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

Promising technologies and use cases
– Part I, II and III

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.

SERIES OF FG-DR&NRR TECHNICAL REPORTS

Technical Report on Telecommunications and Disaster Mitigation

Overview of Disaster Relief Systems, Network Resilience and Recovery

Promising technologies and use cases – Part I, II and III

Promising technologies and use cases – Part IV and V

Gap Analysis of Disaster Relief Systems, Network Resilience and Recovery

Terms and definitions for disaster relief systems, network resilience and recovery

Requirements for Disaster Relief System

Requirements for network resilience and recovery

Requirements on the improvement of network resilience and recovery with movable and deployable ICT resource units

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ITU-T FG-DR&NRR Deliverable

Promising technologies and use cases – Part I, II and III

Summary

Based on the contributions to FG-DR&NRR meetings, this document provides an integrated view of promising technologies for Disaster Relief Systems, Network Resilience and Recovery (DR&NRR). First, an integrated view of DR&NRR technologies is described that allows the support of rescue organizations as well as private persons when disasters occur (Part I). This is followed by descriptions of each technology component explicitly mentioned in the integrated view (Part II). Other technologies, which do not fit into the single pictorial view but that appear promising are also described (Part III).

Information about FG-DR&NRR inputs is also briefly summarised (Part IV) and references provided using a common formal template (Part V).

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Promising technologies and use cases – Part I, II and III

1.   Part I: Integrated view of promising DR&NRR technologies

Telecommunication and ICT systems are important techniques in relation to disaster preparedness and relief. To maintain and/or increase communication chances for people even during disasters, terminals may be enhanced by further access technologies to allow the use of systems on different networks (e.g. fixed access networks, public WiFi, Intelligent Transport Systems (ITS) and satellite networks). The networks will also be enhanced by providing access to several communication paths that are different from the normal communication paths and combining currently independent networks and their capabilities (which are owned and/or operated by different organizations with different policies) in an integrated manner.

Figure 1 shows an integrated view of a network infrastructure that supports disaster relief services. In general, the networks are categorized into three parts; core network, access network and user (shown in three tiers in the figure), and also categorized into two types; owned by service providers and perhaps not owned by service providers (indicated by different the cloud shapes of the networks). The figure highlights emergency communication paths compared with normal paths.
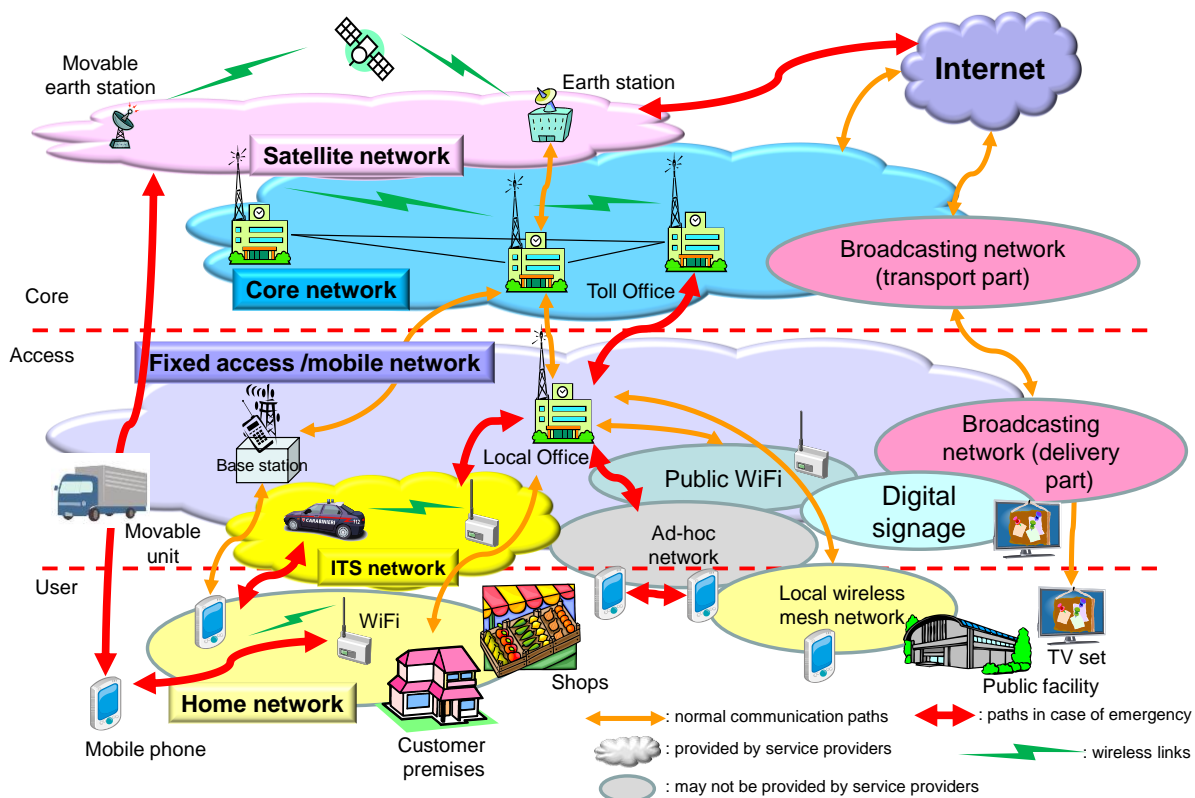
Figure 1 –Integrated view of networks supporting disaster relief services

There are many telecommunication satellites around the earth. These satellites sustain no damage during a disaster even if physical network equipment on earth is damaged. If temporary earth stations can be easily installed, a satellite network can be seen as a disaster-resistant

core network. Mobile phones that can access the satellites directly provide another means of disaster-resistant communication even when the existing network infrastructure on earth is severely damaged by a disaster.

