Draft Output Report of ITU-D Question 5/2

Title: Utilizing telecommunications/ICTs for disaster risk reduction and management

Table of Contents

Figures

Tables

Tables in Annexes

Executive summary

ITU-D Study Group 2 is pleased to share the final report on Question 5/2 “Utilizing telecommunications/ICTs for disaster risk reduction and management.” This report is based on Member States and sector members' contributions and interactive discussions held throughout the study period 2018-21. This report contains an overview of telecommunications/Information and Communication Technologies (ICTs) for disaster risk reduction and management and a range of technologies and policy case studies presented by administrations and organizations regarding implementing ICTs during all disaster phases.

Disasters, including natural and man-made disasters, can have a seriously negative impact on societies, causing disruption of the normal functioning of social and economic life. These negative impacts require an immediate response from authorities and from citizens in order to help those impacted and to re-establish acceptable thresholds of well-being and life opportunities. The combination of hazards, vulnerability, and inability to reduce the potential negative consequences of risk results in disaster. Because many disasters cannot be predicted, preparedness and disaster risk management are crucial to saving lives and protecting property. It is also important to consider risk management (i.e., damage mitigation, damage preparedness, and early warning /prediction) during non-emergency times. Effective planning and preparedness can and does save lives.

In this context, telecommunications and ICTs play a pivotal role in disaster prevention, mitigation, and management. Effective disaster management relies upon the timely and effective sharing of information among diverse stakeholders, and ICTs are essential tools to support these communication requirements. ICTs can support all phases of disasters, including prediction and early warning. It has been noticed worldwide that by effective risk reduction techniques, it is possible to significantly reduce the loss of lives and properties due to disaster.

The focus of Question 5/2 studies, during this period, has been on the use of telecommunications/ICTs for disaster risk reduction and management. Effective policies play an essential role in the overall design and implementation of National Emergency Telecommunication Plans (NETPs). Accordingly, the policy and regulatory environment should help enable and facilitate effective preparedness and response. There can be policies for deployment of emergency communications systems, for early warning, for continuity of communications and for more effective response, etc. While designing the policies, accessibility considerations should always be kept in mind so that the policies designed are inclusive in nature, covering all strata of society. With the rapid development of technologies, particularly the Internet of Things (IoT), Machine to Machine (M2M), and Artificial Intelligence(AI), they have been facilitating and will keep on facilitating all phases of disaster. Therefore, it is necessary to keep abreast of the latest development in disaster communication technologies, and therefore an exclusive chapter has been kept on Disaster Communications Technologies in the report.

Early warning systems (EWS) play a very important in informing people in the possible affected areas about an impending disaster; for this purpose earning warning and alerting systems should be deployed in disaster-prone areas. Effective information transmission and dissemination is important in pre-disaster, during-disaster, and post-disaster scenario. During this period, an exclusive workshop was also kept on EWS, wherein lots of good inputs were received on this subject. Accordingly, a dedicated chapter on EWS has been kept.

Preparedness for disaster involves mock-drills and exercises, which include from table-top exercise to full-scale mock-drills. Gaps found during these drills and exercises require analysis and corrective actions so that whenever actual disaster strikes or about to strike, every action should be taken based on the rehearsed way in a coherent and coordinated manner. It is important to learn from the best practices adopted by the other countries particularly which are prone to disasters and are better prepared due to their prior experience. Therefore, this report contains case studies from various countries and lessons learnt by them. A dedicated workshop on drills and exercises was held during this period, and based on deliberation by the experts, a set of guidelines have been prepared for small and landlocked countries that are included in this report.

Enabling policy environment is a must for managing any disaster. The policies should be such that they enable flexibility when deploying emergency communications equipment and enable successful disaster preparedness and response for telecommunications and ICTs.It is important to know the elements that create an enabling policy environment for increasing emergency telecommunication preparedness, network resilience, disaster risk reduction, and disaster management. During the ongoing Covid-19 time, a webinar was held on ‘Enabling Policy Environment for Disaster Management, including for Covid-19 response’.Countries shared their experiences in dealing with the pandemic situation by way of enhancing and augmenting ICT infrastructure as there has been significant increase in internet traffic due to work from home and lockdown conditions in several countries.

Editor’s Note: This section could be consolidated or streamlined based on additional discussion at the October Rapporteur meeting to identify any gaps or additional elements that could be added.

Chapter summaries: Utilising Telecommunications/ICTs for disaster risk reduction and management

Chapter 1 outlines the scope of the report and provides a brief overview of the role of telecommunications/ICTs in the overall disaster management cycle.

Chapter 2 provides a comprehensive overview of the enabling policies and regulatory environment, including Policies for the deployment of emergency communications systems, early warning, supporting continuity of communications, and enabling more effective response.

Chapter 3 discusses disaster communication technologies.

Chapter 4 discusses Early Warning and Alerting Systems and the use of ICT in its Planning. The chapter also discusses about deploying early warning systems for disaster risk reduction, Broadcast emergency warning systems, Disaster information and relief systems, and Resilient network technologies.

Chapter 5 provides a summary of the Guidelines for preparing and conducting disaster communications exercises and drills.

Chapter 6 presents various Country and industry case studies based on the contributions of ITU-D members.

Chapter 7 – Discusses best practices and lesson learnt identified and suggested guidelines during the study period

1. CHAPTER 1 – Introduction

1.1. Background

The World Summit on the Information Society(WSIS) action lines and United Nations Sustainable Development Goals (SDGs) recognize the need to reduce the risk of disasters and build sustainable and resilient infrastructure. Various Resolutions of the World Telecommunication Development Conference (WTDC), World Radiocommunication Conference (WRC), Plenipotentiary Conference and United Nations International Strategy for Disaster Reduction (UNISDR), Sendai framework, reports of ITU-D, ITU-T, and ITU-R emphasised on the role of telecommunications/ICT in disaster preparedness, early warning, rescue, mitigation, relief, and response. Further, ICT also has a role in supporting humanitarian assistance and in public protection and disaster relief.

In order to support national and regional preparedness for various natural and manmade disasters, ITU has consistently been supporting the use of telecommunications/ICTs for the purpose of disaster preparedness, mitigation, response, and recovery by collaborating and sharing experiences, both regionally and globally. During the last study period 2014–2017 ITU-D study Question 5/2 examined multiple aspects of disaster communications planning, management and response, while during the study period 2018-21, emphasis is on the use of telecommunications/ICT in disaster risk reduction and management.

1.2. Scope of the Report

The scope of this report is to continue the examination of the application of telecommunications/ICTs for disaster prediction, detection, monitoring, early warning, response and relief, including consideration of best practices/guidelines for implementation, and in ensuring a favorable regulatory environment to enable rapid deployment and implementation. The report further contains national experiences and case studies in disaster preparedness, mitigation and response, and the development of national disaster communications plans, and an examination of common themes and best practices between them. As the focus of this study period is on Use of telecommunications/ICTs in disaster risk reduction and management, the report covers four broad categories:

(a) Enabling Policy and regulatory environment

(b) Disaster communication technologies

(c) Early warning and Alerting system

(d) Drills and exercises

The relevant case studies and best practices have been included in the respective chapters.

1.3. Telecommunications/ICTs and Disaster Management and Relief

It is a known fact that Telecommunications/ICTs play a vital role in disaster management and in disaster risk reduction. Through the design of national emergency telecommunication plans (NETPs), the setting up of early warning and monitoring systems using ICT; and the provision of emergency telecommunications equipment when disasters strike, all are crucial to saving lives and assets during or following a disaster event. Telecommunications/ICTs play roles in all phases of disaster detection, risk reduction, early warning, monitoring and rescue, and relief work post disasters. Information access and timely communication are key to reducing the effect of the disasters. Use of different information and communication technologies and networks, including satellite, radio, mobile networks, and the Internet, GIS (Geographic Information System) software, satellite earth observation systems, IoT, real-time analysis using big data and advanced computing, mobile communication technologies, and social media awareness all can contribute to enhancing capacities for disaster management and reducing the vulnerability of people. The local community, the government, the private sector, disaster management agencies, meteorological organizations, civil society, humanitarian agencies, and international organizations all should ensure access to ICTs for better coordination of the disaster management activities. Partnerships and advance planning and preparation are the best ways to achieve this task.

1.4. Use of telecommunications/ICTs in all phases of disasters

Since its earliest days, communication has played an essential role in Disaster Management in providing information to all the stakeholders in Disaster Management, particularly in emergency rescue and relief operations for disaster-affected people.

Telecommunications/ICTs support all phases of disasters, including prediction, vulnerability analysis, and risk assessment, early warning using remote sensing via satellites, radar, telemetry, and meteorology; satellite M2M sensing technologies; alerts distributed via broadcasting and mobile technology; radio and television broadcasting, amateur radio, satellite, mobile telephony and Internet; and post-disaster recovery via temporary base stations, portable emergency systems, etc. Post-disaster ICT helps in assessing the damage caused by the disaster, passing of instructions to search, rescue, relief and, rehabilitation teams, and restoration of communications and other infrastructure, including through the use of devices like satellite phones.

It is essential to learn lessons after every disaster to prepare well to face the next one, whenever it arises. Telecommunications/ICTs help with data collection following major disaster events to analyze the use and performance of ICT networks and applications. It also helps to contribute towards technological developments and for continual improvement in preparing disaster plans and processes.

Therefore, the holistic management of disasters using ICT demands robust and reliable digital infrastructure to help ensure effective communications before, during and after disaster events to minimize loss of lives and property.

1.5. Enabling policy and regulatory environment

The establishment of an enabling policy and regulatory environment is an important component of disaster communications management. The enabling policy environment includes both general telecommunications regulatory and policy framework affecting overall deployment and use of ICTs and the establishment of frameworks and policies specific to disaster events. Public policy considerations include reducing regulatory barriers to the deployment of ICTs, promotion of robust and resilient ICT infrastructure development, streamlining of licensing procedures, and spectrum management. Disaster communications frameworks and policies help guide activities, roles, and responsibilities throughout a disaster event and help ensure continuity of ICT operations following a disaster. Specific ICT policy and regulatory considerations for disaster response frameworks may include the development of special, expedited licensing procedures for use during a disaster, addressing possible customs barriers to entry of emergency communications equipment, or considering implementation of the Tampere Convention. A number of input contributions addressed government and organizational policy and planning throughout the 2018-2021 study period.

1.6. Disaster communication technologies:

As mentioned earlier that Telecommunications/ICTs can support response across all phases of disasters – such as tools for sensing and early warning of impending disasters like Cyclones or Hurricanes and to support exchange of critical information between those affected by a disaster, including citizens and those participating in response, relief and restoration activities. It is also essential to understand the communication technologies and types of information that need to be shared. Various disaster communication technologies are described in Chapter 3 of this report. For example, there are several communication technologies for dissemination of early warning information to citizens such as Mobile phones, VSATs (Very Small Aperture Terminals), satellite phones, IVRS (Interactive Voice Response Systems), Internet including web media, TV, radio, press, digital signage loudspeakers, and national knowledge networks. Social media platforms also can be used as tools for collecting data and sharing information for two-way communications. Relief and response authorities based on requests from social media can respond to requests for help sought. Social media can be useful for establishing contacts across and with diverse groups for sharing information, situational awareness and reporting, etc. There are numerous ICT tools for disaster management, but this report is introducing only a few. It is crucial that experts should strongly consider a standards-based approach to avoid being locked into one or more specific design solutions or technologies.

1.7. Early Warning and Alerting Systems

Early warning systems are essential to reduce the loss of lives and properties due to disasters. Early warning systems may detect or forecast a disaster and then provide timely information to the population by means of telecommunications/ICT networks for monitoring and alerting. Early warning systems help in risk assessment based on historical experience and vulnerabilities, monitoring and forecasting disasters, and also providing clear messages to warn those in the potentially affected areas. They also help in emergency response activities once a warning has been issued.

The Common Alerting Protocol (CAP) helps disseminate information through various means via mobile calls, TV, Radio, loudspeakers/sirens, computer pop-ups, email and text messages, etc. Alert messages in the CAP format are machine-friendly as well as human-friendly In its guidelines on NETP, ITU has recommended that Early Warning Systems should be designed and deployed, linking all hazard-based systems when possible to take advantage of economies of scale and enhance sustainability and efficiency through a multipurpose framework that considers multiple potential hazards and end-user needs. An inventory of such systems should be included in the NETP and periodically reviewed and updated.

1.8. Drills and Exercises:

Drills and exercises play a very important role while preparing for emergency management as these exercises help in capacity building, training and retraining so that when a real disaster strikes, the staff can respond in the predefined fashion. The main purpose of drills and exercises is to understand gaps between defined procedures and their practical implementation. In case any activity or procedure fails in its practical implementation, either the plan or procedure is fine-tuned, or the implementation is perfected so that it does not fail when the real need arises. Another advantage of capacity building is to improve the speed, quality and effectiveness of emergency preparedness and response and to improve accountability, measurement of outcomes, and reducing the risk of disasters wherever possible.

1.9. Good Practices and Guidelines

The Idea of having a collaborative study is to exchange collective learnings from each other's experiences and then to identify and follow the best practices. In addition to discussions throughout study group meetings, four workshops held by Question 5/2 during this study period and information collected in the Annexes of this final report also contributed towards formulating guidelines for all countries, especially small island developing states and landlocked countries, and identify best practices in early warnings, drills and exercises, and policymaking.

1.10. Human factors and stakeholder collaboration

It is well known that when a disaster strikes, it affects areas beyond State and National boundaries. To mitigate the damages from the disaster, in pre and post-disaster situation all the stakeholders whether Governments at the National, regional, state and local level along with foreign aid and relief organizations, NGOs and civil society, private sector entities, and volunteers and citizen action groups must come forward. It is very important that these agencies work in close coordination and have effective communication amongst them for giving an effective response to the challenges posed by the disaster. Another factor is when the individual or family member of the response team is impacted due to a disaster, he may or may not be in a position to contribute to the response efforts. In such situations, adequate measures such as a back-up plan have to be kept. Additionally, all disasters are local i.e. when a disaster strikes, neighbors are the first responders; citizens will first seek to help themselves. ICTs can offer tools to address this reality – enabling citizens to help themselves or by mutual assistance between citizens. For this purpose, with the help of citizens and local government, hazard maps should be prepared in advance for anticipating areas likely to be impacted by a disaster or evacuation and shelter locations to help support disaster risk reduction and improve citizen awareness.

Therefore, human factors and stakeholder collaboration becomes very important when dealing with disaster situations. During drills and exercises, this aspect of communication and coordination is carefully monitored, and wherever gaps are found, they need to be corrected and documented while preparing Standard Operating Procedures or guidelines on the subject.

