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ITU-T Focus Group on Disaster Relief Systems, Network Resilience and Recovery

Requirements for Disaster Relief System

Focus Group Technical Report

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 procedures for establishment of focus groups are defined in Recommendation ITU-T A.7. The ITU-T Focus Group on Disaster Relief Systems, Network Resilience and Recovery (FG-DR&NRR) was established further to ITU-T TSAG agreement at its meeting in Geneva, 10-13 January 2012. ITU-T Study Group 2 is the parent group of FG-DR&NRR. This Focus Group was successfully concluded in June 2014.

Deliverables of focus groups can take the form of technical reports, specifications, etc. and aim to provide material for consideration by the parent group or by other relevant groups in its standardization activities. Deliverables of focus groups are not ITU-T Recommendations.

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ITU-T FG-DR&NRR Deliverable

Requirements for Disaster Relief System

Summary

This deliverable describes requirements for a Disaster Relief System including an Early Warning System, which are used for real and potential victims(note), before, at or during and after disasters.

NOTE – The word "victim" in this document is the person who affected by the disaster.

Keywords

Early warning, disaster relief

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Requirements for Disaster Relief System

1. Scope

Information and communication technologies (ICT) provide crucial services and systems for our daily lives as well as in emergency and disaster situations. If we use the layering model as a basis, systems for use during disasters can be viewed from two standpoints: service/application and infrastructure. Regarding service and application, early warning systems against imminent disasters help people prepare for them, prevent serious damage, minimize the damage if it cannot be prevented, and minimize any loss of human life. 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.

Past experience and a consideration of the latest available technologies have revealed that some disaster relief and early warning systems need further investigation and common specifications if they are to become global standards.

This document discusses 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 as we progress towards the next steps in standardization. With a view to facilitating future enhancements, the main body of the document discusses the topic in general and the annexes deal with DR services, which need further investigation for standardization. It should be noted that the service descriptions in the document are designed to identify common service elements, and allow us to derive the requirements that will result in fundamental network capabilities.

The requirements for network resilience and recovery (NRR) are described in the companion document [b-FG-NRR].

2. References

The following ITU-T Recommendations and other references contain provisions, which, through reference in this text, constitute provisions of this deliverable. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this deliverable are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

The reference to a document within this deliverable does not give it, as a stand-alone document, the status of a Recommendation.

Normative references

[ITU-T E.106] ITU-T Recommendation E.106 (2003) International Emergency Preference Scheme (IEPS) for disaster relief operations End-user multimedia QoS categories

[ITU-T E.107] ITU-T Recommendation E.107 (2007) Emergency Telecommunications Service (ETS) and interconnection framework for national implementations of ETS

[ITU-T E.123] ITU-T Recommendation E.123 (2001) Notation for national and international telephone numbers, e-mail addresses and Web addresses

[ITU-T I.255.4] ITU-T Recommendation I.255.4 (1990) PRIORITY SERVICE

[ITU-T M.3350] ITU-T Recommendation M.3350 (2004) TMN service management requirements for information interchange across the TMN X-interface to support provisioning of Emergency Telecommunication Service (ETS)

[ITU-T H.780] Recommendation ITU-T H.780 (2012), *Digital signage: Service requirements and IPTV-based architecture.*

[ITU-T F.790] Recommendation ITU-T H.790 (2007), Recommendation ITU-T H.790 (2007),Telecommunications accessibility guidelines for older persons and persons with disabilities

[Terminology of UNISDR] United Nations International Strategy for Disaster Reduction (UNISDR) (2009), Terminology on Disaster Risk Reduction, published by The United Nations Office for Disaster Risk Reduction available at http://www.unisdr.org/we/inform/terminology

[3GPP TS 22.268] Technical Specification 3GPP TS 22.268 V11.40 (2012-03) *3rd Generation Partnership Project: Technical specification Group Services and System Aspects; Public Warning System (PWS) requirements (Release 11)*[3GPP TS 23.041] Technical Specification 3GPP TS 23.041 V11.3.0 (2012-06) *3rd Generation Partnership Project: Technical Specification Group Core Network and Terminals; Technical realization of Cell Broadcast Service (CBS)(Release 11))*

[3GPP2 C.S0005] 3GPP2 C.S0005-F v1.0 (December 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 (November 2012) *3rd Generation Partnership Project 2: Short Message Service (SMS) for Wideband Spread Spectrum Systems*

3. Terms and definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1. Disaster [Terminology of UNISDR]: 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.