Fixed and mobile networks consist basically of access and core networks. If the core network is destroyed by a severe disaster, the affected area is extensive. To protect or mitigate serious damage inflicted on the core network, most of the telecommunication service providers adopt some form of redundancy. In addition, the core network connects users to the Internet, and so it is important to maintain minimum availability for all Internet services such as Facebook and Twitter, which played an important role for individuals trying to communicate during the Great East Japan earthquake and tsunami.

TV and radio broadcasts play an important role in disseminating real-time information, that is, safety information, evacuation status, and damaged area information. A broadcast network basically consists of delivery and transport parts. The delivery part of the broadcasting network is different from a telecommunication network except with IPTV and IP-based broadcasting. The transport part may use core network facilities in the telecommunication network. This means that failures and damage in the core network may affect TV and radio broadcasting.

Access networks connect core networks and users. Fixed-line access includes fibre optics, copper lines, and cable networks. In general, access networks have no redundancy because of its high expense, so it is critical to protect access network facilities and restore them if damaged in a disaster. For mobile networks, the situation is similar to fixed access networks, but mobile networks are easier to use than fixed-line access networks since users can move and connect with an alternative base station.

Recently, cars have telecommunication functionality, which has led to intelligent transportation. An ad-hoc network established between cars can be used as an access network during a disaster, because cars have batteries and generators and can move. This kind of ad-hoc network is called an ITS network in the figure.

Most mobile terminals such as PCs and smartphones are equipped with WiFi functionality, and many telecommunication service providers and other companies provide public WiFi services. During a disaster, it is considered that public WiFi should be made freely available for distributing emergency information.

When access or core networks are damaged, an ad-hoc network may provide substitute access and core networks. An ad-hoc network consists of several facilities including WiFi functionality.

A local (private) wireless mesh network is based on a decentralized mesh architecture and avoids the total network blackout that is caused by some damage to part of the network. The network consists of fixed and portable mesh relay nodes that are placed on the top of buildings and/or on the ground.

Digital signage, which is not a telecommunication infrastructure, is connected to telecommunication networks and broadcast networks, and provides information to the public in a similar way to TV and information message board services on the Internet. In the Great East Japan earthquake and tsunami, most users sought for vital information from digital signage rather than from their mobile terminals because they did not want to deplete the batteries.

Recently, most broadband users have started to employ a home network connecting their home appliances. If the home network uses WiFi, it can be open to the general public during a disaster.

To further increase connectivity during a disaster, the networks above interact with each other more closely. In a normal situation, each network is operated independently in its own way and using its own policy. Network information, such as traffic volume, network performance, and resource availability, is not made widely available to other networks and users. In a disaster situation, each network may be required to make its functions available even to the non-subscriber's terminals by relaxing authentication against the terminals and associated charging. When a serious disaster occurs, networks change the way they operate and notify the terminals of this change of operation. Terminals receive notifications about, for example, service availability and the change in the authentication and charging policy. Based on these notifications, terminals can communicate through surviving components, or choose alternative networks. Network information and changes in operation should be shared between the networks to achieve harmonized and effective emergency communications.

2.   Part II: Components of the integrated view

The following paragraphs describe some promising techniques and technologies that can be applied during disasters to one level as well as to different levels.

Requirements derived from the technologies are described in [b-FG-NRR] and [b-FG-MDRU].

2.1.   Local Wireless Mesh Network System

The local (private) wireless mesh network is based on a decentralised mesh architecture and avoids the total network blackout that is caused by damage to part of the network. The network consists of fixed and portable mesh relay nodes that are placed on the tops of buildings or on the ground (see Figure 2).
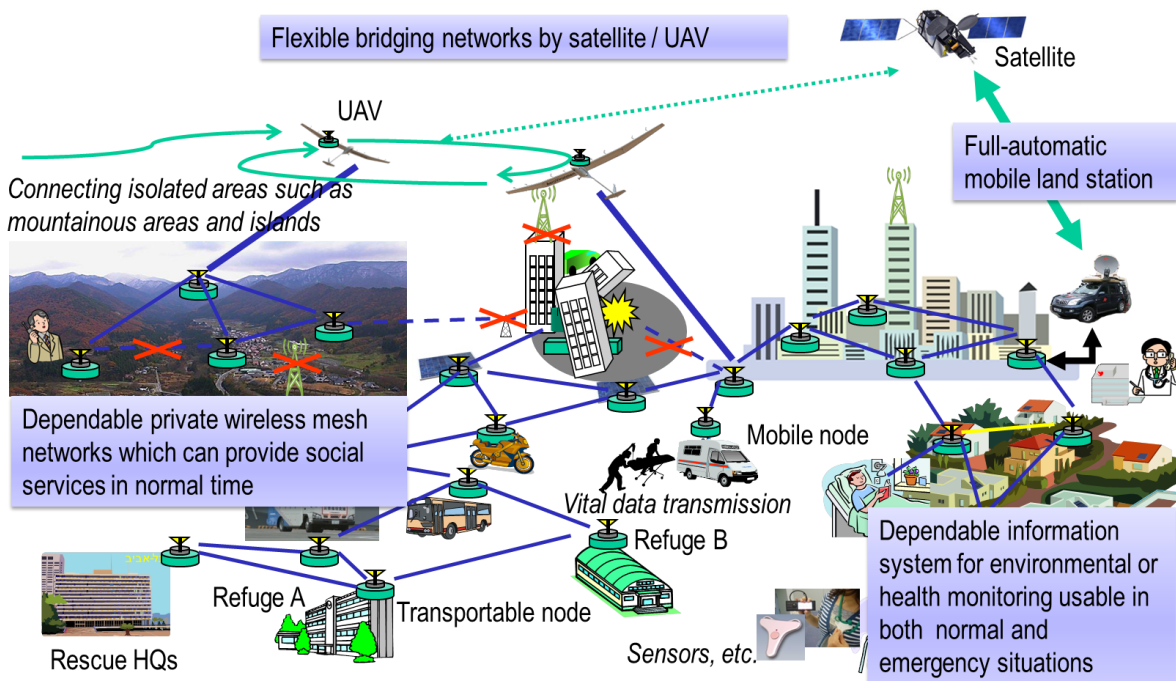
Figure 2 – Local wireless mesh network architecture