1.11. ICTs for disaster management and smart, sustainable development

The issue of Smart Sustainable development is connected with Human factors and stakeholder collaboration. In order to have smart, sustainable development, some key challenges like mechanisms to improve coordination between the wide array of stakeholders involved in emergency ICT response; financing strategies needed for building effective partnerships and securing predictable and flexible funding; ensuring the effectiveness of volunteer training programs and expansion of volunteer exchange networks; and issues like the tapping of regional networks and their capacity building and expertise have to be overcome. In addition, steps will have to be taken to develop public-private partnerships to foster regional and global opportunities for collaboration; creating a broader platform for disaster management to ensure disaster telecommunications relief services at all times; putting pre-planned solutions in place to avoid time lost in improvising solutions on the ground; having the right regulatory framework to facilitate relief efforts, etc. The steps on these points will help in achieving success in the implementation of the Sustainable Development Goals. ITU has come out with a report titled ‘Smart Sustainable Development 2018-Tools for rapid ICT emergency responses and sustainable development[1]. The report is based on the work by three working groups: WG on Global Emergency Fund for rapid response, WG on volunteers for emergency telecommunications, and WG on regulatory toolkit and guidelines. The working groups have comprehensively dealt with the subject of Disaster management and smart, sustainable development.

1.12. Accessibility Consideration

Disaster time is tough for the vulnerable, such as persons with disabilities, children and the elderly, migrant workers, the unemployed, those displaced from their homes due to earlier disasters, underlining the need to ensure that disaster management is inclusive responsive to their needs. Comprehensive information on the role ICTs can play in assisting marginalized populations who face barriers in accessing disaster response services may be found in ITU Report “Accessible ICTs for persons with disabilities: Addressing preparedness”[2].

This report also includes a “How-To Action Guide,” which offers specific recommendations for stakeholders at each phase of disaster management. Cross-cutting recommendations include: – Consult with members of vulnerable populations directly on their needs and facilitate their involvement at all stages of the disaster management process. – Ensure that accessibility and usability of ICTs is considered in any project on ICT-based disaster management processes or ICT-based development projects. – Use different types of strategies and mechanisms to promote accessible ICTs, including legislation, policy, regulations, license requirements, codes of conduct, and monetary or other incentives. – Build the capacity of vulnerable populations to use ICTs in disaster situations through awareness-raising programs, training, and skills development programs. – Use multiple modes of communication to provide information before, during, and after disasters, including through:

1 https://www.itu.int/en/ITU-D/Initiatives/SSDM/Documents/SSDM_REPORT_2018.pdf

2 ITU Report on “Accessible ICTs for persons with disabilities: Addressing preparedness”, 2017 can be found at: https:// www.itu.int/md/D14-SG02-C-0401/.

- Accessible websites and mobile apps designed as per the current WCAG guidelines;
- Radio and television public service announcements (using measures for accessibility such as audio, text, captions, and sign language interpretation);
- Announcements and tips sent through SMS, MMS; mass emails to citizens from government authorities, aid, and relief agencies, and others;
- Accessible electronic fact sheets, handbooks, and manuals;
- Multimedia including presentations, webinars, webcasts, and videos including on popular sites such as YouTube;
- Dedicated social media such as Facebook pages and Twitter accounts created by governments and disaster response organizations;

Citizen focused on working groups and discussion forums. – Be aware of the potential for misuse of personal data of vulnerable populations in disaster situations and develop ethical norms and standards for data sharing. – Provide information packs, guides, and manuals and conduct public awareness campaigns in multiple accessible formats in different languages and provide sensitized resource persons to impart the contents of these packs to persons with disabilities and other vulnerable groups. – Develop, promote, and distribute mainstream and assistive technologies that can be used at times of emergencies and disasters; provide necessary training to persons to use them. – Develop frameworks to facilitate inter-agency collaboration and conduct drills and trust-building initiatives. – Specify accessible ICT infrastructure as part of procurement guidelines wherever applicable. – Ensure that all services, facilities, and infrastructure developed after a disaster are accessible and inclusive. – Provide information in multiple formats and through multiple modes about ongoing recovery efforts and how to get help or access to resources. – Review disaster response efforts to assess any challenges for vulnerable groups, discuss lessons learned, and undertake efforts to fix any issues in ICT-based disaster management services.

2. CHAPTER 2 – Enabling policy and regulatory environment

The international community recognizes the vital role that ICTs play in all phases of disasters as well as the importance of preparing national emergency telecommunications plans (NETPs). There is also an international acknowledgment that efforts to reduce disaster risks must be systematically integrated into policies and plans and programs for sustainable development. In several cases, the success of the deployment and use of ICTs, as well as the development and implementation of NETPs, depends upon having an effective enabling policy environment. The Hyogo Framework for Action (HFA) 2005-15 highlighted the need for “An integrated, multi-hazard approach to disaster risk reduction should be factored into policies, planning, and programming related to sustainable development, relief, rehabilitation, and recovery activities in post-disaster and post-conflict situations in disaster-prone countries”[3]. The Priority Action 1 of the HFA outlines legislative frameworks as a key basis for integrating disaster risk reduction into development policies and planning: “Countries that develop policy, legislative and institutional frameworks for disaster risk reduction and that are able to develop and track progress through specific and measurable indicators have a greater capacity to manage risks and to achieve widespread consensus for, engagement in and compliance with disaster risk reduction measures across all sectors of society’ (ISDR, 2005, p 6). Legislation and formal, written rules are important because they define the responsibilities for which people occupying specific roles are accountable (UNISDR, 2018). Laws and regulations can determine the framework for coordination mechanisms, communication channels, and operating procedures, and identify the decision-makers at relevant agencies. Additionally, legislation and written rules can contribute to the sustainability of the disaster risk management process, so that disaster management policies outlast individual government administrations and secure, among other things, a budget independent from partisan politicking. In many cases, national legislation for DRR helps shape national DRR and resilience strategies with corresponding structures at sub-national levels. This allows for the decentralization of roles and responsibilities to lower government levels and provides an overall coordination structure that can articulate between sectors and government levels. (ITU Guidelines for national emergency telecommunication plans, 2019)

Disaster communications frameworks and policies help guide activities, roles, and responsibilities throughout a disaster event and help ensure continuity of ICT operations following a disaster. Specific ICT policy and regulatory considerations for disaster response frameworks may include the development of special, expedited licensing procedures for use during a disaster, addressing possible customs barriers to entry of emergency communications equipment, or considering implementation of the Tampere Convention.

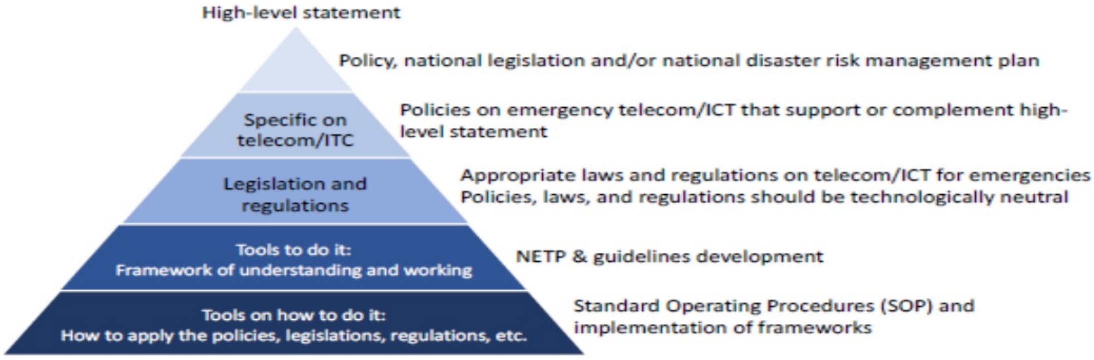
As mentioned in Chapter 1 that one of the scopes of the work for the Question 5/2 was to deliberate on disaster enabling policy and regulatory environment; accordingly, a workshop on ‘The Enabling Policy Environment for Effective Disaster Management including for COVID-19 Response’ was held on the 14th July 2020, see Annex 4, wherein several experts from the field deliberated on the issues namely elements that create an enabling policy environment for

3 https://www.unisdr.org/files/1037_hyogoframeworkforactionenglish.pdf

increasing emergency telecommunication preparedness, network resilience, disaster risk reduction ,and disaster management. They also deliberated on policies that enable flexibility when deploying emergency communications equipment and also enable successful disaster preparedness and response with respect to telecommunications and ICTs. The lessons learnt in developing and implementing enabling policies ,and NETPs and the challenges in developing national emergency plans were also discussed in the workshop.

2.1. Policies for the deployment of emergency communications systems

A national emergency communication plan sets out a clear strategy to enable and ensure communication availability during all the phases of disaster by promoting coordination and engagement across all levels of government, humanitarian agencies, service providers and communities at risk.



Source: ITU

In order to have a policy for deployment of emergency communications systems, there should be a high-level policy statement, national legislation, and/or a national disaster risk management plan. This comprehensive set provides an institutional and inter-institutional framework for the actions of the government and civil society in the face of a threat or disaster.

National guidelines should be based on the premise that disaster risk management is the responsibility of all, be it public, private, and civil society. Further, the participation in the preparation of the deployment plans a multisectoral and interdisciplinary framework, needs to be built.

The plan prepared should have the commitment from the highest levels of the government, which in turn must provide organizational and leadership support and allocate resources and commit to deliver and maintain the desired outcomes. Then there should be a specific set of policies on emergency communications that support or complement national legislation in the implementation of a comprehensive national approach. Care should be taken so that policies are designed to establish, develop, or improve national interoperable telecommunication capabilities.

There are several countries that have a policy framework in place. In India, the importance for disaster communication is given at the highest level. India's National Telecom Policy-2012 (NTP-2012) emphasizes the importance of the creation of robust and resilient telecommunication networks for adequately addressing the need for proactive support for mitigating disasters - natural and manmade. Prescribe sectoral Standard Operating Procedures (SOPs) for aiding effective and early mitigation during disasters and emergencies and encourage the use of ICTs in prediction, monitoring, and early warning of disasters and dissemination of information. The Government of India has put in place disaster policy, plan , and guidelines through a series of measures viz Disaster management Act,2005, Disaster management policy,2009, Disaster communication guidelines 2012, and Disaster Management Plan 2019. During the response to Covid-2019, instructions for lockdown/unlock, safety, and security measures etc., have been issued under the Disaster Management Act,2005. India's telecom regulator Telecom Regulatory Authority of India (TRAI) has also done work on emergency telecommunication. It has given recommendations to the Government on the single emergency number '112', Recommendations on priority call routing for the persons involved in relief and rescue operations, provision of roaming amongst the telecom service providers for their subscribers to roam on other telecom service providers network during the disaster period without incurring the extra expenditure. TRAI has also recommended for having a Public Protection and Disaster Recovery Network (PPDR) for India.

Though Haiti does not yet have an integrated emergency telecommunication system, it established a sectoral committee on emergency telecommunications (Comité sectoriel sur les télécommuncations d'urgence – COSTU), charged with coordinating sectoral responses in accordance with the national disaster and risk management plan. COSTU was set up with a view to using telecommunications and ICTs to enhance the coordination of disaster prevention, preparedness, and response. Thorough COSTU Government demonstrates its will to strengthen disaster prevention, preparedness, and response measures.

The World Food Programme (WFP) and ITU-D have prepared an Emergency Telecommunications Preparedness Checklist that examines key thematic areas that could be considered for inclusion in a National Emergency Telecommunication Plan (NETP), and provides a simple scoring approach to assess the status of progress in each decision point or action over time. It primarily supports the establishment and refinement of NETPs, with a focus on understanding national readiness to enable response communications in a disaster, together with identifying targeted areas that may require attention.

2.2. Policies to which enable early warning, continuity of communications, and more effective response

The goal of early warning systems for natural hazards is to reduce damage inflicted by hazards on people who may be affected. Natural hazards can turn into disasters if the affected people cannot cope with them. Therefore, the primary objective of a warning system is to empower individuals and communities to respond timely and appropriately to the hazards in order to reduce the risk of death, injury, property loss, and damage and not allow it to turn to Disasters. A community without early warnings will be unprepared and suffer from the full-blown damages inflicted by the hazard.

The Hyogo Framework for Action (2005-15) identified the second item on the five priority action point list as "Identity, assess and monitor risks and enhance early warning.". Disaster mitigation decision making authorities require increasingly precise early warnings to ensure effective measures may be formulated. This includes extending the lead time of warnings, improving the accuracy of warnings, greater demand for probabilistic forecasts, better communication and dissemination of warnings, using new technologies to alert the public, targeting of the warning services to relevant and specific users, and clear, unambiguous warning messages which are understood well and which elicits appropriate action in response. It is better to have longer warning lead times together with probability to reduce the false alarms. From the contributions from the member states during the study period (2018-21) it is studied that many countries have taken steps to have a robust and effective early warning systems. India has a very robust early warning system in place. It has Primary nodal agencies for monitoring and early warning of disasters in India. Some of them are the Indian Meteorological Department for cyclones, floods, drought, earthquakes; Central Water Commission for floods); Geological Survey of India for landslides; Indian National Centre for Ocean Information Services (INCOIS) for tsunami early warning; Snow and Avalanche Study (SASE) for snow avalanche.

Indian early warning agencies are also disseminating important information to neighbour countries in the region and to several similar agencies in the Indian Ocean and Asia Pacific region. Indian EW system is also a part of the Global Telecommunication System (GTS) of the World Weather Watch (WWW) program of the World Meteorological Organization (WMO). Because of coherent and coordinated efforts by various agencies in giving early warnings coupled with the dissemination of information in the community through various electronic media, landline/mobile phones, and technologies like Common alerting protocols(CAP), India is able to substantially reduce loss to human and animal lives and able to reduce damage of properties due to natural hazards like Cyclone which strike almost every year in the coastal belts of the country. India is able to increase lead time in a warning for cyclones so that the relevant rescue and rehabilitation agencies get adequate time for rescuing the people and rehabilitate them at safer places.