3.1.2. Early Warning System [Terminology of UNISDR]: 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.

3.1.3. Preparedness [Terminology of UNISDR]: 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.

3.1.4. Prevention [Terminology of UNISDR]: The outright avoidance of adverse impacts of hazards and related disasters

3.1.5. Digital signage (DS) [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.

3.2. Terms defined in this document

3.2.1 Business Continuity Plan: A plan that enables managers and relevant people to continue to operate their businesses even in a disaster.

NOTE – The plans are made before a disaster occurs and are used mainly in public organizations to save victims' lives.

3.2.2 Dedicated systems: Systems for Disaster Relief and Early Warning that have been designed implemented and operated only for dedicated purpose.

3.2.3 Disaster Relief: Information or action designed to be effective for reducing, suppressing, or avoiding impacts caused by disaster.
NOTE -- 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.

3.2.4 Disaster relief for general public: To notify general public of the latest disaster relief information.

3.2.5 Disaster relief for individual: To notify individual persons of the latest disaster relief information and/or collect the latest situation of the individuals.

3.2.2 Disaster Relief System: A system that supports related parties including victims, rescue workers.

3.2.3 Disaster Message Board System: A disaster relief system that enables people to input text messages into network facilities as a message board for delivery to or retrieval by other people.

3.2.4 Disaster Voice Delivery System: A disaster relief system that enables people to input packetized voice messages into network facilities for delivery to or retrieval by other people.

3.2.5 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.

3.2.6 e-Health: The electronic management of health information, which delivers safer, more efficient, and better quality healthcare information. The technologies include tools for health information networks, electronic health records, tele-medicine services, and personal wearable and portable mobile devices.

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

3.2.8 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.

3.2.9 Safety Confirmation: Information about the safety of users who might be affected by a disaster, or actions taken to gather and manage this information.
Note - Safety confirmation information should be gathered and managed at more than one site, and be reported to a specified person.

3.2.10 Safety Confirmation and Message Broadcast System: A disaster relief system that confirms the safety of people in public agencies or discrete groups and broadcasts messages to them regarding their relief activities.

3.2.11 Shared systems: Systems that are commonly used for both usual services and urgent services such as Disaster Relief and Early Warning.

4. Abbreviations and acronyms

This document uses the following abbreviations and acronyms:

CMAS	Commercial Mobile Alert System
DRS	Disaster Relief Systems
DS	Digital Signage
ETWS	Earthquake Tsunami Warning Systems
EU-ALERT	European Public Warning System
EWS	Early Warning Systems
GPS	Global Positioning System
IARU	International Amateur Radio Union
MNO	Mobile Network Operator
PTSD	Post Traumatic Stress Disorder
SDO	Standard Development Organization
SVG	Scale Vector Graphics
UNDP	United Nations Development Programme
UNISDR	United Nations International Strategy for Disaster Reduction (United Nations Office for Disaster Risk Reduction)
3GPP	The 3rd Generation Partnership Project
3GPP2	The 3rd Generation Partnership Project 2

5. Conventions

In this document:

The key term "is required to" indicates a requirement that must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

The key term "is prohibited from" indicates a requirement that must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

The key term "is recommended" indicates a recommendation rather than a requirement and so does not need to be met to claim conformance.

The key term "is not recommended" indicates a condition that is neither specifically recommended nor specifically prohibited. Thus, conformance with this specification can still be claimed even if this condition is present.

The key term "can optionally" indicates an optional condition that is permissible, without implying any sense of it being recommended. This term is not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

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 along with the time frame. 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 sub-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

Until now, radio and TV broadcasting, amateur radio and fixed phones have mainly been used for disaster relief systems. Recently, mobile communication and digital signage 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 huge 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, and it irritates users.

