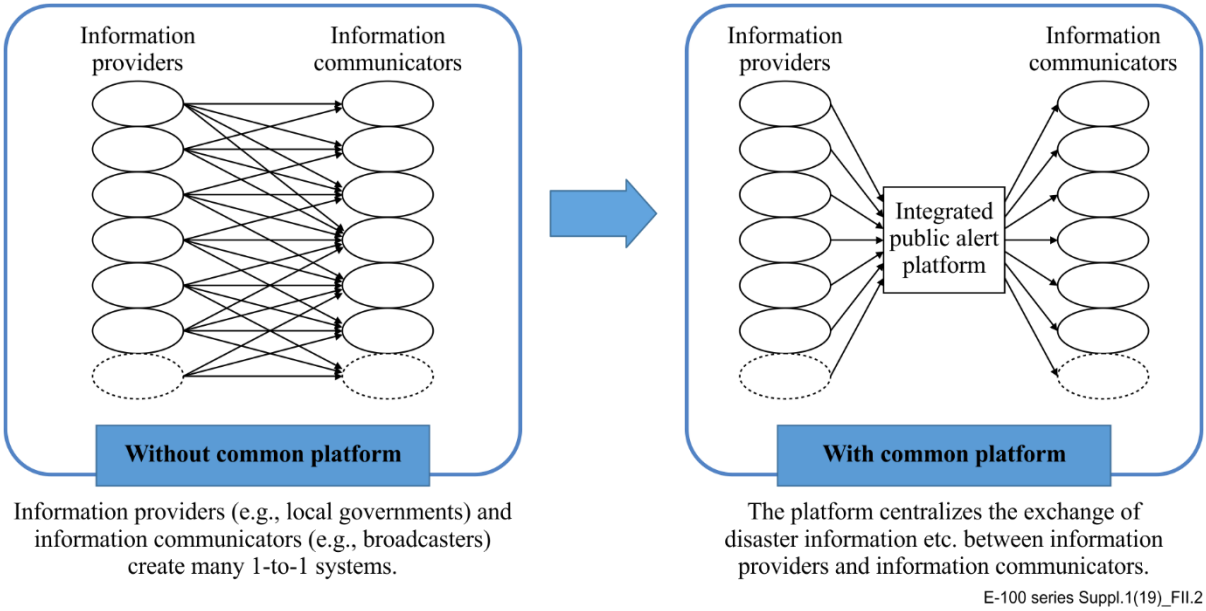

Figure II.2 – Common platform

Disaster information sharing through the common platform operates on three levels. It serves for collecting information, centralizing information and providing information. The benefits from using the DISS are as follows:

– Local residents can obtain accurate information in the event of an emergency and receive emergency information no matter where they are.

– Information providers can provide emergency information to local residents with certainty and can assess the damage across a wide area at the time of disaster.

– Information communicators can not only transmit information and gather information about a wide area without delay, but also transmit localized information to each individual community.

II.2.2 Collecting information

There are many information providers to issue alerts. See Figure II.3 for the example of information provider and alert as follows:

1) Municipality: Evacuation order, etc.

2) Local government: Disaster information, notification, etc.

3) Central government: Weather information, etc.

4) Utility companies: Restoration prospect.

Information on alerts, orders, notifications and others is transmitted to the common platform of the DISS from various information providers. Each provider can use its own data format, but are required to use a secure transmission line to prevent false information from being added.