New Zealand, USA, Japan, China, Brazil etc., also have similar early warning systems in place and are having mechanisms to disseminate early warnings through various mediums the latest one is through Common Alerting Protocol(CAP) for an effective response to Disasters. There are other disaster communication technologies that are described in the Chapter-3. As a part of the work, this Study Group organized a Panel Session on Early Warning Systems, including Safety Confirmation on 8th May 2018. Based on the contributions and discussions held during the panel discussion, there are some policy considerations for early warning policies, continuity of communication, and effective response. Some of the points are:

- **Regulatory flexibility:** Developing policies that enable regulatory flexibility before a disaster is critical. Communications regulators should grant “Special Temporary Authorities” (STAs), which can provide flexibility to shorten the approval period for emergency communications deployments.
- **Ensuring flexibility:** Flexibility in designing, tailoring and testing alerts for multiple hazards that developing countries experience is crucial.
- **Evolving technologies:** Evolving technologies are playing an important role in more effective and efficient dissemination of Multi-Hazard Early Warnings. For example, in addition to detecting natural disasters such as tsunamis and floods, IoT based technologies can help in the collection of data that can be processed using big-data analysis technologies to detect

probable diseases in livestock. Procedures and technology must be continually evaluated and updated to ensure alerts and warnings are timely, relevant, and followed by the communities that receive them.

- **Evolving emergency alert system:** Countries must consider the means of alerting emergency information to citizens through broadcast media (radio, television, etc.) and mobile devices
- **The need for enabling policies:** The Tampere Convention on the Provision of Telecommunications Resources is a valuable tool for countries to increase disaster preparedness and response capabilities.
- **Ensuring connectivity:** A lack of connectivity is not just a development issue, it’s a safety issue as lifesaving alerts, and warnings may not be received when disasters strike, in addition to delaying or hindering disaster response and recovery. It is important that communications development policies consider potential emergency communications needs and the resiliency of networks.
- **Capacity Building:** There is a need to enhance the capacity of Least Developed Countries (LDCs) and Small Island Developing States (SIDS) to generate and communicate effective, impact-based, multi-hazard, gender-informed early warnings and risk information. Capacity building to improve alerting, detection and response is critical.
- **Continual Improvement in emergency procedures**: Pilot projects, disaster management drills, and exercises are important to test procedures and make adjustments as needed to better prepare for specific types of emergencies.
- Importance of hazard early warning checklist was recognized.

Chapter 7 of the report also covers the above and some additional points.

3. CHAPTER 3 – Disaster Communications Technologies

This chapter summarizes different emerging disaster communication technologies that can be implemented to support disaster management.

3.1. Communication technologies

The use of telecommunications/ICT tools can be helpful in disaster management and relief such as disaster prevention, disaster preparedness, early warning and disaster response and relief. Most ICT tools are connecting to telecommunication networks, and it is important to ensure telecommunication infrastructure is in place in the case of disaster. Different telecommunication networks can be useful when managing different aspects of a disaster such as:

- **Satellite communication networks**: the communication technology of transmitting radio waves from telecommunication satellites to relay stations has the characteristics of not being damaged by natural disasters. Satellite technologies such as Tiantong and Beidou positioning satellites are currently used in emergency communications.
- **Aerial vehicles:** similar to satellite communication network, the communication technology of transmitting radio waves from transponders mounted on aerial vehicles including UAV to relay station. The aerial vehicles have not any barrier on the ground, so they might be useful in the case of natural disasters.
- **Ad hoc network technology:** ad hoc network is one of emergency communication technology with mesh capability. Although ad hoc networks do not have large-scale networking capabilities, they have unique mesh capabilities, which can be used as a supplementary technology for emergency rescue when covering wilderness, temporary basement, and high-rise routes.
- **5G mobile networks:** 5G has capabilities of wide bandwidth, low delay ,and high reliability; thus, the application of 5G emergency communication scenario needs to be studied. 5G plays a very important role in promoting the development of emergency communication towards broadband and intelligence. The three major application scenarios of 5G, enhanced Mobile Broadband (eMBB), Ultra-Reliable Low Latency Communications (URLLC) ,and massive Machine Type Communications (mMTC), meet to a great extent the business needs of emergency communication for large bandwidth, low latency and high reliability. These scenarios might be great significance to enhance emergency communication rescue capability and comprehensive emergency support capability, and to achieve a new level of emergency management. It is anticipated that in the future, private networks and 5G public networks will work together to provide communication guarantee services for emergency management. The combination of the public network and private network will realize the three-dimensional emergency communication guarantee network of space-Earth integration and interoperability sharing, and jointly adapt and match the emergency communication guarantee system in the whole process of emergency

3.2. Emerging technologies in disaster communications

3.2.1. Mobile applications

With the popularization of smartphones, people heavily use Internet-based services such as social networking, information search, and e-commerce services. The use of Internet-based mobile applications is becoming an important issue for making solutions more feasible in disaster situations nowadays. The Fisher Friend Mobile Application (FFMA) is, as an example of a mobile application of early warning system, and a unique, single window solution for the holistic shore-to-shore needs of the fishing community, providing vulnerable fishermen immediate access to critical, near real-time knowledge and information services on weather, potential fishing zones, ocean state forecasts, and market-related information. Fishermen now receive regular ocean weather forecasts, early warnings about adverse weather conditions, and advisories on potential fishing zones.

In addition, another example is the Facebook disaster maps. When people use the Facebook app with the location service enabled, they will receive their longitude and latitude information on a regular basis. When gathered and de-identified, such geological location data can render post-disaster information. The Facebook data set types may include movement of people and crowd density, as well as Facebook Safety Check information collected after the disaster.

3.2.2. Utilizing Social network services

In the rescue operations and donation activities in the aftermath of a major disaster in Japan, social media such as Twitter and Facebook were widely used. According to a survey conducted after the disaster, social media have demonstrated outstanding effects in the transmission of information. Compared with traditional communications channels, social media can disseminate information about disaster recovery facilities and materials in a much faster, accurate, and reliable manner. The widely distributed cell broadcast, as well as dedicated message recording phones, etc. launched during the emergency, had played a significant role in providing locally generated information including emergency food and beverage supplies or delivery time and locations of the disaster recovery supplies, as well as in providing psychological counseling services.

In India, during the Chennai flood in 2015, people extensively used social media to connect to the outer world. The calamity brought out thousands of helping hands. Chennai residents took to social media to offer their homes to strangers seeking shelter from the rain and floods. #ChennaiFloods and #ChennaiRainHelps were equally being used by victims and helping hands.

As a countermeasure for the outage of telecommunication services, especially Internet-based services, in disaster situations, a portable and local networking system was developed in Japan. The system called Locally Accessible Cloud System, LACS, is comprised of a Wi-Fi access point, a small PC server, a battery, and other peripheral devices. These components are assembled in a portable carry case so that it can be carried to disaster-affected areas easily. The server acts as a web server and offers basic communication functions demanded in disaster situations.

3.2.3. Integrated public alert

The United States established the Integrated Public Alert and Warning System (IPAWS) as a unique, multi-hazard, multi-user alert and warning nationwide infrastructure that the Federal Emergency Management Agency (FEMA) makes available for use by Federal, state, local, tribal, and territorial entities across the United States. It is critical in developing an alert and warning system to have the proper authority, policy and governance as a foundation in place to prioritize personnel and funding resources. The IPAWS uses technology and information standards to join multiple private sector communications technology infrastructures providing an ability to deliver a single emergency message simultaneously to multiple public dissemination pathways; for example, radio, TV, mobile devices, and internet-connected systems, websites, and applications.

The IPAWS architecture was designed to support interoperability with any A&W system in the nation that employs the same standards. The Integrated Public Alert & Warning System Open Platform for Emergency Networks (IPAWS-OPEN) is the infrastructure that routes authenticated A&W messages to the public using the radio and television systems in the Emergency Alert System (EAS), Wireless Emergency Alerts (WEAs) to cell phones, National Oceanic and Atmospheric Administration (NOAA) Weather Radios, and other communications systems.

The IPAWS architecture is shown in Figure 1.

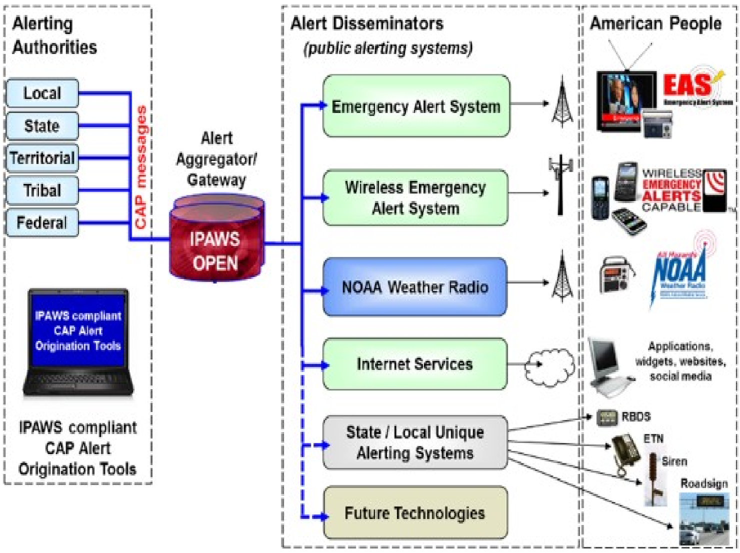


Figure 1 IPAWS architecture

3.2.4. The use of manned or unmanned aerial vehicles

Unmanned Aerial Vehicle (UAV) has become an important tool for government, consumer, and business applications. UAVs support a wide range of sector solutions and are widely used in utilities, agriculture, express delivery, emergency response, energy, etc.

(1) Fire fighting

In April 2019, two civilian UAVs were used to put out the fire at Notre-Dame in Paris. A spokesman for the Paris Fire Brigade told reporters: “These UAVs allow us to use our existing firefighting tools in the best way possible.” Equipped with thermal imagers that provide real-time aerial images of the fire, the UAVs helped firefighters to track the spread and source of the fire and guided firefighting. In addition, the images were taken by UAVs also provided important reference for making the decision on fire hose placement.

At present, the 4G network is able to support the communication needs of some UAV scenarios, but there are also many challenges, as there is still room for 4G network optimization in terms of bandwidth, latency and interference coordination. With the rapid development of UAV industry, there have emerged new requirements for UAV communication links and a development trend of close integration with cellular mobile communication technology. Targeting the sore points of bandwidth, latency and so on, 5G, once crossing path with UAV, has given birth to the "Networked UAV".

(2) Emergency telecommunication platform by high-altitude base station

In case of natural disasters, UAVs can quickly put high-altitude base stations in place to restore the communication service functions (voice and data).

The traditional Emergency Communication Vehicle (ECV) has been the main force in ensuring temporary communication after large-scale communication interruption caused by earthquake, flood, mud flow and other natural disasters. The ECV, however, is relatively small in service coverage and weak in signal stability due to the limitation in technology, hardware and other factors, and may even not be able to reach the central disaster area as a result of road collapse and congestion, thus unable to provide timely emergency communication service. Therefore, relying on the traditional way to set up emergency communication stations and restore base stations is inefficient, costly, difficult, and time-consuming. The maturity of UAV technology and its integration with emergency communication provide a new, faster, and more convenient way for operators to restore communication in disaster areas.

(2-1) Tethered UAV + high-altitude base station

The tethered UAV system is powered from the ground and raised to UAV take-off platform by a tethering cable capable of uninterrupted flight. When a UAV aerial base station is working, the ground power supply devices supply power to the tethered UAV systems and the onboard RRU devices. The onboard RRU devices communicate with the emergency communication vehicles via the ground BBU devices through the fiber optic line of the tethered UAV systems, and the emergency communication vehicles can connect with the nearby base station tower through microwave devices, optical fiber or satellite communication vehicles, and then connect the signal to the core network to achieve mobile signal coverage, thus effectively dealing with the impact of terrain on the electromagnetic wave and guaranteeing continuous communication coverage in a certain area.

A UAV emergency high-altitude base station can cover up to about 50 square kilometers and provide instant messaging service to thousands of mobile phone users simultaneously. Capable of quickly climbing up to 50-200 meters, it now can provide 24-hour uninterrupted VoLTE and other data services to disaster areas.

In case of natural disasters such as earthquake, flood and mud flow followed by large-scale communication interruption, the tethered UAVs + aerial base stations can quickly restore on-site communication, address the problem of signal coverage in emergency situations and effectively improve the emergency communication support capability of the government and operators in response to natural disasters.

Featuring long air-stay and large payload, the tethered UAVs, in conjunction with high-altitude searchlights and loudspeakers, are able to provide high-altitude illumination over large areas to support rescue operations at night. The loudspeaker facilitates the command and coordination of people on site, message broadcasting and other similar work, and improves the level of hardware support on site. The UAVs, using a mount-and-drop mechanism, carry rescue items into areas too difficult and dangerous to access at short notice and with a heavy load.

When the trapped people carry their mobile phones into the coverage of a UAV base station, the phone will be automatically connected to the onboard base station, which will send the user's IMSI number and the current geographic information in graphical form to the search and rescue clients in real-time.

This all-new emergency communication method aims to solve the problems of slow deployment, high cost and poor environmental adaptability of the device, featuring quick response, easy operation, flexible coverage, long air-stay and strong scalability.

(2-2) Fixed-wing UAV + high-altitude base station

By flying to the target area a large fixed-wing UAV carrying mobile communication base stations and satellite communication systems, it is possible to provide a long time (not less than 24 hours) stable continuous mobile signal coverage in an area of more than 30 square kilometers, which restores communications in no time and reduces the loss of life and property of the people in the disaster area.

It is possible to obtain Geographic Information System (GIS) data through a networked fixed-wing UAV equipped with an orthographic camera and a photoelectric pod, to achieve rapid data transmission and efficient generation of a three-dimensional map of the earthquake area, providing a basis for rescue decisions.

During the single-soldier system drill, the ground advance team can report key rescue information, send back real-time video and image information, and quickly dispatch rescue personnel and equipment based on the geographic information system data provided by GIS, effectively improving the timeliness and accuracy of emergency rescue information transmission to ensure the precise implementation of the emergency rescue operation.

(2-3) Research Direction of UAV Emergency Communication

Standard-setting is one of the challenges to be solved urgently for UAV emergency communications. China is developing technical requirements for emergency communications of high-altitude base stations based on tethered UAVs. Besides, since the ordinary base stations mainly provide ground coverage, the UAVs need special base stations for aerial coverage; moreover, 5G UAVs now rely on the general 5G CPE (Customer Premise Equipment, which is currently used to convert 5G signals to WiFi signals) for communication, while in the future, dedicated terminals and 5G communication modules are needed to improve the integration and make further improvements in the light of the characteristics of 5G UAVs.