IP-based technologies are capable of mitigating the congestion or providing other communication means (e.g. IP telephony, voice-based messaging, text messaging, e-mail, 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. Movies taken by individuals are expected to reveal the exact nature of any damage and help us create an up-to-date map. Big-data processing will assist us to identify key parameters from the information and advise 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 and 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 life. Each refugee should be treated as a member of the community. They must be supplied with food and goods them without any waste. ICT systems must 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, have to be investigated.

5) Consideration of accessibility

It should be noted that the systems must be helpful for people with disabilities such as the visually and aurally impaired. It is 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 [1],[2].

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 optimised 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 needed to contribute to 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 we must classify information to be protected and publish a Privacy Policy Statement before a disaster occurs.

In addition, during the East Japan Earthquake, some refugees moved frequently from one evacuation site to another. Staff sometimes inputted information on behalf of information owner. They resulted in incorrect data finding its way onto 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 huge 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 sub-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 (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. These can be called dedicated systems. The other systems are commonly shared during both disasters and in normal situations. One example is TV broadcasting. These can be called 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

Timing	*Before Disaster (for Preparedness, Prevention)*	*During Disaster (for Rescue, Evacuation)*	*After Disaster (for Safety confirmation, Life sustainability)*
Type of Notification / *Flow Direction of Notification*	**Early Warning**	**Disaster Relief**	
Public agency to General public[1)]	*TV broadcasting including Hybridcast -Shared*		
	Radio broadcasting-Shared		
	Digital signage (new) –Shared		
	Fixed radio communications-Dedicated		
Public agency to Public agency	*Fixed radio communication-Dedicated*		
	Satellite fixed-Dedicated		
	—		*Satellite Vehicle-Dedicated*
Public agency to people within the agency		*Mobile phone-Dedicated*	
		Fixed phone-Dedicated	
		Safety confirmation and message broadcast (new)	
Public agency to Individual2)	*Mobile broadcast to phone (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 – (New) means a new NRR measure which needs study for standardization.

NOTE – 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.

6.3. New study areas for disaster relief including early warning

This sub-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

Until now, 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 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 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 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

Until now, TV and radio broadcasting systems 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. So, ITU-T is 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, people generally want to talk over the telephone network to find out about the condition of their family, relatives, and friends. However, they may fail to make contact due to severe voice traffic congestion. IP packet traffic is less congested than voice traffic. So, with an IP messaged-based mobile service, victims can easily inform their friends and family members of their safety or the damage situation.

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.

Message board systems using mobile phones should be investigated.

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 damage situation 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.

A voice-based notification delivery system should be investigated.

3) Disaster relief guidance system

During and after a disaster, victims may need to go to hospitals and temporary evacuation shelters whose locations they do not know. After a disaster (e.g. an earthquake) is over, 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 along 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 GPS) 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 should be investigated 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).

4) Disaster relief system with digital signage

Digital signage (DS) 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 should be investigated that can cope with the amount of information, the use of pre-stored graphics, and new technologies (e.g. scale vector graphics (SVG)).

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 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 that can collect information about the safety of the people working for the agency and broadcast messages to them from the agency to realize a Business Continuity Plan.

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 example 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 tsunami mobile warning system