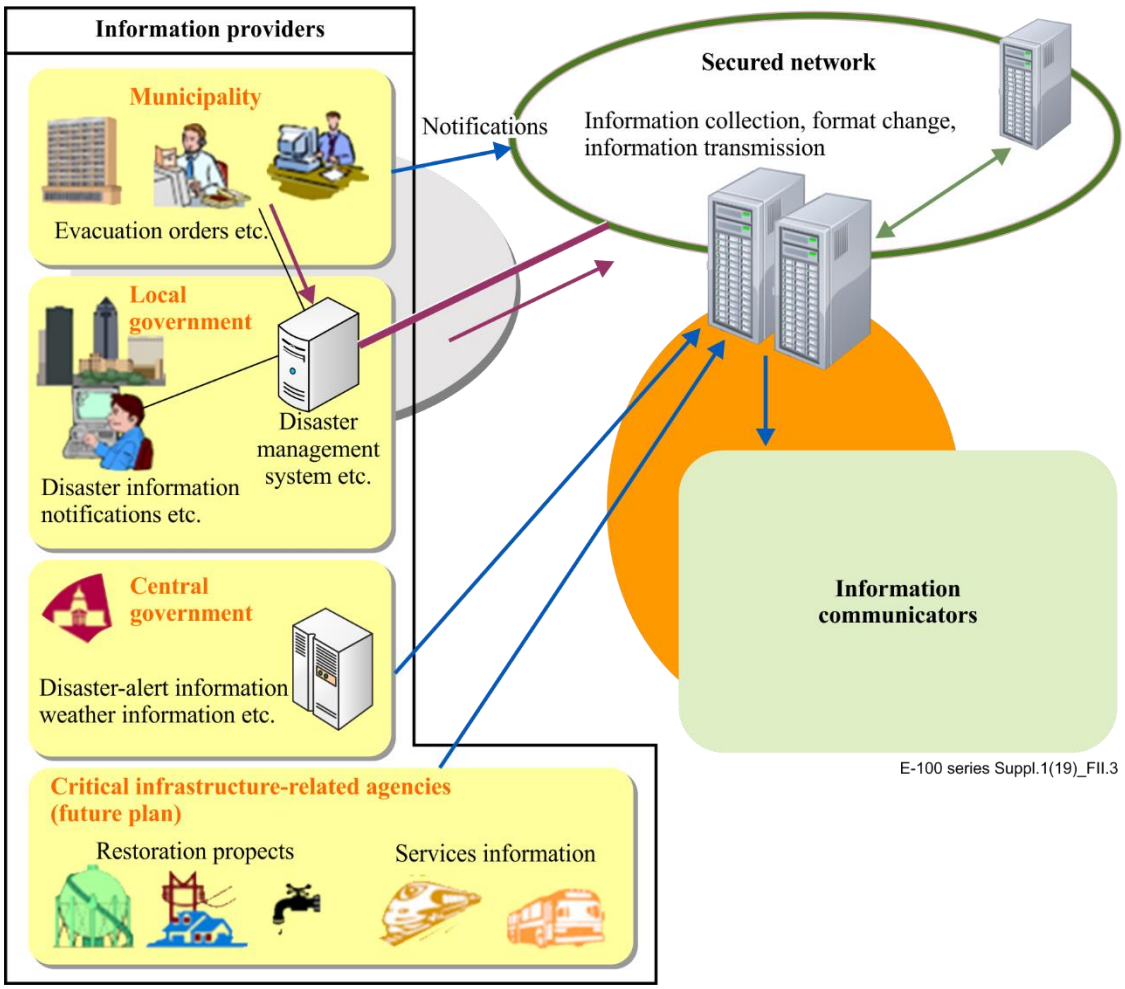

Figure II.3 – Collecting Information of DISS

II.2.3 Centralizing information

As explained in clause II.2.1, centralizing information is the most important objective of collecting the information from each provider, to then make it available to each communicator. To achieve this objective, it is important that the information providers, such as a local government, establish a management organization in cooperation with the communicators, such as broadcasters, to securely introduce and manage the information network and server. Using such a network and server, the following kinds of disaster information should be shared with local residents:

– Evacuation order / instruction;
– Information on evacuation centres;
– Information on disaster management centres;
– Property damage information such as bridge destruction information;
– Public events such as a disaster drill;
– Notifications such as an evacuation order;
– Water level in the river;
– Weather warning for rainfall, etc;
– Sediment disaster warning.

II.2.4 Data format unification

Disaster information centralized at the common platform's server is unified to the same information format so that information communicators can easily collect the information on the server. The most

likely unified data format is television common mark-up language (TVCML) so that information communicators can use it easily for their transmission.

Figure II.4 shows a centralization and data format exchange of disaster information.

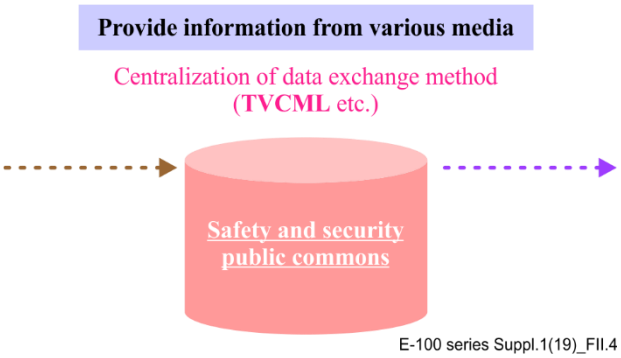

Figure II.4 – Data exchange

II.2.5 Providing information

The information communicators derive the necessary information from the common platform when needed and promptly distribute it to the residents whenever the information changes. The distribution structure, which the information communicators operate is desired to be resilient and robust against disasters. Several mediums should be used to distribute the information to ensure that it reaches the residents.