Meanwhile, China has issued a successive series of regulations on UAV production, sales and flight. Regulations concerning the transaction process include Regulations on the Management of Real-name Registration of Civil

Unmanned Aircraft, Interim Regulations on the Management of Unmanned Aircraft Flight (Draft for Comments) and so on. The difficulties related to flight plan application process, the complicated procedures involved and other issues are expected to be resolved following the establishment of a comprehensive UAV regulatory platform. In terms of corporate operations, the Management Measures for the Operational Flight Activities of Civilian Unmanned Aircraft (Interim) has greatly simplified the entry requirements for unmanned aircraft operating licenses, and only retained the basic licensing requirements including corporate legal persons, real-name registered unmanned aircraft, certified training capabilities (for enterprises in training category), and ground third party liability insurance.

3.3. Emerging technologies in disaster response and Relief

To gain the maximum benefit from remote sensing data, a local emergency management agency is needed to direct the appropriate information to people in the field who need it. The United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) is focused on helping nations develop the capacity to manage disasters. While UN-SPIDER helps organize relief organizations and train their personnel, other organizations are more data-oriented.

The World Meteorological Organization (WMO) provides an Observing Systems Capability Analysis and Review Tool (OSCAR) that includes a table showing all known past, current, and future satellites for meteorological and earth observation purposes. It is available here: https://www.wmo-sat.info/oscar/satellites. This can be used to identify additional sources of data.

Another source of analyzed remote sensing data is UNOSAT, a United Nations programme created to provide the international community and developing nations with enhanced access to satellite imagery and geographic information systems services.

3.4. Satellite-based technologies helpful in managing natural disasters

Meteorological aids, meteorological-satellite and Earth exploration-satellite services play a major role in activities such as:

- identifying areas at risk;
- forecasting weather and predicting climate change;
- detecting and tracking earthquakes, tsunamis, hurricanes, forest fires, oil leaks, etc.;
- providing alerting/warning information of such disasters;
- assessing the damage caused by such disasters;
- providing information for planning relief operations; and
- monitoring recovery from a disaster.

These services provide useful if not essential data for maintaining and improving the accuracy of weather forecasts, monitoring and predicting climate changes and for information on natural resources. Those services (objectives) and their associated applications (satellite-based technologies) are summarized in Table 1

Table 1 Objectives and satellite-based technologies

Objective / Technology	SAR Imagery	InSAR Imagery	Active MW Imagery	Radar Altimetry	Radar Scatterometry	Precipitation Radar	GPS Radio Occultation	Passive MW Imagery	Passive MW Sounder	Geo. Visual and IR Imagery	Optical Imagery	Multispectral Optical Imagery	IR Imagery
Coastal Hazards	X										X		
Drought	X		X	X	X			X		X	X	X	
Earthquakes	X	X					X				X		
Extreme Weather					X	X	X	X	X	X	X		
Floods	X		X		X	X	X	X	X		X		
Landslides	X	X									X	X	
Ocean Pollution	X											X	
Pollution											X	X	
Sea/Lake Ice	X							X			X		
Volcano	X	X						X			X	X	X
Wildland Fires								X			X	X	X

3.5. Big data analysis for disaster management

Conducting big data analysis through mobile network-related network management and based on customer information, i.e. the analysis of the locations of damage, number of victims and/or damage/impact/repairs, and informing the relevant government agencies of the results for use in disaster relief command.

There are huge number of short messages and tweets on SNS, which include both valuable and invaluable information, especially in the event of a disaster. These messages and tweets can be called as big data. Disaster-information SUMMarizer (D-SUMM) automatically extracts disaster reports from Social Network Services (SNS) and organizes, summarizes, and presents the content in a user-friendly way. DISaster information ANAlyzer (DISAANA) outputs the extracted disaster reports as they are (e.g.: “there is an earthquake!” or “we still have aftershocks!”), but D-SUMM gathers reports that are very similar and summarizes them into one report to present a more compact output. By making summaries of disaster reports for each sub-area comprising the specified area (e.g.: local governments in Kumamoto Prefecture if it is specified), this function enables users to quickly understand what is happening where. Multiple categories can also be specified and displayed on a map, and the number of times an item was reported can be displayed, making it easy to have an overview of disaster conditions on the map.

Social media analysis is the process of collecting information or data from social media sites. A huge volume of data collected, which is mostly semi-structured or non-structured, is analysed for getting important results outcome. Several machine learning algorithms such as decision tree, support vector machine, random forests, Naive Bayes, logistic regression, AIDR, etc. can be applied to the data for analysis. These algorithms do an analysis of data and present requisite outcomes from the data and also help in visualizing the outcome in a precise and desired way. This information can be effectively used for search-and-rescue function during response and for post-disaster triage, relief, and rehabilitation. Many Artificial Intelligence and Machine Learning (AI&ML) tools focus on how social media updates are an indication to some incidents and have contributed efficiently to situational awareness.

3.6. AI for disaster management

Real-time information generated through crowdsourced data sharing is voluminous with the help of data analytics using Artificial Intelligence (AI) may predict important outcomes required for response and relief. AI is the simulation of human intelligence processes by machines, especially computer systems. These processes include learning (the acquisition of information and rules imbibed in the form of algorithms for using the information), reasoning (using rules to reach approximate or definite conclusions), and self-correction. Several new and recent smartphones also have hardware optimized for AI. Machine learning is defined as the ability of machines to learn automatically by using AI. Machine learning is involved with the creation of algorithms that can modify itself without human intervention or without being explicitly programmed to produce learning output. This is achieved through analysis of structured data fed to such machines algorithms. Thus the genesis of the learning process involves data observation, processing and analysis and take actions accordingly.

The potential opportunities and benefits of machine learning and AI has been leveraged by Artificial Intelligence for Disaster Response (AIDR) . AIDR uses machine learning to automatically analyze real-time tweets data collected for natural and man-made disasters. This tool is accessible for all who are involved in disaster response.

3.7. Internet of Things (IoT) for disaster management

With the benefits of the Internet of Things (IoT), real-time monitoring and emergency alerting can be achieved for abrupt natural hazards such as earthquakes and mudslides, and monitoring data can be transmitted in time to emergency management and command centers for issuance, thereby increasing disaster prevention and mitigation capabilities. 3GPP has already launched a set of LTE-based narrowband IoT technologies, i.e., NB-IOT and eMTC, which have expanded the LTE technology portfolio, hence supporting the broader application of the more energy efficient IoT services.

3.8. Smart city with disaster management

Apart from introducing new generations of ICTs to emergency telecommunications by the conventional telecommunications industry, in an effort to build smart cities, countries around the world have shown great enthusiasm about the application of ICTs in the emergency management sector of cities. The world-renowned consulting firm McKinsey & Company noted in a

2018 report entitled "Smart Cities: Digital Solutions for a More Livable Future" that one key aspect of building smart cities is about using digital technologies to improve emergency telecommunications. With more comprehensive, real-time, and dynamic data, emergency response services are able to follow the development of emergency incidents closely, understand the changing models of needs, and hence can implement emergency response plans more speedily and more cost-effectively in the management of emergencies. Emergency technological systems and emergency efforts that can be linked to the development of smart cities include at least the following: disaster early warning systems, emergency response optimization (i.e. back-office call processing and field operations such as the strategic deployment of emergency vehicles), personal alert applications (transmit emergency alerts such as location and voice data to emergency response services, or loved ones, etc.), smart monitoring of the operation zone, etc.

3.9. Ordinary use of emergency telecommunication systems

Emergency telecommunication systems can be utilized in the ordinary situation (not in disaster phase). The following scenarios are examples of the ordinary use of emergency telecommunication systems.

Emergency telecommunication systems like MDRU and LACS are considered for use in emergency situations, so it is preferable to prepare enough number of these systems before a disaster occurs. In general, however, emergency telecommunication systems which are installed in advance may not be used for a long time, since it is very hard to estimate disaster occurrence. In such a case, it is likely that the installed system could not be used in the case when a disaster occurs because of problems linked to operation skill and battery life. In ordinary situations, emergency telecommunication systems can be used for temporary telecommunication infrastructure in rural areas where telecommunication infrastructure is not sufficient. MDRU enabled a connection between the elementary school and two nearby villages as shown in Figure 2.

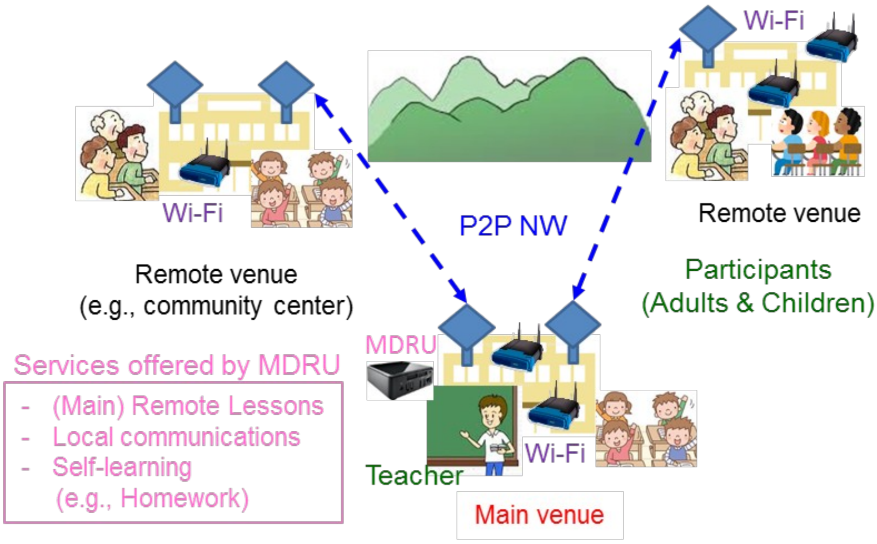


Figure 2 Example of temporary telecommunication infrastructure in rural areas as an ordinary use of emergency telecommunication system

Disaster management solutions such as emergency telecommunication systems can be utilized for remote education in rural areas without enough telecommunication infrastructures in ordinary situations. It is expected that children and farmers have skills for using emergency telecommunication systems in the case of disaster because ordinary use of disaster management solutions could be considered as one of disaster management training.

4. CHAPTER 4 – Early Warning and Alerting Systems

Telecommunications/ICTs play a critical role before, during and after any disaster. ICTs support all phases of disasters, including preparedness, prediction, early warning, response, and recovery. Technological advancements are making it possible to increase resiliency and ensure redundancy with the faster restoration of connectivity after a disaster takes place. However, effective disaster management depends on preparedness, including the implementation of early warning systems and regular drills and exercises. Early Warning Systems (EWS) are well recognized as a critical life-saving tool for floods, droughts, storms, bushfires, and other hazards (earthquakes, tsunamis). The recorded economic losses linked to extreme hydro-meteorological events have increased nearly 50 times over the past five decades, but the global loss of life has decreased significantly, by a factor of about 10, thus saving millions of lives over this period[4].

4.1. Use of ICT in Planning for Early Planning and Alerting Systems

The roadmap for disaster management rests on the premise that disasters are inevitable, and proper initiatives are required to be in place for early warning of the impending disaster, saving lives and property, reducing large scale impacts, enabling immediate relief, and ensuring the mitigation of similar calamities in the future.

Information dissemination before, during, and after disasters is important. Effective early warning before disasters requires the ability and means to publish disaster warning information. When necessary, the warning of imminent danger should quickly reach every person in the designated area as soon as possible.

The use of technologies, including GIS software, satellite earth observation systems, IoT, real-time analysis using big data and advanced computing, mobile communication technology, and social media awareness, can help in the management of disasters and inform more sustainable and resilient development perspectives.

4.2. Deploying early warning systems for disaster risk reduction

4.2.1. Common Alerting Protocol (CAP) and its use in Early-Warning Systems

In the meetings held during the year, India presented its case studies on Common Alerting Protocol (CAP) and its use in Early-Warning Systems in disseminating information of early warning systems in case of Earth Quakes, flash floods etc. India has done trials of this technology, which has been successful, and some lessons learnt during the trial are being attended.

4.2.2. EWS for Earth Quakes and Tsunamis

In the case of earthquakes and tsunamis, early warning systems help in containing damages of human lives and property. In the present day, technologies exist to detect moderate to large earthquakes so quickly that a warning can be sent to locations outside the epicenter before the destructive waves arrive. Data from a single station or from a network of stations form the basis of earthquake early warning. Using a combination of alerts from single

4 http://www.wmo.int/pages/prog/drr/projects/Thematic/MHEWS/MHEWS_en.html

stations and a regional seismic network, the accuracy and warning time can be enhanced. The on-site and regional warning alerts are combined in the Shake Alert demonstration system for the desired performance during a moderate to large earthquake. The future of earthquake early warning systems may be contained in smartphones and vehicles, and “smart” appliances and the increasing number of everyday objects embedded with sensors and communication chips that connect them with a global network. In India, more than 100 sensors are deployed in the Himalayas region to cater to the need of earthquake early warning systems to the cities of Northern India for event detection and location identification, estimation of magnitude,and issue of alert notification. Following the Tsunami, the Government of India has taken major steps to build robust early warning systems. At the national level, India’s Ministry of Earth Sciences has established the National Tsunami Early Warning System at the Indian National Centre for Ocean Information Services (INCOIS) in Hyderabad, Andhra Pradesh. The Indian Meteorological Department (IMD) under the Ministry of Earth Sciences has developed ICT based systems for issuing accurate warnings and generating real-time weather reports disseminated to all important disaster management agencies.

4.2.3. EWS for Cyclone

The benefits of early warning and preparedness were seen when Cyclone Phailin, the strongest storm to hit India in more than a decade, swept across the Bay of Bengal on the eastern coast provinces (states) of Andhra Pradesh and Odisha in October 2013, with winds over 200 km/hr and heavy rainfall. The red message, the highest alert warning message from the Indian Meteorology Department in Delhi, was concise, accurate, and to-the-point. The alert also enlisted where and what type of damage was expected to shelter and infrastructure.

4.2.4. Torrential rainfall short-term using phased array weather radar

Incidences have been occurring like cloud burst, torrential/heavy rainfalls, which rapidly leads to disaster. Japan has developed a Phased Array Weather Radar (PAWR) to detect torrential rainfall information to prevent damages from it. The PAWR can observe three-dimensional rainfall information (radar reflectivity and Doppler velocity) every 30 seconds to detect locally and rapidly developing cumulonimbus in the early stage.

4.2.5. Early Warning Systems for Flooding and Mudslides

ITU and the Zambia Information and Communications Technology Authority (ZICTA) entered into a Cooperation Agreement to co-finance a Project to allow the establishment of two EWSs in two communities, Mbeta Island and Kasaya Village. These EWS disseminate alerts on flooding and impending disasters to these communities living close to the main river. The systems will also be used for public safety and will facilitate the exchange of information between local communities and government agencies. A video on the implementation of the two EWSs is available at the link https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/EWS_ZAMBIA.aspx.