They also provide WLAN access in the area around them. A WiMAX link is also included in order to establish a wireless link between mesh nodes separated from each other. Relevant aspects related to the infrastructure components are: necessary telecommunication facilities, transport access, electricity supply, distance to the nearest local exchange and/or IP network, human resources and security. The wireless mesh network has a significantly improved disaster resilience achieved through the use of a distributed database and distributed application technologies, which are not provided by the current systems. The network is designed to have low running costs so that in future it can be privately operated by local governments. It also employs connections to small and on-vehicle satellite earth stations and mobile repeaters that will be provided by vehicles and program-controlled small unmanned aircraft. These earth stations and mobile repeaters are expected to rapidly provide isolated areas with communication and monitoring links until the infrastructure recovers.

Annex B to [b-FG-NRR] describes further details of the requirements for local wireless mesh networks.

2.2. Delay Tolerant Networking (DTN)

After a major disaster many components of the communications infrastructure may be severely damaged or destroyed. This will prevent disaster victims from obtaining necessary information or communicating with others outside the disaster area. As a result, DTN-based communication systems have attracted a lot of attention due to their robustness to network disruptions and disconnections. Delay-tolerant networking describes a protocol architecture that is used to overcome the technical issues in heterogeneous networks that may lack continuous network connectivity. DTN may be related to mobile terminals as well as to nomad stations.

2.2.1. Mobile terminals with DTN functionalities

Currently, most user terminals such as smartphone or tablet devices are equipped with WiFi functionality. The WiFi functionality of these devices can be enriched by DTN functionalities to achieve a dynamic network structure where each mobile terminal is able to send a delay tolerant message to other terminals in a multi-hop fashion as shown in Figure 3.
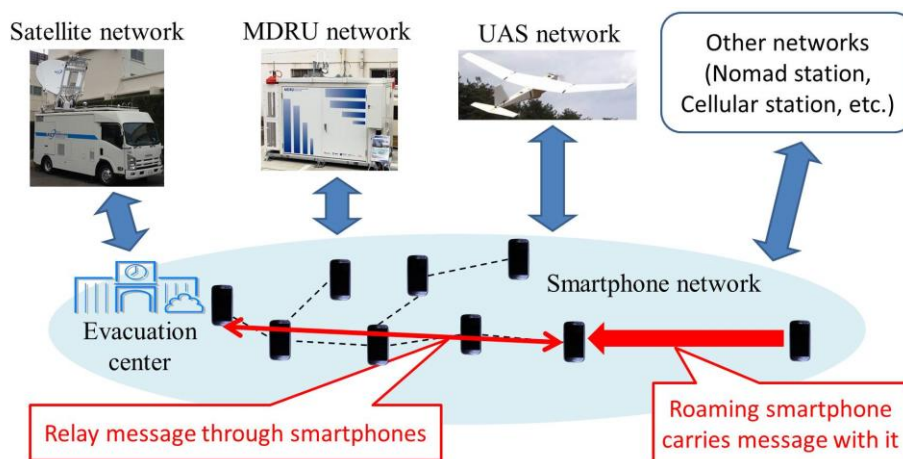
Figure 3 – Mobile terminal delay tolerant networking enrichment

By this enrichment it is possible to utilize common WiFi equipped devices such as smartphones and/or tablets to communicate with other devices within or outside the disaster

area without needing any physical infrastructure. In addition to the absence of any need to deploy a specific fix installed infrastructure, it is also simple for users since the only action required is as simple as opening a distributed application on his/her device and to follow the instructions. Message relay performance in DTN can be improved by adopting a Mobile Ad-hoc Network (MANET). Routing information provided by MANET can greatly increase the efficiency with which messages are relayed through multiple terminals without applying any DTN procedures in intermediate nodes, especially in areas with high population density or where mobility is limited such as evacuation centres. However, since MANET needs to maintain routing information, it can lead to an increase in the control overhead of the network. This can reduce the efficiency with which messages are relayed in an area with low population density or among nodes with high mobility. To this end, an optimisation technique is needed to maximize the message relay performance. In other words, each terminal can choose one of two different communications modes, namely the DTN or MANET mode, and invoke only a DTN function or DTN and MANET functionalities, respectively. Mode selection can be automatically determined by each terminal, as directly decided by the user, or remotely set up by controllers if one is available. With automatic mode selection, valuable information, such as GPS signals, a three-dimensional accelerometer reading, the number of neighbours, and the remaining amount of battery can be used to determine the mode in which the terminal will operate. In addition, this information can be easily obtained in widely used mobile terminals, which make them even more attractive. In the prototype system, the DTN mode is chosen for a device with high mobility, no other neighbour, or a low battery level. In this system, it is possible to detect movement with GPS, however, that was not implemented because of battery constraints.