The likely information communicators, among others, are as follows:.

1) Broadcasting: TV, Radio;
2) Newspaper publishing company: Newspaper;
3) Internet: Disaster-related home pages;
4) Cellular phone: Disaster warning service.

Figure II.5 shows the routes providing public information to local residents through various media.

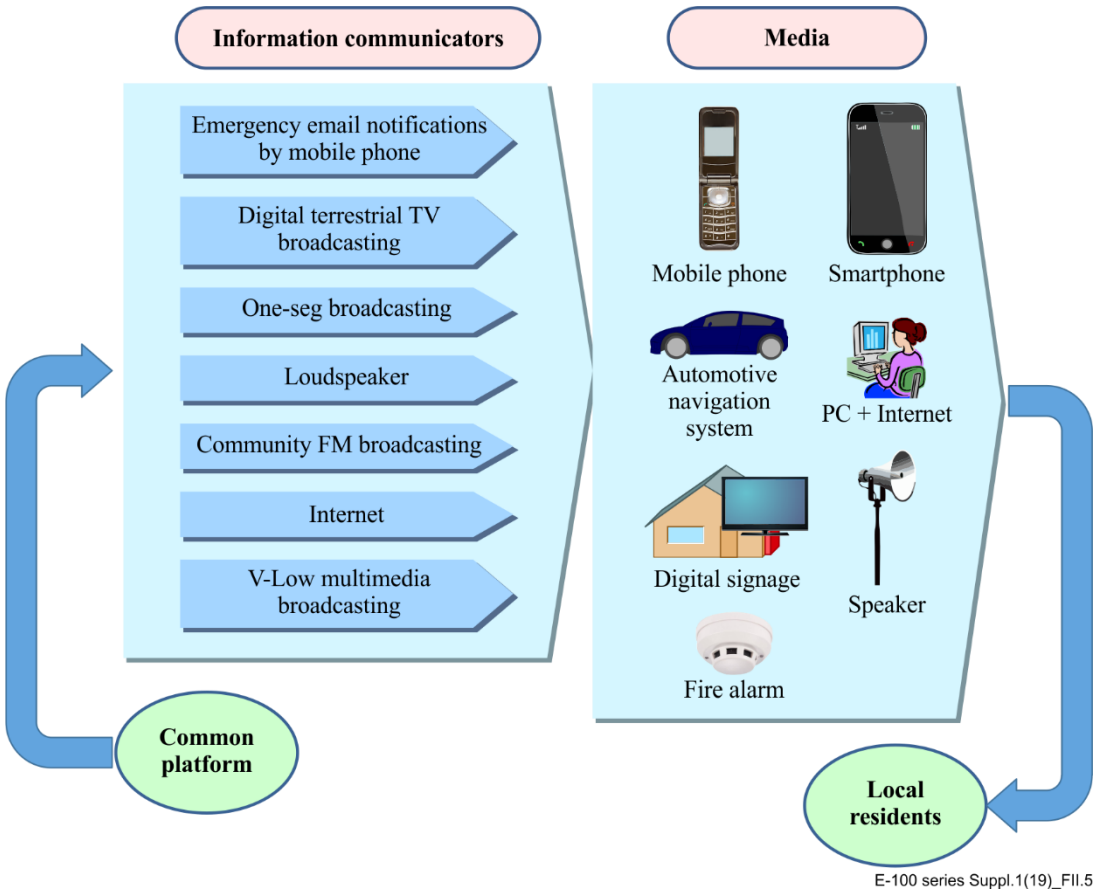

Figure II.5 – Providing information to local residents through various media

II.2.6 Requirements for DISS

The DISS has the following three functions:

1) Collecting information
2) Centralizing information
3) Proving information

The requirements to realize these functions are as follows:

1) A management organization to operate and utilize the DISS should be created, and the information providers and the information communicators should participate in the organization.
2) The information from the information providers should be centralized and administered at one common platform.
3) The security of the network from the information providers to the information communicators should be ensured.
4) Several medium should participate in the organization to ensure the distribution of the information to the residents.
5) The distribution structure of each media should be well prepared for such events, to prevent power failure and flood from interrupting the information distribution.

The disaster information can be reliably distributed with speed and accuracy by satisfying these requirements.

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