4.3. Broadcast emergency warning systems

Apart from disseminating information through normal SMS methods, there are several other modes of communication alert messages via broadcast radio and television, cable television, and direct broadcast satellite etc. The USA has improvised Alerting Systems, including Emergency Alert System (EAS) and Wireless Emergency Alerts (WEA). EAS enables the delivery of alert messages by broadcast radio and television, cable television, and direct broadcast satellite. WEA can send alert messages to mobile phones in targeted areas. WEA can also transmit Child Abduction Alerts.

4.4. Early Warning and Alerting System Technology

4.4.1. Multi-Hazard Early Warning Systems (MHEWS)

The Sendai Framework for Disaster Risk Reduction 2015–2030 recognizes the benefits of multi-hazard early warning systems and enshrines them in one of its seven global targets (target (g)): “Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030”.

The Framework urges a paradigm shift in the way risk information is developed, assessed, and utilized in multi-hazard early warning systems, disaster risk reduction strategies, and government policies. During the Q 5/2 workshop in May 2018 on Early Warning, an expert from World Meteorological Organisation (WMO) explained the activities that can benefit national early warning and alerting activities, including the Multi-Hazard Early Warning Systems (MHEWS) Checklist and the Climate Risk and Early Warning Systems (CREWS) Initiative. The countries can use MHEWS checklist, which is available on the WMO web site. WMO also adopted the common alerting protocol (ITU-T X.1303) and the alerting platform called Alert Hub. The Global Multi-hazard Alert System (GMAS) objective is to provide authoritative information and advice to UN agencies and the humanitarian community, in both their operational and long term decision making processes.

4.4.2. Integrated Public Alert and Warning System (IPAWS)

The IPAWS uses technology and information standards to join multiple private sector communications technology infrastructures providing an ability to deliver a single emergency message simultaneously to multiple public dissemination pathways; for example, radio, TV, mobile devices, and internet-connected systems, websites, and applications.

The first critical step in initiating the design solution for the U.S. national system was to use the Common Alerting Protocol (CAP) and other technical standards. When A&W services are made CAP-compliant and integrated with IPAWS, the platform acts as a mediator by authenticating messages from authorized users disseminating authentic emergency information to people in a specific geographic area quickly through multiple dissemination pathways. This way, information from a single source about a single incident can reach the public via radio, television, wireless phones, Internet services, and future CAP-compliant IPAWS connected technologies. The standards-based technology approach enables a national A&W architecture to adapt to and leverage future technologies. Making use of multiple dissemination pathways for public alerts significantly increases the likelihood that the messages will successfully reach the public. In addition, disseminating a single CAP alert message simultaneously via multiple pathways reduces the time and workload required by emergency managers, compared to preparing and sending multiple separate channel-specific formatted alerts. IPAWS’ standards-based approach speeds the delivery of critical, lifesaving information.

Use of the open CAP standard enables industry partners (i.e. Internet, carriers, software vendors, broadcast) to develop technology and/or devices that can be used by individuals with disabilities and others with access and functional needs, to receive A&Ws. Due to standards-based interoperability, CAP enables the transport of rich multi-media attachments and hyperlinks in all A&W messages. IPAWS adopted the Emergency Data Exchange Language (EDXL) CAP, which is developed and maintained by the Organization for the Advancement of Structured Information Standards (OASIS). FEMA IPAWS continues to work with the OASIS Standards Committee to adopt changes to the specifications on the CAP standard for IPAWS-OPEN. The current system utilizes the CAP v1.2 Standard and the CAP v1.2 IPAWS USA Profile v1.0. IPAWS does not provide an Alert Origination Tool; however, FEMA IPAWS works with more than 25 different alerting origination tool vendors to ensure their products are compliant with the CAP v1.2 standard and USA profile specification. Constituent AAs can find the tool that best fits local operations. IPAWS engages and provides training to AAs and tool vendors and encourages them to adopt IPAWS for their A&W needs.

IPAWS participated with the Alliance for Telecommunications Industry Solutions (ATIS), a US-based technical and operational standards and solutions development organization for the ICT industry, to develop and adopt standards used for WEA in the United States. ATIS addresses common, critical priorities and sharing of resources, effort, and costs to develop large-scale, interoperable solutions. ATIS is accredited by the American National Standards Institute (ANSI). IPAWS actively participates in ATIS meetings with cellular service providers and partners to continuously update WEA capabilities.

FEMA IPAWS maintains liaison and collaboration with relevant professional associations, including the National Association of Broadcasters, the NCTA Internet & Television Association (formerly the National Cable & Telecommunications Association), the National Emergency Management Association, and the International Association of Emergency Managers. In addition to working with standards institutes and various associations, FEMA IPAWS ,in coordination with FEMA headquarters actively engages with the FCC and Congress to update laws and regulations to facilitate improving A&W capabilities. FEMA IPAWS supported committees of the National Research Council and The National Academies Press in the development of published workshop reports on the “Public Response to Alerts and Warnings on Mobile Devices” and “Geotargeted Alerts and Warnings.”

FEMA IPAWS’ regular use and development of standards, and participation in associations, results in proactive participation in operational tests, training, exercises, and evaluations of new and emerging technologies. These activities enable progress toward the integration of additional and new technologies into the national A&W interoperability backbone, as well as encouraging industry and other private sector innovators to meet the mitigation risk reduction and risk management needs of the emergency management community at large.

4.5. Early warning and remote sensing systems

As discussed in chapters 1 and 3 that ICTs support all phases of disasters, including prediction, Vulnerability Analysis and Risk Assessment, early warning , and post-disaster recovery; the early warning information is disseminated through various medium i.e. via mobile, radio, TV, amateur radio, satellite, Internet and other media. Early detection and warning about the disaster are done using remote sensing systems via satellites, radar, telemetry and meteorology, satellite M2M sensing technologies, etc. For this purpose, a local emergency management agency is needed to direct the appropriate information to the concerned people in the field. In section 3.3 & 3.4 the details about the role of UN-SPIDER, WMO, and UNOSAT are given. In addition, ITU-R RS.1859 has worked on the use of national remote sensing systems for data collection in the event of a disaster.

As explained in para 4.2, Japan has developed a Phased Array Weather Radar (PAWR) to detect torrential rainfall information to prevent damages from it.

In India, the National Remote Sensing Centre (NRSC) under the Indian Space Research Organization (ISRO) and other organizations such as Geological Survey of India (GSI), Bureau of Indian Standards (BIS), Chemical Weapons Convention (CWC) have done zonation of India on the basis of hazard vulnerability using sensing data. These maps are very useful for pre-disaster planning, prevention and mitigation activities. “BHUVAN” is Indian geo-platform of ISRO which provides extensive range of services based on GIS maps.

Based on satellite-based sensing data, Indian early warning agencies are also disseminating important information to neighbour countries in the region and to several similar agencies in Indian Ocean and Asia Pacific region. Indian EW system is also a part of the Global Telecommunication System (GTS) of the World Weather Watch (WWW) program of the World Meteorological Organization (WMO).

Similarly, as explained in chapter 3 the United States of America’s Meteorological aids, meteorological-satellite and Earth exploration-satellite services play a major role in early warning and remote sensing activities.

4.6. Disaster information and relief systems

In addressing natural catastrophes and public disaster management, governments are challenged. Private companies are also forced to react to disasters. To manage such catastrophic conditions, fast and accurate management of information and communication becomes of utmost importance. Establishing appropriate procedures, define responsibilities, and make decisions becomes critical. In such times of emergencies, information systems (IS) are important instruments used to improve the efficiency and effectiveness of disaster-handling activities. Information systems support governments and companies in their efforts to regain trust, reestablish reputation, and sustain their ability to operate.

In India, because of dissemination of disaster information, establishing procedures and protocols, responsibility and decision making structures the national level, state level, and local level and having accurate data of the path of Cyclone ‘Philine’ of 2013 and cyclone ‘Fani’ of 2019, there has been a substantial reduction in a number of deaths due to these super-cyclones.

As part of relief operations, the India State Orissa’s State Disaster Management Authority (OSDMA) team and the ministry for disaster management managed one of the largest-ever evacuation exercises in the state. Nearly millions of people were evacuated in time and moved to higher grounds and safer cyclone shelters in these two cyclones. The state government, federal government, local administration, international and national NGOs, and community leaders joined hands for well-planned large-scale relief operations. Control rooms were set up ten districts, mobile phone numbers were updated and verified, leaves were canceled to have almost all the staff on stand-by, and food and relief stocks were kept in readiness. The National Disaster Management Authority (NDMA) facilitated local efforts in Odisha by mobilising rescue teams and by sending equipment to possible hot spots. The NDMA deployed thousands of personnel of the National Disaster Response Force(NDRF) in the states of Andhra Pradesh, Odisha, and West Bengal. The teams were equipped with satellite phones and wireless sets to maintain smooth communication.

By virtue of an efficient early warning system and rapid evacuation measures deployed by national and local governments, the death toll of the cyclone reported was very low in two digits, only considering millions of people who lived in the storm's path. In contrast, a 1999 cyclone in the same area had a much more devastating impact, killing about 10 000 people.

The early warning issued by IMD was suitably backed up by disaster preparedness and mitigation activities of state government in the form of availability of shelters, food, volunteer system, regular conduct of mock drills, and preparation of standard operating procedures for disaster management at the state and village level and well-prepared community at risk.

Use of Social Media information :

Social media can be very helpful in generating resources for disaster relief operations. In India as part of its coordinating efforts, the Government of the Indian State of Kerala took to social media to share information about donations to the Chief Minister's Distress Relief Fund[5]. As the scope of the disaster became clear, the state Government of Kerala reached out to software engineers from around the world. They joined hands with the state-government-run Information Technology Cell to create a website. The website allowed volunteers who were helping with disaster relief in Kerala's many flood-affected districts to share the needs of stranded people so that authorities could timely respond to the situation. These volunteers were hand-holding in emergency operation centers. People joined social media groups with hundreds of members who were coordinating rescue and relief efforts. These people were able to reach people marooned at home and faced with medical emergencies. A team of volunteers called Kerala Designers Collaborative to compile vital information in the form of infographics. These graphics involved topics ranged for how to assess your car after floods (check for lizards, venomous snakes, and remove moisture content from the lights) to burying animal bodies to prevent the spread of disease. These infographics were very useful and were translated into five Indian languages.[6]

5 https://scroll.in/article/890699/as-kerala-battles-flood-social-media-helps-connect-anxious-relatives-coordinate-relief-efforts

6 https://www.cpr.org/2018/08/22/how-social-media-came-to-the-rescue-after-keralas-floods/

A fraternity of mechanical engineering students at a government-run engineering college at Barton Hill in Kerala created a group called 'Inspire.' The group built over 100 temporary power banks and distributed the devices among those unable to contact their families in flood-affected areas and relief camps. A power bank could boost a mobile phone's charge by 20 percent in minutes, which could be critical for people without access to electricity. Authorities agreed to distribute the power banks, wrapping them in bubble wrap and airdropping them to areas where people were marooned[7]. As the waters receded, ordinary citizens tweeted about where to go for free medical care and other services[8]. Further, charity organizations also used their website to collect donations for relief kits.

Similarly, during the Chennai flood of 2015, people extensively used social media to connect to the outer world. The calamity brought out thousands of helping hands. Chennai residents took to social media to offer their homes to strangers seeking shelter from the rain and floods. #ChennaiFloods and #ChennaiRainHelps were equally being used by victims and helping hands. These hashtags in India utilised to offer shelter, food, transport, and even mobile recharges sharing of government helpline numbers, details of NGO offering helps, etc.

Thus, the importance of disaster information, data, effective organization of relief and rescue operation, use of social media, and community participation in relief operation can result in a substantial reduction in human and animal lives and quick recovery of economic losses.

7 https://www.news18.com/news/india/engineering-students-develop-power-banks-for-those-unable-to-contact-families-due-to-kerala-floods-1849233.htm

8 https://www.npr.org/sections/goatsandsoda/2018/08/22/640879582_

5. CHAPTER 5 – Drills and Exercises

ITU Members are aware that telecommunications and ICTs play critical roles in all phases of disasters, as well as the importance of preparing NETPs. However, without a means to test national communications readiness, NETPs remain theoretical and might not work in a disaster. Since the concept of conducting drills and exercises may be daunting, during the 2018-2021 study period, Study Group2 prepared an annual deliverable Report “Guidelines for National Level Drills and Exercises.” These guidelines were created to satisfy a need for guidance that is adaptable or scalable for use by governments and organizations in developing countries, as well as in Small Island Developing States (SIDS) and Least Developed Countries (LDCs). While the complete guidelines are found in the annual deliverable, this report offers a brief summary of key elements. Conducting regular drills and exercises provides clear benefits and can help organizations involved in disaster preparedness in response to:

- Test preparedness to maintain and restore communications in an emergency.
- Assess the adequacy of communications procedures, policies and systems related to emergencies.
- Make improvements to NETPs based on outcomes of the exercise debrief.
- Increase the awareness of the stakeholders of potential strengths and gaps in telecommunications coverage and continuity planning.
- Enable practical learning in a safe environment.
- Assess the allocation of resources and manpower among the stakeholders, noting potential gaps and overlaps.
- Develop teams and help to build strong working relationships.
- Develop and test cross-sectoral cooperation.
- Engage and motivate stakeholders to coordinate more closely on preparedness actions.
- Ensure communications competencies of emergency response professionals.
- Evaluate communications between various stakeholders and increase interoperability.
- Build a continuous culture of improvement.
- Increase communications resiliency.

5.1. Guidelines for preparing and conducting disaster communications exercises and drills

The Study Group 2 Report “Guidelines for National Level Drills and Exercises” provides comprehensive guidance for those who are working to plan and conduct a drill or exercise in a manner that is adaptable, depending on the scale or type of drill or exercise and the particular needs of the country or organizations. The following provides a brief summary of the key elements or steps involved in planning and conducting a drill or exercise.

- Start with a concept note emphasizing objectives
- Ensure top management are supportive of holding the drill
- Assemble a planning/facilitation team to thoroughly plan the exercise
- Write the scenario
- Create an evaluation plan
- Conduct the exercise

- Record the exercise in detail to facilitate follow up and lessons learned
- Debrief the participants to help identify gaps in preparedness, as well as reinforce what went well, and identify lessons learned, strengths and weaknesses
- Hold an after-action review to ensure that the next steps moving forward in a structured way
- Identify and assign objectives for corrective actions
- Update response plans, policies, procedures, equipment, as needed, to take account of results
- Monitor ongoing progress and remain committed to supporting a program of continuous improvement through regularly held drills/exercises

5.2. Assessing and updating plans

Results from the drills or exercises, as captured in the after-action review and debriefs, should be used to set the action plan for areas within a NETP or within related policies and procedures that need improvement or adjustment, as well as identifying the areas of strength. Demonstrating the impact of exercises, in terms of identifying needed improvements and implementing actions to enhance preparedness, is critical to securing management support for a regular and continuing program of drills and exercises.