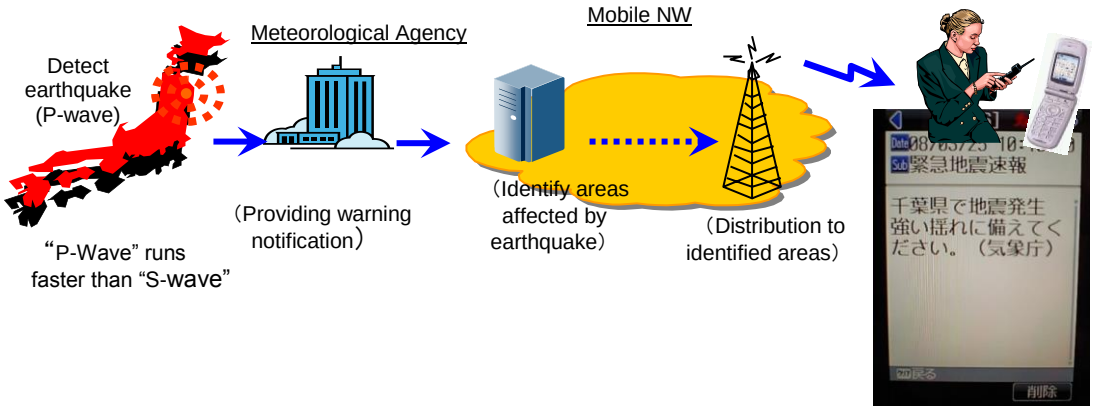

Figure 1 – Tsunami Mobile Early Warning System Japan

The mobile terminal broadcast channels for early warning use have already been specified. For broadcast technologies, 3GPP specifies TS 22.268, TS 22 041, 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 below.

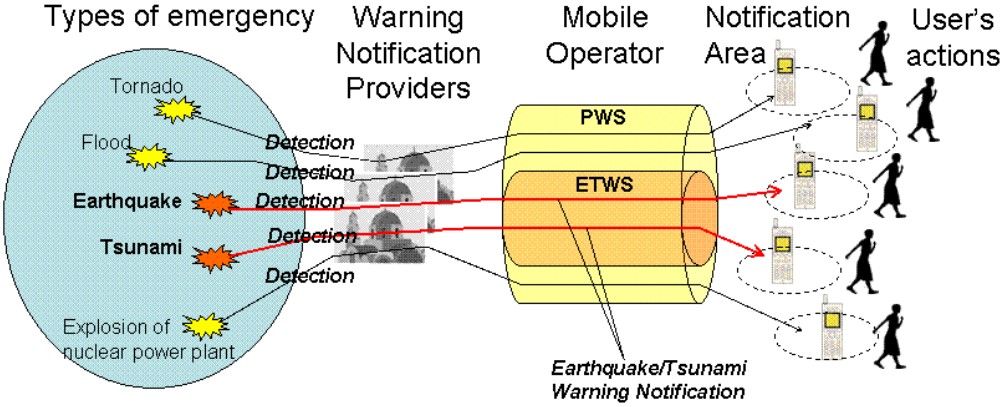

Figure 2 – Relationship between PWS and ETWS

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:

1) It shall 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 Mobile Network (VPLM) supporting Public Warning System (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 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 draft ITU-T Recommendation H.DS-DISR on "Digital signage: Requirements of disaster information services".