Even when it is possible to cover a large area using just WiFi equipped smartphones or tablets, DTN can also be easily incorporated into other kinds of networking technologies such as satellite networks, movable and deployable resource unit (MDRU) networks, unmanned aircraft systems (UAS), nomad stations, or other cellular networks. By establishing a connection with a satellite network or an MDRU network, it is possible to send messages to other recipients who are farther away such as those in different cities or even different parts of the world. If it is impossible to deploy satellite station or resource units to the area, an unmanned aircraft can act as a terminal that can carry messages from the disaster area to other areas where there are connectivity services. Another possibility is that since the message sent using DTN can propagate over a very long distance, the message may reach a terminal that has cellular connectivity that in turn can then relay the message over a cellular network. In addition to reaching a terminal that has a cellular connection, the message may also propagate to a location that still has WiFi connectivity or to a location equipped with a nomad station such as an evacuation centre where it is possible to forward the message beyond the disaster area.

2.2.2. Nomad stations with DTN functionalities

Current WiFi technology is not the most suitable for handling locally crowded terminals. Its throughput degrades when the number of terminals rises to tens and becomes almost impossible if the number reaches hundreds. Therefore, it would be useful to develop nomad stations that are able to handle hundreds of terminals with WiFi.

One of the problems this nomad station faces is connectivity with the public backbone network. During disasters it is not always possible to connect such a station to a public backbone network, which prevents the nomad station from accessing the information source. Traditionally this has been achieved by installing a satellite communication facility at the station, but this is rather expensive and the bandwidth is limited. Therefore, DTN technology that stores

the information when it is connected to the source, and delivers the information to the destination when it finds the end user, seems to be suitable. Figure 4 shows an image of the system.
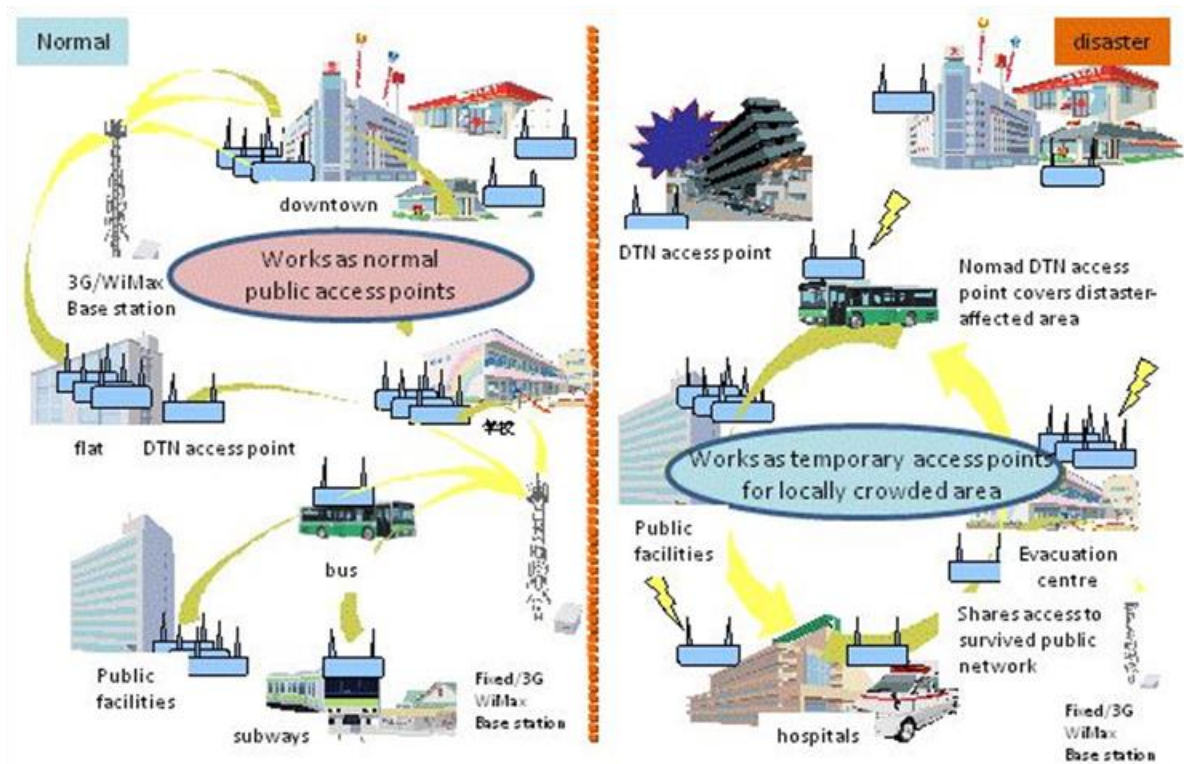
Figure 4 – Nomad stations with DTN functionalities

In a normal situation, the nomad station works as a temporary access point for e.g., the downtown are and schools for temporary event and others/specific events. They are connected to the public backbone, and work as normal WiFi access points, i.e., they relay information between end-user terminals and the information source, e.g., various websites.

When a disaster occurs, the station switches to the DTN mode. It then starts to circulate information to various places, e.g., a connecting point to a backbone network, city hall, and hospitals, and stores necessary information such as which evacuation centre is available, where is the food, and who is evacuating where. The nomad station then goes to evacuation centre, train station and other such places, distributes the stored information and also collects requests for server access. This information collection and distribution continues until the public network becomes sufficiently stable.

2.3. Resilient network architecture based on Movable and Deployable Resource Unit (MRDU); Portable Emergency Communication System (PECS)

During emergencies and disasters, communication service disruptions occur quite often and are sometimes unavoidable. It is the responsibility of the public authorities to restore these services and this must be done very quickly to gain control over chaotic situations.