Additionally, in order to develop a continuous improvement culture, try to reinforce momentum following the after-action review by driving the points identified for improvement into best practices. By embedding the principles and discipline of recording, tracking, and closing actions that have a positive effect on preparedness planning, assigning owners, and holding regular improvement meetings, an organization can drive the improvements into the next emergency preparedness plan iteration, including the next exercise. This process continues between and across each drill or exercise. This will help build momentum for a methodology for continuously improving NETPs.

6. CHAPTER 6 - Country and industrial case studies

This section summarizes country and industrial case studies submitted to Q5/2 meeting during this study period. Case studies are categorized into five topics; Enabling policy and regulatory environment, Disaster Communications Technologies, Early Warning and Alerting Systems, Drills and Exercises and others. Detail case studies are described in Annex A of this report, and Table 1 shows titles, country and the related sections in Annex A for each topic.

Table 2 : Case studies

Topics	**Country**	**Company**	**Title of case study**	**Sections**
Enabling policy and regulatory environment	India		Policy frameworks on ICT and disaster management	A1.1.1
	India		The importance of ICTs in disaster management	A1.1.2
	Haiti		Emergency telecommunications under Haiti’s Sectoral Working Group	A1.1.3
	World Food Programme		Emergency Telecommunications Preparedness Checklist	A1.1.4
	New Zealand		CAP-based early warning	A1.1.5
Disaster Communications Technologies	People’s Republic of China	China Telecommunications	Integration of space and terrestrial emergency communications network resources	A1.2.1
	India		The Fisher Friend Mobile Application (FFMA)	A1.1.1
	People’s Republic of China		Intelligent emergency telecommunications management	A1.2.2
	People’s Republic of China		Emergency communications services and networks	A1.2.3
	India		The role of social media platforms	A1.2.4
	People’s Republic of China		The delivery of communications services to disaster zones	A1.2.5
	Japan		Locally Accessible Cloud System (LACS)	A1.2.6
	United States of America	Loon LLC	Balloon-enabled preparedness and emergency telecommunications solutions	A1.2.7
	ITU-R		Global broadband Internet	A3.7

Topics	Country	Company	Title of case study	Sections
	WP4A		access by fixed-satellite service systems	
	ITU-T SG11		The fast deployment emergency telecommunication network	A3.8
	ITU-R SG5		Fixed Wireless Systems for disaster mitigation and relief operations	A3.9
	ITU-R WP4B		Satellite Systems	A3.10
	Several countries		The session on disaster drills and emerging technologies on disaster management	A4.2
Early Warning and Alerting Systems	India		Common alert protocol based Earth Quake Early Warning system in North Region of India	A1.3.1
	India		Case study – Disaster management	A1.1.1
	India		Implementing a trial of a Common Alerting Protocol (CAP)	A1.3.2
	People's Republic of China	China Telecommunications Corporation	ICT disaster preparedness	A1.3.3
	Brazil		Implementation of emergency alerts	A1.3.4
	Japan	NICT	Early warning and the collection of disaster information	A1.3.5
	Japan		Advanced early warning technologies	A1.3.6
	People's Rep. of China		The concept of emergency alerts	A1.3.7
	United States of America		The status of remote sensing activities	A1.3.8
	India		Monitor and accurately predict the path of the cyclones	A1.3.9
	United States of America		Alert and Warning Systems	A1.3.10
	ITU-T SG2		Framework of disaster management for disaster relief systems	A3.6

Topics	**Country**	**Company**	**Title of case study**	**Sections**
	Several countries		Panel Session on Early Warning System including safety confirmation	A.4.1
Drills and Exercises	People's Republic of China		Emergency telecommunication drills	A1.4.1
	People's Republic of China	China Telecommunications Corp	Emergency communications exercises	A1.2.1
	Several countries		The session on disaster drills and emerging technologies on disaster management	A4.2
	Several countries		The Session on Conducting National Level Emergency ICT Drills and Exercises	A4.3
Others	Japan		Global disaster statistics	A1.5.1
	Japan		Pre-positioned emergency telecommunication systems	A1.5.2
	Democratic Republic of the Congo		Fight against the Ebola virus disease	A1.5.3
	United States of America	Facebook	Disaster Maps program	A1.5.4
	ITU-T SG15		Framework of Disaster Management for Network Resilience and Recovery	A3.1
	ITU-R WP7C		Remote sensing systems	A3.3
	ITU-T SG2		Terms and definitions for disaster relief systems, network resilience and recovery	A3.5

7. CHAPTER 7 - Good Practices, Guidelines and Conclusions

During the study period, Q5/2 team conducted four workshops: Early warning systems, Disaster drills and emerging technologies on disaster management, Conducting National Level Emergency ICT Drills and Exercises: Guidelines for Small Island Developing States (SIDs) and Least Developed Countries (LDCs) and on Enabling Policy Environment for Disaster Management including for Covid-19 response.

7.1. Analysis and identification of Best Practice Guidelines and lessons learned

During the discussion, deliberations, contributions, and expert opinion in the workshops, the following good practices and guidelines emerged in the areas of:

(A)**Early Warning Systems:**

- **Keeping a developing country needs in mind:** Alerting systems must meet developing countries' needs and take into account the level of technologies in use.
- **Ensuring flexibility**: Flexibility in designing, tailoring, and testing alerts for multiple hazards that developing countries experience is crucial.
- **Regulatory flexibility:** Developing policies that enable regulatory flexibility before a disaster is critical. Communications regulators have granted "Special Temporary Authorities" (STAs), which can provide flexibility to shorten the approval period for emergency communications deployments.
- **Evolving emergency alert system**: Countries must consider the means of alerting emergency information to citizens, recognizing the ongoing and critical importance of broadcast media (radio, television, etc.) for distributing information to citizens in the case of disaster, while simultaneously recognizing that people are increasingly relying on mobile devices to get information.
- **Ensuring connectivity:** A lack of connectivity is not just a development issue, it's a safety issue as lifesaving alerts, and warnings may not be received when disasters strike, in addition to delaying or hindering disaster response and recovery. It is important that communications development policies consider potential emergency communications needs and the resiliency of networks.
- **Capacity Building:** There are potential opportunities for the BDT to enhance the capacity of Least Developed Countries (LDCs) and Small Island Developing States (SIDS) to generate and communicate effective, impact-based, multi-hazard, gender-informed early warnings and risk information. Capacity building to improve alerts, detection, and response is critical.
- **The need for enabling policies:** The Tampere Convention on the Provision of Telecommunications Resources is a valuable tool for countries to increase disaster preparedness and response capabilities, but often, countries that have signed the Convention have not put the necessary enabling policies and procedures in place.
- **Continual Improvement in emergency procedures:** Pilot projects, disaster management drills and exercises are important to test procedures

and make adjustments as needed to better prepare for specific types of emergencies. There is also a need for ongoing Stakeholder coordination.

- **Evolving technologies:** Evolving technologies are playing an important role in the more effective and efficient dissemination of Multi-Hazard Early Warnings. For example, in addition to detecting natural disasters such as tsunamis and floods, IoT based technologies can help in the collection of data that can be processed using big-data analysis technologies to detect probable diseases in livestock. Procedures and technology must be continually evaluated and updated to ensure alerts and warnings are timely, relevant, and followed by the communities that receive them.
- **Other areas for consideration:**
    - Advance training on satellite systems
    - Warnings in the last mile for sending warning messages from local government to citizens, and the capacity of satellite systems
    - The ongoing pursuit of disaster risk knowledge, which can be expanded based on the systematic collection of data and disaster risk assessments; Detection, monitoring, analysis and forecasting of the hazards and possible consequences. This enables the communication of timely, accurate, relevant, and actionable warnings with information on likelihood, impact, and actions that citizens should take.
    - The need for ongoing Stakeholder coordination

(B) **Disaster drills and emerging technologies on disaster management**

- The importance of satellite imagery in assessing the extent of disaster-affected areas and damages occurred during disasters.
- Importance of using exercise such as Triplex, effective coordination at local site with the control center.
- The use of Virtual Reality (VR) designed by using actual data from prior disasters could help build a more realistic simulated disaster scenario to make training more “life-like”.
- Importance of having Movable and Deployable ICT Resource Unit (MDRU) for quick restoration of ICT networks during disaster.
- Necessity of planning for resilient network capacity, because in emergency situations, even if networks are not damaged, they tend to congested during disasters. It is also observed that network batteries could get depleted during disasters, transmission lines could get disconnected, and there might be direct damage to physical infrastructure.
- “ Technology does not stand alone.” Attention to planning, coordination, exercises, and drills, then revising policies and procedures on an ongoing basis, is key. Testing equipment on a regular basis is likewise critical.
- Low technology solutions might be essential in disaster response. Responders should be prepared for technologies not to work and have redundant means of communication when there was a lack of connectivity and electricity.
- Planning is critical. It is important prior to exercises to outline the goals of the exercise and socialize them with participants and stakeholders.
- The exercise scenario is important and should be appropriate for local hazards and conditions. However, surprises always happen, so the need to adapt and adjust, and encourage flexibility is key. To better prepare participants for complex and shifting scenarios, it should be ensured to

include a number of "injects" that escalate a scenario and test the ability of participants to react to increasingly complex situations.
- Practice! Practice! Practice! Frequent training, re-training, and disaster response simulations were key to identify gaps and refine policies and procedures.
- Immediately after a disaster happens, the demand for communications would be very high, given the need for the public to contact loved ones for safety confirmations and for responders to coordinate responses on congested and damaged networks. This demand would go down over time and through the recovery period.
- Drills should be specialized by priority needs and applications such as for medical Information sharing.
- Drills and planning should include persons with disabilities (PwDs), and ensure that PwDs could access information and enable communications. Their communication needs should be fulfilled using all available means, including sign language and captions.
- Enabling early evacuation is key to survival for Persons with Disabilities.
- Countries should encourage citizens to learn to use amateur radio as a means of redundant communications when all other network infrastructures fail.
- The exercise debriefs (or after-action), where facilitators and participants share experiences and challenges, and provide feedback, was the most important part of an exercise. The debrief should set an action plan for areas that need improvement or adjustment, in addition to confirming areas of strength in the preparedness program. This action plan should prioritize actions for follow-up, starting with "quick wins" identified in the exercise.
- A table-top drill can be a very effective first effort, which can identify gaps and allow for refinements to plans and procedures. It should be followed by mock drills, functional drills, and then full-scale exercises. Team building during drills helps in coordinating the activities during real situations.
- Importance of including a range of different actors in communication drills, such as communication officials, responsible for emergency frequencies, public safety and regional responsibilities.
- Drills and exercises should also consider ways to increase regulatory flexibility, such as Special Temporary Authorities (STAs), to enable the quick import and deployment of ICT infrastructure.
- Countries should contact the BDT for capacity building assistance, as well as information on disaster/emergency communications preparedness.
- Seek outside assistance wherever desirable.

  Prepare Standard Operating Procedures (SOPs) at the national, state and district/community level, and consider how interoperability among these entities might be increased

(C)**Conducting National Level Emergency ICT Drills and Exercises: Guidelines for Small Island Developing States (SIDs) and Least Developed Countries (LDCs)**

1. Recommended planning steps/milestones
- **Start with a concept note** that outlines the goal and expects outcomes of exercise, the required resources, and the timeline. The concept note will introduce stakeholders to the exercise.

- **Assemble the planning team:** A planning team that thoroughly plans the exercise scenario, timelines, participants, necessary resources, etc.
- **Write the scenario:** All exercises from TTX and drills to full-scale need a scenario. The scenario is the script that sets the stage for the exercise. Ensure that the scenario links to the exercise goals!
- **Create an evaluation plan:** It will be the main element that makes the exercise a valuable learning experience.
- **Conduct the exercise:** check that all equipment and other resources are in place. Then the facilitation team briefs the participants and runs the scenario-based exercise.
- **Monitor:** Evaluate how participants respond to key events, have the objectives and outcomes been met?
- **Record**: Record all major decision points and outcomes from the exercise.
- **Debrief the participants.**
- **Hold the after-action/hotwash**.
- **Identify and assign corrective actions** based on exercise observations.
- **Update** – Plans, policies, procedures, equipment, as needed.