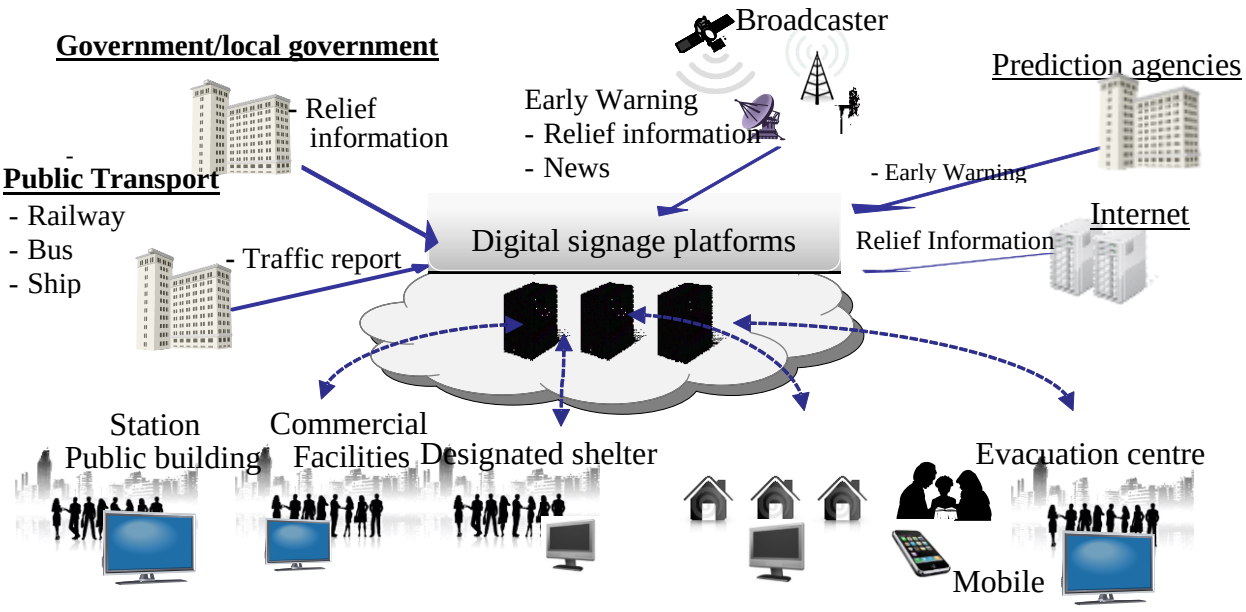

Figure 3 – Digital signage system for disaster relief and early warning

8. Requirements for new disaster relief systems

Disaster relief notification is important and should be effective in relation to, for example, rescue, evacuation, safety confirmation, and life sustainability. In clause-6.3.2, five new disaster relief systems are nominated; “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

Annex 1 to the Document details the requirements for Disaster Message Board Service.

8.2. Disaster voice delivery system

Annex 2 to the Document details the requirements for Disaster Voice Delivery Service.

8.3. Disaster relief guidance system

During and after a disaster, victims want to go to evacuation shelters, hospitals and their homes. However, they do not normally know the locations of these shelters and hospitals. And public transportation may have stopped operating. 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 GPS 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 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 stopped 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, because the locations of evacuation shelters and dangerous locations must be updated in a timely manner depending on the situation.

8.3.1. 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 it. Then the victim can easily identify the walking route to the selected location.

The concept of “Guidance Service for Disaster Relief” is shown in Figure 4.

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. And the maps are stored in both a central server and local servers because the connection to the central server may be shut down after disasters.

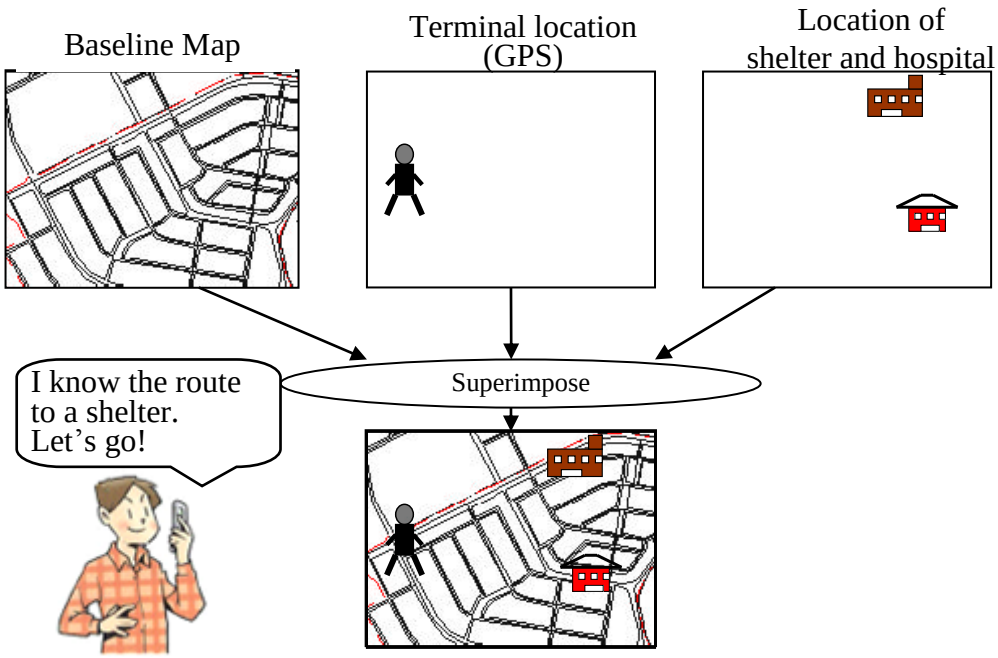

Figure 4 – Guidance Service for Disaster Relief

8.3.2. Requirements

Guidance Service for Disaster Relief is required to provide the following basic functions.