During the recovery phase, a "Portable Emergency Communication System (PECS)" may play an important and intermediate role in speeding up the transition from the "communication lost" state to "stable communication" state. Various PECS with different scope and designs are available; either designed in operational vehicles, vans, and trucks or even as

standalone trailers. Each of these designs has advantages and disadvantages as regards use in emergency operations in the field. The PECS considered in this document is designed to be installed in several strong cases made of aluminium, rubber or a similar rugged material conforming to military standards. PECS are frequently used in military systems but civilian versions differ in terms of technology and mobility properties from vendor to vendor. It is likely to have at least the following components:

a)   User terminals

   i.   Analogue and Digital Radios: VHF, UHF, HF/SSB, DMR, P25 (APCO), TETRA

   ii.   Mobile Phones: Cellular Interfaces such as GSM, CDMA, W-CDMA,

   iii. Phones: Analogue/Digital PABX Phones, DECT/WiFi phones

   iv.   Satellite Interfaces: Low and high orbit satellite phones

b)   IP based Integration Switch

User terminals are connected to the "integration switch" through proper interfaces.

The integration switch interconnects different types of interfaces such as analogue/digital radios to mobile phones, and satellite phones to IP phones. This enables different user groups to communicate and also provides the flexibility of teleconferencing.

c)   Antennas and Quasi Antenna Products

Depending on the air interface requirements, different kinds of antennas are utilized in various frequency bands. One or two expandable tripods are included with the antennas for open field applications/operations.

d)   Power Units

Lightweight power units must be designed for the PECS in order to achieve easy portability. This requires the use of, for example, batteries, solar (foldable) panels, and generators.

e)   Accessories

Power converters, cables, electrical/mechanical user adapters etc.

f)   Measurement Devices

Devices needed to maintain the PECS components such as voltmeters, power meters, and SWR meters.

g)   Peripheral Devices

Tablet PCs, rugged notebooks, smartphones, etc.

All the above devices can be packed into several rugged military standard cases; thus they can be easily transported and used by the relevant parties in the operations field.


Another type of transportable ICT resource is referred to as movable and deployable ICT resource unit (MDRU), which consists of some of the above components and ICT resources simulating a data oriented services. The MDRU is a collection of information and communication resources that are packaged as an identifiable physical unit, movable by any of multiple transportation means, and can be deployed as a stand-in for damaged network facilities and so substitute for their functionalities. The MDRU also brings extra ICT resources to meet the

huge communication demands in the disaster area. It can also be used in normal situations by providing local networks supported by local governments and other private sector organisations.

[b-FG-MDRU] describes further details of the requirements for MDRU.

2.4. Restoration of optical fibre links in remote areas

The optical fibre network infrastructure can suffer severe damage from unexpected, large-scale natural disasters. As learned from the Great East Japan Earthquake and Tsunami, even if the above ground infrastructure, such as repeater stations, switches or exchanges are irreparably damaged, the buried fibre can survive and still be used to support vital emergency services. In these cases, a portable erbium-doped fibre amplifier (EDFA) can enable the swift reconnection of surviving fibre links to optical fibre networks or provide a means of bypassing any damaged network infrastructure (See Figure 5).
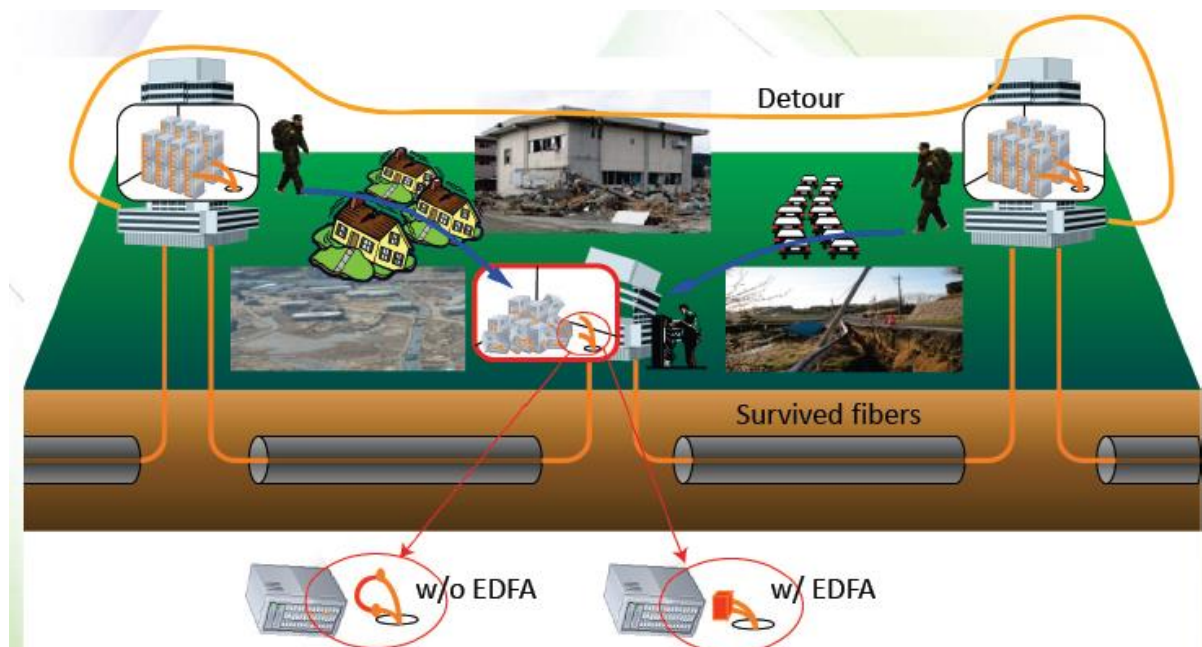

Figure 5 – Reconnection of optical fibre links

The portable EDFA is battery powered allowing optical amplification even in remote areas without electrical power. Furthermore, since it is also waterproofed and shock-proofed, it can be used even in harsh environments. The full-duplex, module is also burst-mode compatible, and is thus able to amplify bursty or intermittent optical signals without distortion or causing surges in optical power that can damage downstream equipment.