2. Exercise planning best practices

- **Ensure a long planning lead time**: Allow sufficient lead time in your exercise planning cycle to give notice to participants if you are pre-notifying the exercise. For example, if an exercise or drill includes communications industry participants, these teams need plenty of notice to these teams to allow them to line up the necessary resources to respond.
- **Fully plan the scope, draft the scenario,** and then build a timeline of the time and resources required of internal and external teams to meet the expected outcomes of the exercise.
- **Hold exercises or drills at regular intervals**, such as annually, if possible, to reinforce results.
- **Draft an exercise timeline that has two timescales:** 1) Real chronological time and 2) exercise time duration. For instance: If the exercise starts at 0900 on a Monday real-time, the scenario could but it could be 0300 on a Sunday morning, then move the exercise along in chunks of time. e.g. Start Exercise is 03:00 on a Sunday morning and then move it along as “start time + 1 hour”, then “start time + 2 hours etc.” This will equal 09:00, 10:00 and 11:00 in real-time.
- **Extending the exercise timeline** to discuss actions that should have taken place days before the simulated event. **For example,** a hurricane/cyclone scenario should cover preparedness, mitigation, and recovery/response actions from T minus “-“5 days through to +3 days after the event. This could include pre-positioning of assets, fuel, provisions, emergency teams on standby, network lockdown, staff availability, flood control measures like sandbagging or sand. Add the injects into the exercise timeline.
- **Consider scenario timing:** Peak tourist season vs. a less busy time of year? Holiday season v peak year-end or month’s end? This will test resource availability, especially if the simulation is to ensure readiness for an important upcoming event.
- **Include a detailed timeline** for the exercise/scenario a timeline of the time and resources required of internal and external teams to meet the expected outcomes of the exercise

- **Involving industry**: Design the scenario that it is clear the industry operators can provide input on whether the scenario is realistic and whether they will see benefits from the exercise. These could include allowing them to see cross-sector coordination, stronger links to the regulator and Government agencies, and to test their own communications.
- **Base the exercise on testing existing plans (if they are available)**: Understand the scope and scale of the national plans and policies that will apply to the drill (it is inadvisable to design a test that bypasses all current regulations processes). What Recovery Time Objectives (RTO) do they have? What are the recovery targets (if any)? Then design an evaluation/ test to assess the ability to hit those and pull in resources along the way. Have key response/business processes with associated RTO's been identified in the plans? If not, then you already have a finding that the exercise can shine a spotlight on.
- **Align language and vocabulary:** Ensure all players are familiar with the terms to be used. If necessary issue a glossary beforehand (See Annex 1).
- **Keep the scenario realistic:** Design a scenario that has benefits for all players. This will help the stakeholders' role play better and consider the geographic scope of the exercise. Will there be a need to move people over longer distances? Will the scenario involve the general population (evacuations, setting up emergency medical facilities, cell broadcast, etc.)?
- **However, the scenarios and injects should be dynamic,** pushing organizations and individuals to deal with cascading events. Natural disasters do not follow a pre-determined plan, so being prepared for a multitude of scenarios is crucial.
- **Get key stakeholder buy-in:** Draft a list of key participants to understand who MUST participate, and which participants are optional. Prioritize participants. If you involve stakeholders outside of your immediate control and organization, ensure you have their permission to include their staff as it may tie them up for a significant period of time. Ensure their reporting line and leadership are aware if you intend to have them participate for a number of days.
- **Resource Impacts:** Be cognizant of resource impacts from the exercise if you are asking for deliverables that require a lot of work (such as data gathering, for example).
- **Know when to terminate:** Be prepared to pull the exercise if circumstances render the running of the exercise impractical or outcomes won't be useful or unrealistic. This experience will serve to improve the next exercise.
- **Add "stress":** Consider removing technology platforms from the exercise and fall back onto manual processes with limited communications - this will "stress" the processes and test the ability of teams pre-planning, knowledge of their plans, and team's ability to exercise without direction.
- **Use real-world processes & systems:** Avoid creating "exercise only" groups, email addresses, and communications paths that will not actually validate whether the systems used on a real event would be effective.

3. Conducting drills and exercises

- **Facilitating a scenario-based exercise**

In advance of conducting this exercise, the Facilitator should distribute the organization's emergency plan if one exists, to invitees, as advanced reading. The Facilitator may also contact local and state emergency managers and community responders for input on this exercise in advance, such as input on current local emergency management issues that may impact the organization's planning[9].

- **The role of the facilitator** is to create a framework to encourage dialogue and steer discussions to meet the objectives of this exercise, inform of the organization's emergency plans, create teamwork and educate participants. Facilitator roles can include:
    i. Give participants an overview of the exercise, including the scope, scenario, timeline goals, participant roles, and next steps.
    ii. Have participants introduce themselves.
    iii. Have participants work together as a team (or broken into multiple teams).
    iv. Introduce participants to the incident as if experiencing it as a real incident.
    v. Guide the team to work through interactive modules to accomplish the exercise objectives based on the stages of disasters – preparedness, response, recovery and mitigation, at each stage, discussing specific actions to be taken.
    vi. Encourage a full discussion of preparedness, mitigation, and response actions appropriate to the scenario to improve the ability to communicate when future disasters occur.
    vii. Introduce "injects" at critical times.
    viii. Facilitate a "debrief" or "hotwash" discussion, engaging participants to sum up observations, and findings, ideally to inform and amend national emergency plans.
    ix. Participate in a comprehensive after-action process.

4. Conducting exercises best practices

- **Recording events:** Assign a scribe to capture the timeline and key decisions.
- **Provide a timeline**, and at the start, explain how the exercise will play out. Include in this the participant call frequency. Set out a timeline of what calls will happen when. Have the timeline show the end of the exercise.
- **Keep a tight agenda**: Regardless if it is face to face or on a conference call. Try to keep the administration overhead to a minimum.
- **Injects:** Should be designed to stimulate the actions, activities and conversations of teams, agencies, and individuals, whether directly or indirectly involved in the exercise. They should also explore existing plans. Example: if you have developed a scenario to examine your contingency response to a hurricane at your facility the first inject could be a media weather report of a tropical depression that is developing into a hurricane. The next inject would be a follow-on report of the hurricane tracking toward your area.
- **Injects should link the simulated event to the actions that you want people to take**. They provide unity to the exercise and are provided by controllers to drive the scenario. Injects usually happen regardless of the actions of the players, For example: a simulated road emergency could impair the ability to evacuate via a key road. This is an inject because the exercise controller would inform the players at a pre-set time that this simulated event has taken place, regardless of the actions of the players.

9 https://www.gsma.com/mobilefordevelopment/resources/exercising-business-continuity-plans-natural-disasters-quick-guide-mnos/

- o Other inject examples could include: Generator failures, fuel shortages (no fuel in the next 3 hours), chemical leak requiring hazardous materials teams to clean up, a civil disturbance occurring near a hospital etc. When drafting an inject, link the simulated effect of the inject to the actions you want people to take.
- **Develop injects that challenge the structure of the response, test the flexibility of the response plans, and which force priority discussions**: Example: communications are impacted – cell towers in key areas are destroyed or damaged, phone lines are down, the internet is down, subsea cables are damaged and perhaps no access to cloud recovery Or the **infrastructure issues that impact response** such as airport is closed, roads are damaged.
- **Set expectations of what deliverables are due when and to what level of detail** they must comply (full or partial).
- **Set ground rules in terms of communicating during the exercise** – use "this is an exercise only" at the beginning and end of all exercise-related communications.
- **Reporting during the event**: What monitoring is going on and by whom, and what information can they give? What status are reports being delivered? What are the operators required to report, and how will they do this?
- **Reporting lines** – What, to whom and how frequently? How understood are these lines of communication?

(D) **Lessons learnt: Enabling Policy Environment for Disaster Management including for Covid-19 response**

- Access to a robust, resilient and secure ICT infrastructure worldwide is critical in a pandemic and in any kind of disaster.
- ICT is essential to have power, security, health and sanitation – essential services in a global emergency. However, the ability of ICTs to perform the necessary function relies on an enabling policy environment, from granting temporary authority for additional spectrum use to giving complimentary recharge margins for emergency calls.
- The world's telecommunication networks and digital infrastructure must be better prepared for disasters of all kinds. Collectively, it should be ensured that drills are carried out and rapid response measures are ready, since future disasters – including pandemics – can occur anytime, anywhere, and with little to no warning.
- Any negative consequences of disasters can be diminished if robust resilience networks and disaster management tools are in place well ahead of time.

7.2. Conclusions

Throughout the study cycle, ITU-D Study Group 2, Q5/2 has been able to examine a wide range of activities related to the use of telecommunications/ICTs during Disaster and emergency situations in both developed and developing countries. It is heartening to note that more and more countries and organizations are taking steps to develop early warning systems, deploying the latest technologies, and to make telecommunications/ICT networks more resilient to disaster risks. The lessons learned and guidelines as prepared during the period, as mentioned above, will certainly help in better preparations in terms of early warning, drills and exercises, and timely and effective policymaking. That being said, discussions during the study cycle identified the need for additional implementation support for developing countries in the area of disaster communications. Having studied the matter now focus should be to use Telecommunications/ICTs in Disaster response and recovery operations. However, experience sharing and contributions for the use of Telecommunications/ICTs in all areas of disaster management should continue as before. More time can be devoted to the exchange of experiences among developing countries to identify common challenges and successful practices and support ongoing development and implementation of disaster communications frameworks, technologies, and plans.

Editor’s Note: This section could be consolidated or streamlined based on additional discussion at the October Rapporteur meeting to identify any gaps or additional elements that could be added.

Abbreviations and acronyms

5G	The fifth generation mobile networks
BBU	Base Band Unit
CAP	Common Alerting Protocol
COVID-19	coronavirus disease 2019
CPE	Customer Premise Equipment
CREWS	Climate Risk and Early Warning System
EAS	Emergency Alert System
ECV	Emergency Communication Vehicle
EWS	Early Warning System
FEMA	Federal Emergency Management Agency
FFMA	Fisher Friend Mobile Application
eMBB	enhanced Mobile Broadband
GIS	Geographic Information System
GMAS	Global Multi-hazard Alert System
HD	High-definition
HFA	Hyogo Framework for Action
ICT	Information and Communication Technology
IoT	Internet of Things
IPAWS	Integrated Public Alert and Warning System
IPAWS-OPEN	Integrated Public Alert & Warning System Open Platform for Emergency Networks
IVRS	Interactive Voice Response Systems
M2M	Machine-to-machine
MHEWS	Multi-Hazard Early Warning Systems
mMTC	massive Machine Type Communications
NETP	National Emergency Telecommunication Plans
NOAA	National Oceanic and Atmospheric Administration
OSCAR	Observing Systems Capability Analysis and Review Tool
PAWR	Phased Array Weather Radar
RRU	Remote Radio Unit
SDGs	United Nations Sustainable Development Goals
SNS	Social Network Service
UAV	Unmanned Aerial Vehicle
UNISDR	United Nations International Strategy for Disaster Reduction
UNITAR	United Nations Institute for Training and Research
UNOSAT	UNITAR's Operational Satellite Applications Programme
UN-SPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
URLLC	Ultra Reliable Low Latency Communications
VoLTE	Voice over LTE (Long term evolution)
VSAT	Very Small Aperture Terminal
WEA	Wireless Emergency Alert
WMO	World Meterological Organization
WRC	World Radiocommunication Conference

WTDC World Telecommunication Development Conference

Annex 1: Detailed case studies

A1.1. Enabling policy and regulatory environment

A1.1.1 Policy frameworks on ICT and disaster management (India)

(1) India's policy framework – Role of ICT in disaster situations

The National Telecom Policy - 2012 (NTP-2012) emphasizes importance of disaster management and it contains various provisions in this regard. Some of them are as mentioned below:

- Creation of the robust and resilient telecommunication networks for adequately addressing the need for proactive support for mitigating disasters - natural and manmade.
- To prescribe sectoral Standard Operating Procedures (SOPs) for aiding effective and early mitigation during disasters and emergencies.
- To create appropriate regulatory framework for provision of reliable means of public communication by telecommunication service providers (TSPs) during disasters.
- To encourage use of ICTs in prediction, monitoring and early warning of disasters and dissemination of information.
- To facilitate an institutional framework to establish nationwide unified emergency response mechanism by providing nationwide single access number for emergency services.

(2) India's Standard Operating Procedure (SOP) for telecommunication services response to disasters

Department of Telecommunication (DoT) under Ministry of Communications, Government of India had prepared SOP, for responding to disasters and ensuring emergency communication telecommunication, in 2015. A crisis management plan for disaster communication was also released in 2015. Subsequently latest SOP has been released by DoT in March, 2017, which covers detailed procedures for assurance of communication services during all kinds of disasters. The highlights of the SOP are:

a) Organizational set-up for telecom services during disasters and emergencies at all levels viz. central, state and district level for implementing and monitoring the disaster management plans;
b) Constitution of committees at national, state and district level which will meet once in 6 months to review the plans and activities related to disaster management;
c) Having robust and preventive measures of the telecommunications systems;
d) TSPs are required to have physical infrastructure safety, redundancy in traffic management;
e) TSPs to identify vulnerability of their respective telecommunication infrastructure and accordingly prepare plan for emergency situations including backup components e.g. engine alternator, batteries, etc.;
f) There should be overload protection mechanism for traffic overload and congestion management etc;
g) Provision of control room management/activities during disaster phase and aftermath;
h) Periodic training for continuous awareness and drills to check preparedness.

Details thereof can be seen at http://www.dot.gov.in/dataservices/data-services/.

(3) TRAI's initiatives

Telecom Regulatory Authority of India (TRAI) has given its recommendations on implementation of single emergency number in India giving an entire framework for implementation of integrated emergency communication and response system. The recommendations been accepted by the government of India (DoT) and number "112" has been allocated to this service. DoT has also issued necessary instructions to telecommunication service providers for implementation. TRAI has also given recommendations on 'priority call routing for the persons involved in the rescue and relief operations' in 2013. The same has been largely which has been accepted. TSPs have been asked to provide Intra Circle Roaming (ICR) for subscribers of TSPs so that in case mobile services during disaster are interrupted due to infrastructure failure for any TSP, subscribers of that TSP may continue to get services for 15 days on roaming from the network of another TSP whose network is in working condition. Now TRAI is doing consultation on "Next Generation Public Protection and Disaster Relief (PPDR) communication networks" which will pave ways for efficient PPDR network in India. Detailed information as available at www.trai.gov.in.

(4) Early warning systems

India has a very robust early warning system in place. Primary nodal agencies for monitoring and early warning of disasters in India are:

- Indian Meteorological Department (cyclones, floods, drought, earthquakes);
- Central Water Commission under Ministry of Water Resources (floods);
- Geological Survey of India (landslides);
- Ministry of Earth Sciences through Indian Tsunami Early Warning Centre at the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad (tsunami);
- Snow and Avalanche Study (SASE) for (snow avalanche).

Indian early warning agencies are also disseminating important information to neighbour countries in the region and to several similar agencies in Indian Ocean and Asia Pacific region. Indian EW system is also a part of Global Telecommunication System (GTS) of World Weather Watch (WWW) program of World Meteorological Organization (WMO). Some important websites which provide information on EW system and services in India are: http://www.imd.gov.in, http://www.incois.gov.in, http://www.nrsc.gov.in, http://www.india-water.gov.in, http://www.india-wris.nrsc.gov.in, http://drdo.gov.in/drdo/labs/SASE.

National Remote Sensing Centre under Indian Space Research Organization (ISRO) and other organizations such as Geological Survey of India (GSI), Bureau of Indian Standards (BIS), Chemical Weapons Convention (CWC) have done zonation of India on the basis of hazard vulnerability. These maps are very useful for pre-disaster planning, prevention and mitigation activities. "BHUVAN" is Indian geo-platform of ISRO which provides extensive range of services based on GIS maps.

(5) Case study – Disaster management: an integrated approach with ICT applications as enabler for efficacy of disaster prediction. A very good example which shows what preparedness can do is case of cyclone Phailin in Odisha and Andhra Pradesh States

Following the tsunami, the Government of India has taken major steps to build robust early warning systems. At the national level, India's Ministry of Earth Sciences has established the National Tsunami Early Warning System at the Indian National Centre for Ocean Information Services (INCOIS) in Hyderabad, Andhra Pradesh. The Indian Meteorological Department (IMD) under Ministry of Earth Sciences has developed ICT based systems for issuing accurate warnings and generating real-time weather reports disseminated to all important disaster management agencies.