8.3.2.1. 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 one 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.

8.3.2.2. Geographical position of victims

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

8.3.2.3. Specification of evacuation shelter

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

8.3.2.4. 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.

8.3.2.5. 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.

8.3.2.6. Geographical direction

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

8.3.2.7. Security

The system must be secure against malicious access.

8.3.2.8. Language

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

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 visually and aurally 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 requirement of disaster relief for digital signage is under study in ITU-T SG16.

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 Annex 3 to the Document.

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[b-UNESCO] UNESCO (2012), *Disaster Preparedness and Mitigation*, http://www.unesco.org/new/en/natural-sciences/special-themes/disaster-preparedness-and-mitigation/disaster-risk-reduction.

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Annex 1

Base document for “Requirement for Disaster Message Board Service”

(This Annex has been transferred to ITU-T SG2 (T13-SG02-C-0029!R1!).)

Annex 2

Base document for “Requirement for Disaster Voice Delivery Service”

(This Annex has been transferred to ITU-T SG2 (T13-SG02-C-0030!R1!).)

Annex 3

Base document for "Requirements for Safety Confirmation and Broadcast Message Service for Disaster Relief"

(to be developed further)

1. Scope

This document describes the requirements for Safety Confirmation and Broadcast Message for Disaster Relief.

During and after a disaster, public organizations such as hospitals, local governments and telecommunication service providers have to continue their business as far as possible in order to save the lives of victims.(note) Most public organizations have made Business Continuity Plans (BCP) for use during a disaster, and it is important to realize the BCP to provide as many public services as possible. In the event of a disaster, the Safety Confirmation system is used to confirm staff status such as their availability, and the Broadcast Message system distributes orders to the available staff to enable them to continue functioning. Public organizations can realize their BCP by using the Safety Confirmation and Broadcast Message system, and can protect victims' lives and property to the best of their ability.

NOTE – The word "victim" in this document is used to denote a person affected by a disaster

2. References

The following ITU-T Recommendations and other references contain provisions, which, through reference in this text, constitute provisions of this deliverable. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this deliverable are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

The reference to a document within this deliverable does not give it, as a stand-alone document, the status of a Recommendation.

Normative references:

<TBD>

3. Definition

3.1. Terms defined elsewhere

This Recommendation uses the following terms that are defined elsewhere:

3.1.1. Disaster [Terminology of UNISDR]: 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. Terms defined in this recommendation

3.2.1. Disaster Relief: Information or action designed to be effective for reducing, suppressing, or avoiding impacts caused by disaster.
NOTE -- 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.

3.2.2. Disaster Relief System: A system that supports related parties including victims, rescue workers.

3.2.3. Safety Confirmation: 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.

3.2.4. Business Continuity Plan: A plan that enables to continue to operate their businesses even in a disaster. The plans are made before a disaster and are used mainly in public organizations to save victims' lives.

4. Abbreviation and acronyms

<TBD>

5. Conventions

The word "required" indicates a requirement that must be strictly followed and from which no deviation is permitted if conformance to this Deliverable is to be claimed.

The word "recommended" indicates a characteristic that is recommended but which is not absolutely required. Thus this requirement need not be present to claim conformance.

The word "optional" indicates an optional characteristic that is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

6. Background and Concept

6.1. Background

In the event of a disaster, it is very important that public organizations, such as telecommunication companies, electric power companies, hospitals, fire departments and local governments continue to operate and help save the lives of victims. For example, telecommunication companies should

provide telecommunication services to enable safety confirmation and emergency telecommunication immediately after a disaster, and local government should aggregate information about disaster victims and the situation in affected areas. Confirmation of the safety of officials or company staff is important, because managers have to organize officials or staff members in order to continue operating. In addition, managers have to call officials or staff to continue operating and to share accurate information, which is essential in emergency situations. Broadcast message systems are required to accomplish this.