Annex A to [b-FG-NRR] describes the requirements for a portable burst-mode EDFA in further detail.

2.5. Satellite Communication Network

For the rapid technical resolution of problems, technologies aimed at making one Very Small Aperture Terminal (VSAT) compatible with multiple communication methods are being researched and developed. The goal is to efficiently secure satellite communications lines to

meet the needs of areas where the communication infrastructure has been destroyed by an earthquake or tsunami (see Figure 6).
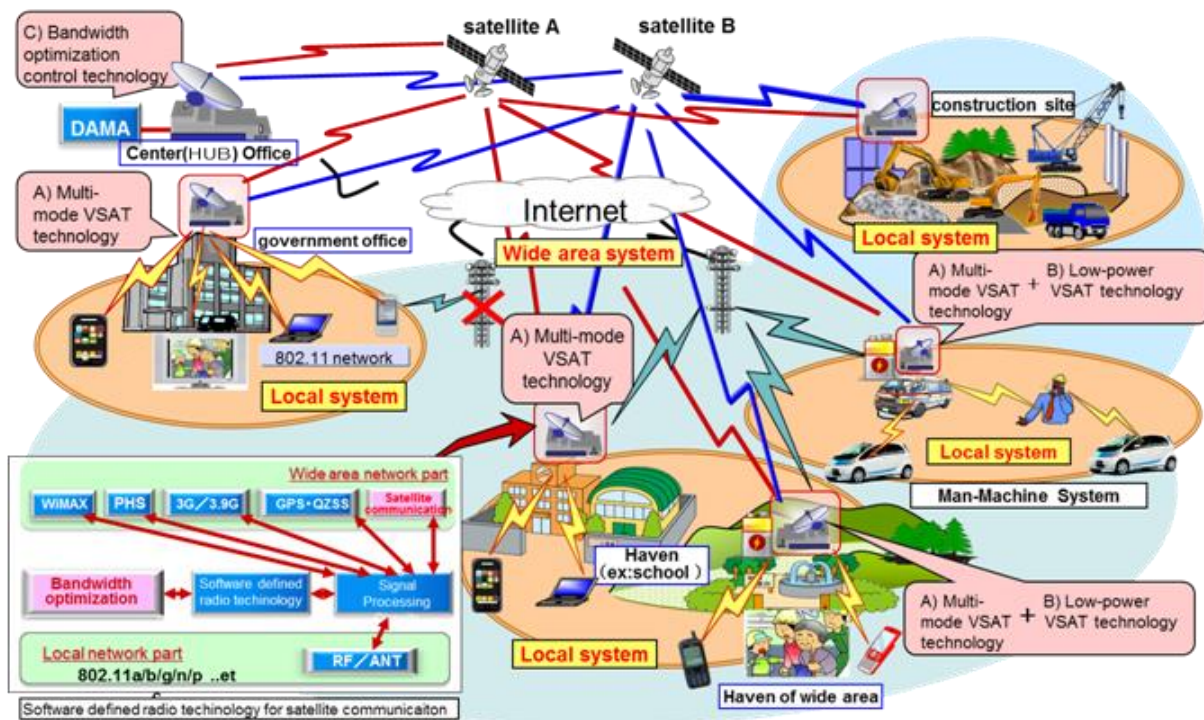
Figure 6 – VSAT enrichment for disaster preparedness

The work focuses on resolving issues related to satellite communications systems as follows:

- Shortage of VSATs for disaster area

Target: Multi-mode VSAT Technology

- Prolonged electric power failure causes deactivation of VSAT equipment

Target: Low-power VSAT technology

- Satellite network traffic congestion

Target: Bandwidth optimisation control technology

These technologies enable VSAT to be available within 12 hours of a great disaster in the affected area. VSAT will be used from the relief phase to the restoration and reconstruction phases.

The research and development of a software definition radio system for a VSAT, small size antenna, and an algorithm for accessing plural communication satellites make it possible to communicate between different satellites communication systems with single VSAT. Multi-mode VSAT technologies, which accommodate these functions, make it possible to establish a robust satellite communication system that is sustainable even with heavy traffic congestion in time of disaster (see Figure 7).
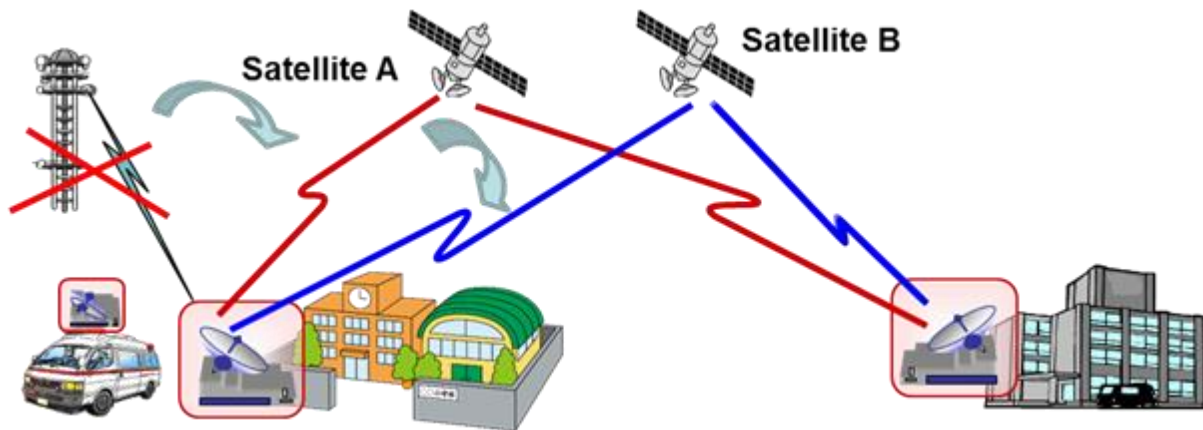
Figure 7 – Communication between different satellite systems

When satellite communication system A is unavailable because of traffic congestion caused by a disaster, VSAT accesses another satellite communication system B, which is available as a substitute as a result of the developed multi-mode VSAT.