6.2. Concept

To save victims' lives in the event of a disaster, public organizations such as local governments, fire departments, hospitals and telecommunication companies should continue to operate normally as far as possible. For such public organizations, a Safety Confirmation and Broadcast Message Service by using Cloud Computing is a suitable way to confirm the safety of members of the organizations and dispatch available people to appropriate work sites. This service is divided into two parts. One is safety confirmation where the service image is shown in Figure 1, and the other is broadcast messages where the operation image is shown in Figure 2.

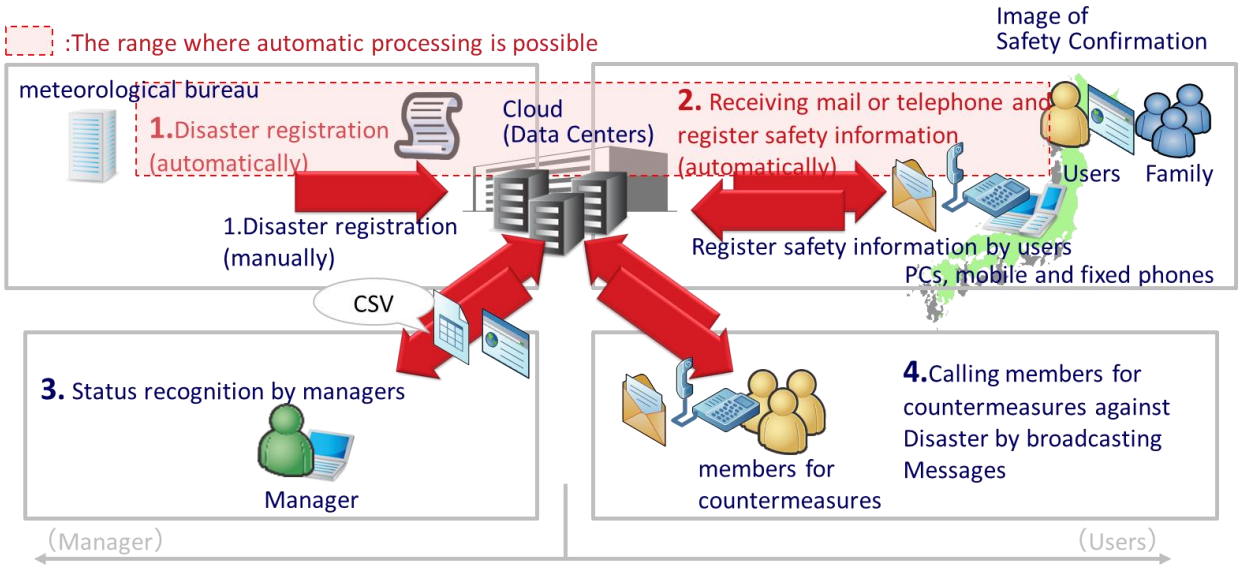

Figure 1 – Concept of Safety Confirmation

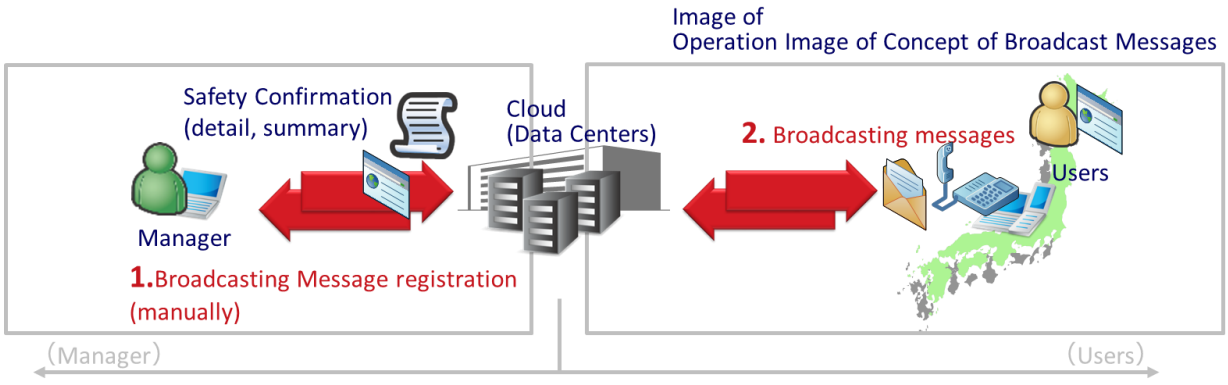

Figure 2 – Operation Image of Concept of Broadcast Messages

To continue in the work of public organizations during disasters, the manager must first confirm the safety of the people working in the organizations, and then dispatch available staff to appropriate work sites to continue operations. In this sense, the flow direction of the notification is “Public organization to staff of the organization,” which is a new category.