2.6. Low-power VSAT technology

The research and development of a practical portable satellite terminal adopts new low-power technologies to provide an essential communication tool in a great disaster as follows:

- Practical power management and control scheme for optimising power consumption.

- Practical integrated ODU/IDU with enhanced maintainability.

2.7. Bandwidth optimisation control technology

The research and development of satellite bandwidth optimisation control is different from bandwidth control schemes for terrestrial wired communications system. A Demand Assignment Multiple Access (DAMA) controller allocates the optimum bandwidth on a session-by session basis to avoid traffic congestion in satellite communications systems.

2.8. VSAT Recovery

VSAT Recovery is based on the development of a small transportable VSAT, which provides easy installation and simple operation, so that unskilled people can establish satellite links during a disaster.

The system concept is as follows:

- A transportable VSAT is monitored and controlled by a HUB station. In this case, a new function for controlling this VSAT is installed as an experimental extension into the SKY Perfect JSAT Corporation owned-operated "EsBird" HUB system.

- When installing an antenna, there is no need to adjust the horizontal level. And antenna azimuth, elevation and polarization angles are auto adjustable.

- Uplink Access Test (UAT): Adjustment transmitting cross polarization discrimination while transmitting carrier operation is performed automatically after antenna deployment.

- When the direction of an antenna is changed by the aftershock of an earthquake, VSAT detects the change and automatically made adjusts the antenna direction.

- Transport to a stricken area is a key factor when roads and railroads have been severed.

System features are:

- Compensation for sloping ground; by detecting the inclination of an installation position using a built-in inclination sensor, it is quick and easy to orientate the satellite correctly to within 7 degrees on sloping ground.

- Optimizing receive filter bandwidth; VAST targets the HUB Common Signalling Carrier (CSC) to acquire the satellite. The receive filter bandwidth for receiving a narrow band carrier should be optimal for quick and correct satellite acquisition.

- Automatic UAT function: After the auto adjustment of the antenna azimuth, elevation and polarization angles, VSAT automatically transmits the continuous wave carrier and optimises the Cross Polar Discrimination (XPD) level. This HUB side function is also performed automatically.

- Detecting the trigger of automatic UAT: When there is a satellite lock failure during operation, VSAT detects the antenna condition from sensor information about the receive level, sync status, and roll and pitch inclination and adjusts the direction in which the antenna is pointing. And VSAT asks the HUB station to perform an automatic UAT.

- Easy handling for non-skilled operator: VSAT is equipped with a user-friendly man machine interface that displays safe operating techniques via a touch panel display and audio guidance.

- Assembly-free one-box earth station: There is no need for extra electric wiring work for installation and the operator only has to push one button to deploy the antenna.

- Easy conveyance: A lightweight design can enable people to carry the earth station to a stricken area even without a vehicle.

3. Part III: Disaster relief systems and other promising technologies

This clause describes promising DR&NRR technologies that do not appear explicitly in the integrated view in Figure 1. First early warning systems are considered followed by systems for disaster relief. Finally the concept of Hybridcast is addressed.

3.1. Early warning system

An early warning system is a system that can warn people of an imminent disaster or about the possible effects of a disaster that has actually occurred.

[b-FG-DR] describes the requirements for early warning systems in further detail.

3.1.1. Warning system with mobile terminals

When a disaster occurs, mobile networks may be heavily congested by individual voice calls. If mobile systems distribute notifications via mobile broadcast technology, which is independent of or less affected by voice calls, the warning notification can reach multiple mobile terminals simultaneously within the areas affected by a disaster such as an earthquake. The

recipients of the notification can recognize the potential disaster and can prepare for it in advance.

3.1.2.   Warning system with digital signage

Digital signage (DS) is a kind of information delivery display that shows TV programming, 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 an early notification to DS in local public and semi-public areas.

3.2.   Disaster relief system

A disaster relief system is a system that can provide information or support actions for the reduction and suppression of serious disruptions to the functioning of society. The disruptions may be caused by accidents, natural phenomena or human activity, and result in a significant widespread threat to human life, health, property or the environment.

[b-FG-DR] describes the requirements for disaster relief systems in further detail.

The specific new areas being studied by ITU-T are;

i)   Disaster Message Board System

After a disaster, people generally want to talk over the telephone network to reassure their family, relatives, and friends about their condition. However, they may fail to communicate due to heavy voice traffic congestion. IP packet traffic is less congested than voice traffic. So, with an IP message-based mobile service, victims can easily inform their friends and family members of their safety or about the damage they have suffered.

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 friends and family members.

Message board systems using mobile phones should be investigated.

ii)   Disaster Voice Delivery System

Some people prefer live voice-based communication to reassure their family, relatives, and friends about their condition. Voice-based calls are also easy for the elderly to make. Traditional circuit switched networks may suffer from congestion, whereas IP packet networks are generally not 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. With this kind of packetized voice service, a victim's friends and family can easily receive information about the victim's safety and the damage situation.