After the requesting safety confirmation, the staffs of the organizations send their status to the manager. In this case, the flow direction of the information is also “Staff of the public organization to the organization,” so the direction “Public organization to the staff of the organization” is bidirectional.

7. Requirements

Safety Confirmation and Broadcasting Message service for Disaster Relief must provide the following functions.

7.1. High-reliability/availability

The system itself must be highly reliable and easily available, since the system is used during and after a disaster.

1) **Data duplication**
   Data synchronization and redundant server configurations are needed for storing users’ contact information in the case of an emergency.
2) **Geographical distribution of data**
   Several secure data centres located in different places are needed to protect against damage to one data centre and to enable services to continue in the case of an emergency.
3) **Stable telecommunication network**
   It is recommended that a stable telecommunication network be used for communication between end users and data centres.
4) **Multiple telecommunication techniques**
   Several telecommunication techniques, such as e-mail, fixed telephony and mobile telephony, are recommended for communication use.

7.2. Security and integrity

The system deals with data that have security requirements, such as vital data related to officials in public organizations.

1) **Secure telecommunication network**
   A secure telecommunication network is needed that prevents malicious access.
2) **Privacy policy**
   Private information about individuals such as their private contact information must be managed securely and handled in accordance with permissions received from individuals in advance. A privacy policy statement must be made and published before a disaster. The above are important because information stored by a cloud computing service is one form of individual data such as the private contact

information of officials or staffs. In some organizations, the permissions are given by individuals (e.g. officials or staffs) when they sign a contract with the organization.

3) **Data integrity**
   Data integrity is required even if data are stored at several data centres and frequently updated.

4) **Identify data source**
   It is recommended that the source of the data be identified (e.g. who, when and why) to allow traceability and confirmation.

7.3. Easy operation

A safety confirmation system must be as easy to operate as possible, because operation may be difficult during a disaster. Regarding the terminal, a victim can select a relief location such as an evacuation shelter or hospital, if his/her own terminal will not work.

1) **Easy registration**
   The easy registration, updating and deletion of individual pieces of information are recommended.

2) **Easy registration method**
   An easy registration method is recommended so that staff can store safety confirmation information even in an emergency situation.

3) **Unified operation**
   It is recommended that the operation of registering safety information be unified for different terminal types.

4) **Push service for smart phone**

   An application for smart phones can be optionally provided for pushing safety confirmation requests from a cloud (data centre) to smart phones.

7.4. Interoperability for safety confirmation

A safety confirmation system should perform automatically as far as possible to shorten the operation time, because organizations have to make decisions regarding continuing to operate in the event of a disaster.

1) **Connection with other agencies**
   Connection information with a metrological organization system for automatic disaster registration is required.

2) **Connection within internal systems**
   Interoperability with a mail server is needed to send e-mail to users.

7.5. Functions for safety confirmation

The safety confirmation system requires the following core functions.

1) **Retry function**
   A safety confirmation request must be re-sent to users who have not responded to previous requests.

2) **Family option**
Confirmation of the safety of the user's family can be optionally facilitated for working with ease.

3) **Search function**
It is recommended that safety confirmation information can be searched for by employing search terms such as area and organization.

7.6. Functions for broadcast message

The broadcast message system requires the following functions.

1) **Selection function**
It is recommended that messages be broadcasted to selected users to collect additional information.

7.7. Security

The system must be protected against malicious access.

7.8. Language

1) Local languages (required)

2) English (recommended as a lingua franca)

3) Other languages (optional)