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

A voice-based notification delivery system should be investigated.

iii)   Disaster relief guidance system

During and after a disaster, victims may have to go to the nearest hospitals and temporary evacuation shelters whose locations are unknown to them. After a disaster (e.g. an earth-

quake) is over, people working in offices want to go home, however the public transportation method that they normally use may have stopped operating. They may have to take long and unfamiliar routes on foot, some of which may be inaccessible due to the disaster.

Basically, a victim first identifies his or her terminal location (by GPS) and selects a target location for example a shelter, a hospital or home. Then, the terminal can display a graphical route to the location.

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

v)   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 disaster, a disaster relief system with DS that takes account of the amount of information, the use of pre-stored graphics, and new technologies (e.g. scale vector graphics (SVG)) should be investigated.

vi)   Safety confirmation and message broadcast system

During and after a disaster, organizations want to confirm the safety of their staff immediately and thus enable their businesses to continue operating. Available staff must be dispatched to the targeted areas and undertake their allotted tasks as soon as possible.

For example, a public agency wants to know the condition of its staff and dispatch them to help save lives in the devastated areas.

A safety confirmation and broadcast message system should be investigated that can gather safety information about the people working for an organization and broadcast messages from the organization to its staff members.

3.3.   Hybridcast (hybrid broadcast-broadband television systems)

Prompt and reliable information is urgently required in the event of a large-scale natural disaster such as the Great East Japan Earthquake. Hybridcast is an integrated broadcast-broadband system designed to enhance a broadcasting service with broadband, and which has been standardized by the IPTV Forum Japan. The advantages of broadcasting are that is provides high quality content and simultaneity, whereas the advantage of broadband is its flexible response to a user's personal request. By combining these two advantages, advanced broadcasting services can be provided on Hybridcast. Hybridcast's characteristics mean it can also be effectively applied during a disaster. Figure 8 shows an overview of the Hybridcast system.
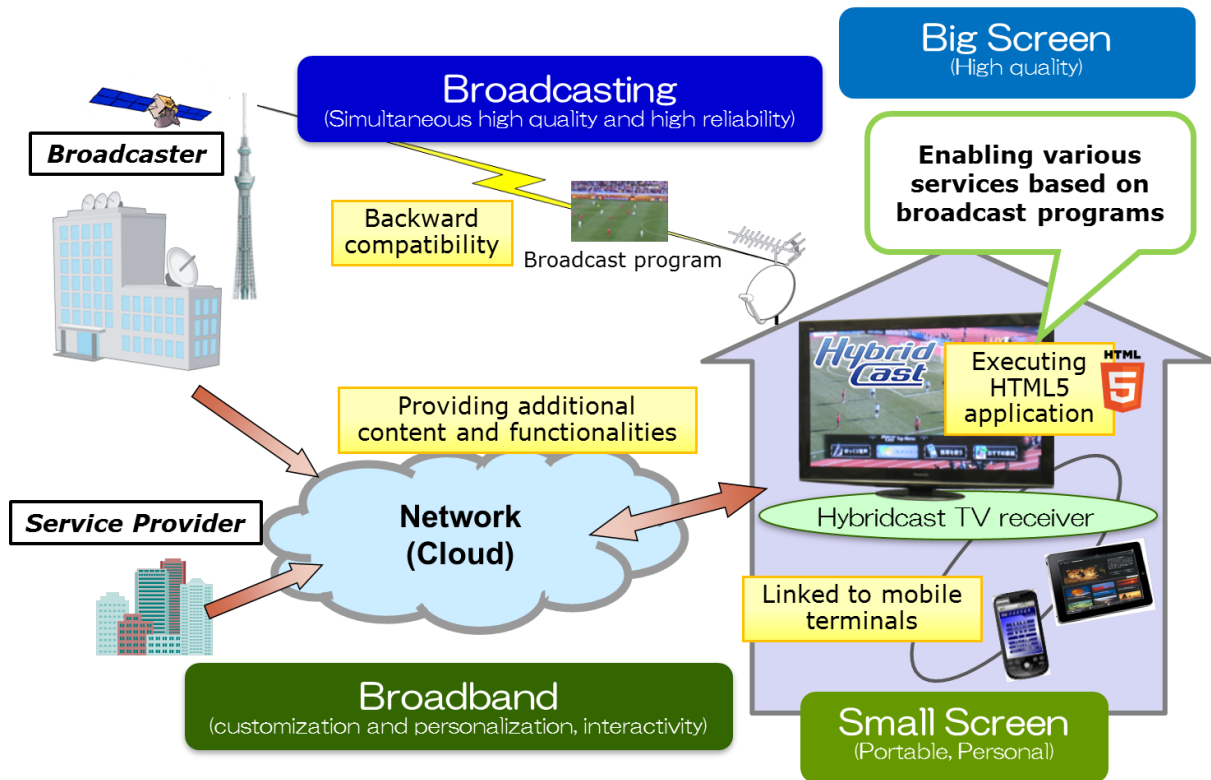
Figure 8 – Hybrid cast system overview

Users can obtain required information that may change rapidly on the day of a large earthquake and when a tsunami warning has been issued.

On the day of a big earthquake

When an "Earthquake Early Warning" signal from broadcast is sent to a Hybridcast TV receiver, the receiver launches an application immediately and automatically, and starts displaying detailed disaster information for local areas. The application displays content appropriate to the area. (Figure 9)

Figure 9 – Display detailed disaster information

When "Tsunami Warning" is issued

The receiver displays a warning message, such as "Please evacuate the area immediately!", based on perceived urgency, for those who live in an area that will probably be hit by a tsunami. (Figure 10).

Figure 10 – Tsunami warning

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