The benefits of early warning and preparedness could be been seen when Cyclone Phailin, the strongest storm to hit India in more than a decade, had swept across the Bay of Bengal on the eastern coast provinces (states) of Andhra Pradesh and Odisha on Saturday the October 12, 2013, with winds over 200 km/h and heavy rainfall. The red message, the highest alert warning message from the Indian Meteorology Department in Delhi, was concise, accurate and to-the-point. The alert also enlisted where and what type of damage was expected to shelter and infrastructure.

The Orissa State Disaster Management Authority (OSDMA) team and the ministry for disaster management managed the largest-ever evacuation exercise in the state. Nearly 500 000 people were evacuated in time and moved to higher grounds and safer cyclone shelters. State government, federal Government, local administration, international and national NGOs, and community leaders joined hands for a well-planned large-scale relief operation. Control rooms were set up ten districts, mobile phone numbers were updated and verified, leaves were cancelled to have almost all the staff on stand-by, and food and relief stocks were kept in readiness. The National Disaster Management Authority (NDMA) facilitated local efforts in Odisha by mobilising rescue teams and by sending equipment to possible hot spots. The NDMA deployed nearly 2 000 personnel of the National Disaster Response Force in Andhra Pradesh, Odisha and West Bengal. The teams were equipped with satellite phones and wireless sets to maintain smooth communication.

By virtue of an efficient early warning system and rapid evacuation measures deployed by national and local governments; death toll of the cyclone reported was very low as only 21 people died considering the 12 million people who lived in the storm's path. In contrast, a 1999 cyclone in the same area had a much more devastating impact, killing 10 000 people. Similarly, the 2004 tsunami took the lives of about 10 000 people in coastal states of India.

The early warning issued by IMD was suitably backed up by disaster preparedness and mitigation activities of state government in form of availability of shelters, food, volunteer system, regular conduct of mock drills, and preparation of standard operating procedures for disaster management at state and village level and well prepared community at risk.

(6) The Fisher Friend Mobile Application (FFMA)

Indian National Centre for Ocean Information Services (INCOIS) has collaborated with a very renowned research institution the M.S. Swaminathan Research Foundation, to develop the Fisher Friend Network, which ensures safety at sea and improves the livelihood of fishermen. The Fisher Friend Mobile Application (FFMA) is a unique, single window solution for the holistic shore-to-shore needs of the fishing community, providing vulnerable fishermen immediate access to critical, near real-time knowledge and information services on weather, potential fishing zones, ocean state forecasts, and market related information. Fishermen now receive regular ocean weather forecasts, early warnings about adverse weather conditions, and advisories on potential fishing zones. The application is an efficient and effective decision support tool for the fisher community to make informed decisions about their own personal safety and the safety of their boats, as well as make smart choices for fishing and marketing their catch.

FFMA is developed on an android platform in partnership with Wireless Reach Qualcomm and Tata Consultancy Services and is currently available in vernacular languages Tamil, Telugu and in English. Fishermen have been trained to recognize warning signs to ensure their own safety and to their community.

A1.1.2 The importance of ICTs in disaster management (India)

(1) Disaster management governance and law (India)

Major disasters, for example, earthquakes of Uttarkashi (1991), Latur (1993), Chamoli (1999), Assam floods (1998), Orissa super cyclone (1999), created an environment of serious brainstorm on the state of disaster management in India and on the requisite actions required to improve the situation. India was a party to Yokohoma declaration on disaster reduction for a safer world. The constitution of High Power Committee (HPC), chaired by Mr. J. C. Pant, former secretary of Indian Government, was a key step in this direction. HPC resulted in a detailed study report with a set of fundamental and practical recommendations. The Gujarat Bhuj earthquake 2001 experience triggered proposition of Disaster Management Bill, which after another major disaster the Indian Ocean Tsunami 2004 culminated in to Disaster Management (DM) Act 2005. The DM Act 2005 legally established a paradigm shift to “prevention-mitigation based holistic disaster management”. Interestingly, year 2005 also witnessed India’s participation in Kobe world conference on disaster reduction that resulted into Hyogo Framework for Action (2005-15). Though India’s pioneering law which enabled for systemic planning and preparedness for disaster emergencies and tiered approach of authorities, was the “Emergency Planning, Preparedness and Response Rules 1996” under the Environmental Protection Act 1996 of India, the mechanism of holistic planning for disaster management and authorities at national, state, district and local level has been brought by the DM Act 2005.

The DM Act 2005 clearly spells out about the institutional structures with corresponding functional responsibilities, to bring about paradigm shift; accordingly, a National authority for Disaster Management (NDMA), National training and Capacity Building Institute (NIDM) and National Disaster Response Force (NDRF) have been created. Similar roles are to be performed at state and local level as well, therefore respective institutions at state and district levels (SDMA, SDRF, DDMA) have also been created. This DM institutional framework ensures that in a post-disaster situation, the affected communities may be assured of sustainable livelihoods and reduced vulnerability to future disasters. India is also a part of all international strategies on Disaster Risk Reduction and is a signatory of current Sendai Framework for Disaster Risk Reduction (SFDRR), the 2030 Agenda for Sustainable Development and The Paris Climate Agreement 2015.

NDMA has prepared a National Policy on Disaster Management which defines India's vision on DM. The policy aims to promote a culture of prevention, preparedness and resilience at all levels through knowledge, innovation and education. It mentions about encouraging mitigation measures based on technology, traditional wisdom and environmental sustainability and mainstreaming disaster management into the developmental planning process. Policy envisions about using science and technology in all aspects of disaster management in India. It is available in https://ndma.gov.in.

(2) National telecom policy and emergency telecommunication initiatives in India

The Ministry of Communications in India in its National Telecom Policy - 2012 (NTP-2012) has identified DM as an important area to be worked upon. Various provisions of NTP-2012 underline the importance of creation of suitable infrastructure for disaster proof emergency communication such as :

- Creation of the robust and resilient telecom networks for adequately addressing the need for proactive support for mitigating disasters - natural and manmade;
- To prescribe sectoral Standard Operating Procedures (SOPs) for aiding effective and early mitigation during disasters and emergencies;
- To create appropriate regulatory framework for provision of reliable means of public communication by Telecom Service Providers (TSPs) during disasters;
- To encourage use of ICTs in prediction, monitoring and early-warning of disasters and dissemination of information;
- To facilitate an institutional framework to establish nationwide Unified Emergency Response Mechanism by providing nationwide single access number for emergency services.

As emphasized in NTP-2012 Department of Telecommunication (DOT) under the Ministry of Communications, Government of India had prepared Standard Operating Procedure (SOP) for responding to disasters and ensuring emergency communication in 2015. A crisis management plan for disaster communication was also released in 2015. Subsequently, the latest SOP has been released by DOT in March 2017, which covers detailed procedures for assurance of communication services during all kinds of disasters. Detailed SOP can be seen at http://www.dot.gov.in/dataservices/data-services/.

Going further, the Department of Telecommunication (DOT) has now created an organizational structure at each Telecom Licensed Service Area level (which normally coincides with states of India) by creating functional role specific to disaster management to implement SOP in all Telecom Licensing Areas and bring about impetus on emergency telecommunication at federal and state government levels.

Telecommunication Engineering Centre (TEC), a telecom research and standardization arm of DOT came out with paper on disaster communication in the year 2008. Recommendations of ibid paper have been adopted in SOP of the DOT. TEC has recently released a testing procedure for Enhanced Multi Level Precedence and Pre-Emption (e-MLPP) priority services for emergency communication.

The Telecom Regulatory Authority of India (TRAI) has already given recommendation on priority call routing, single emergency number and next-generation Public Protection and Disaster Relief (PPDR) communication networks.

(3) ICT-based forecasting and warning networks in India

A paradigm shift is now taking place regarding disaster management and Disaster Risk Reduction (DRR) and according to new paradigm disaster risk reduction, climate change adaptation and sustainable development are interrelated this can be very much verified from priorities and action points of the Sendai Framework for Disaster Risk Reduction (SFDRR), the 2030 Agenda for Sustainable Development and The Paris Climate Agreement 2015. In India, a lot of emphasis is now laid on DRR through prevention, mitigation and preparedness. India has built up a very strong early-warning system. India Meteorological Department (IMD), the National Meteorological Service of the country, was established in 1875. It is the principal government agency in all matters relating to meteorology, seismology and allied subjects. IMD offers observational, data collection, monitoring and forecasting services across various sectors namely monsoon, hydrology, agriculture, health, aviation, transport, shipping, cyclone, climatology, mountaineering, disaster management etc. IMD offers many web-based forecast services for example weather forecast, meteorological information, nowcasting, warnings, normal etc. are provided through the IMD headquarters at Delhi and various offices of IMD. The meteorological telecommunication in IMD consists of an integrated network of point-to-point and point-to-multipoint (MPLS VPN) links with meteorological centres within the country and the world for receiving data and relaying it selectively. It also possesses VSAT based network. It is mainly organized on a two-level basis, namely:

- The Meteorological Telecommunication Network (MTN) within the Global Telecommunication System (GTS) of World Weather Watch (WWW) program of World Meteorological Organization (WMO);
- The National Meteorological Telecommunication Network (NMTN).

The Global Telecommunication System (GTS), the main part of WMO, National Meteorological Telecommunication Centre (NMTC), in Mausam Bhavan, New Delhi, acts at Regional Telecommunication Hub (RTH) of the GTS of WMO.

IMD is mandated:[10]

- To take meteorological observations and to provide current and forecast meteorological information for optimum operation of weather-sensitive activities like agriculture, irrigation, shipping, aviation, offshore oil explorations, etc;
- To warn against severe weather phenomena like tropical cyclones, nor'westers, dust storms, heavy rains and snow, cold and heat waves, etc., which cause destruction of life and property;
- To provide meteorological statistics required for agriculture, water resource management, industries, oil exploration and other nation building activities;
- To conduct and promote research in meteorology and allied disciplines;
- To detect and locate earthquakes and to evaluate seismicity in different parts of the country for development projects.

IMD offers many service details thereof, which may be seen at http://www.imd.gov.in

10 http://www.imd.gov.in

Apart from IMD, other agencies for monitoring and early-warning of disasters in India are:

- Central Water Commission under Ministry of Water Resources for Floods (http://www.india-water.gov.in);
- Geological Survey of India for Landslides (https://www.gsi.gov.in);
- National Remote Sensing Centre under Indian Space Research Organization for all kinds of space navigation services (https://nrsc.gov.in);
- Indian National Centre for Ocean Information Services (INCOIS), Hyderabad for Tsunami early-warnings (http://www.incois.gov.in);
- Snow and Avalanche Study (SASE) for snow avalanche (https://www.drdo.gov.in/drdo/labs1/SASE/English/indexnew.jsp?pg=about-lab.jsp).

Indian early-warning agencies are also disseminating important information to neighbour countries in the region and to several similar agencies in Indian Ocean and Asia pacific region. Indian early-warning system is also a part of the Global Telecommunication System (GTS) of the World Weather Watch (WWW) program of the World Meteorological Organization (WMO).

(4) Mapping and hazard zonation

The National Remote Sensing Centre under the Indian Space Research Organization (ISRO) and other organizations such as GSI, BIS, CWC have done zonation of India on the basis of hazard vulnerability. These maps are specific to hazard profile of an area. For example, for earthquake disaster vulnerability, hazard map is available at https://ndma.gov.in/images/atleses/India/India_%20Atlas_Full.pdf *(size: 295MB). These maps* are very useful for pre-disaster planning, prevention and mitigation and mainstreaming of disaster risk reduction and development planning activities. These maps are being used for implementation of building bylaws as well.

(5) Bhuvan data discovery and metadata portal

The National Remote Sensing centre of India (NRSC) of the Indian Space Research Organization (ISRO) has created "Bhuvan", a geo-platform to provide extensive range of services based on GIS maps. The portal is meant:

- To improve access to and integrated use of spatial data and information;
- To support decision making;
- To promote multidisciplinary approaches to sustainable development;
- To enhance understanding of the benefits of geographic information.

It is extensively being used for Disaster Risk Reduction. It also helps in location identification of an event, for example forest fire location can be quickly traced and remedial action can be taken through this geo-portal. Details of various disaster services being offered are available at: http://bhuvan.nrsc.gov.in/data/download/index.php.

A1.1.3 Emergency telecommunications under Haiti's Sectoral Working Group (Haiti)

(1) Disaster management in Haiti

In Haiti, disaster management is entrusted to the Civil Defence Directorate (Direction de la Protection Civile (DPC)), which is under the authority of the Ministry of the Interior and Local Government. DPC receives support from many other State bodies and private and international institutions in the area of natural disaster management.

Beyond the planning and coordination of relief activities, DPC also manages a UHF telecommunication network to facilitate communication among different bodies involved in the disaster management process.

In the field telecommunications, DPC relies on the support of CONATEL for the mobilization of all telecommunication/Internet operators and broadcasters.

CONATEL's responsibilities in terms of emergency telecommunications are as follows:

- Coordination with telecommunication operators with a view to ensuring availability of telecommunication networks for relief operations
- Issuing of alerts by radio and television stations
- Activation and distribution of satellite telephones to government officials for the coordination of relief operations
- Coordination of the deployment of telecommunication systems with ITU.

(2) Regulator's emergency telecommunication plan of action

The regulator's emergency telecommunication plan of action is based on the following:

- Coordination with DPC, mobile operators, Internet access providers, radio and television stations for the issuing of emergency alerts to the public
- Ensuring the resilience of mobile operator, Internet access provider and radio and television station networks
- Coordination of assistance from ITU and other international organizations in the area of emergency telecommunications
- Advocacy for the adoption and implementation of a national plan for emergency telecommunications
- Introduction of a mechanism for the efficient and optimal use of telecommunication resources during emergencies.

(3) Roles of telecommunication/Internet operators and broadcasters

Telecommunication operators and Internet access providers have the following responsibilities:

- Provision of telecommunication services in affected areas
- Issuing of emergency alerts at DPC's request
- Offering of calls free of charge to persons living in affected areas.

Radio and television stations are supposed to issue emergency alerts to affected populations.

(4) Support from international organizations

The International Telecommunication Union (ITU) provides appropriate support to Haiti during emergencies.

ITU interventions take two forms:

- Deployment of emergency telecommunication equipment to facilitate communication among relief teams
- Distribution of satellite telephones to government officials for the coordination of relief activities.

Several other international non-governmental organizations, either established in Haiti or arriving specifically for emergencies, deploy their telecommunication equipment to support of DPC.

<u>(5) Projects under way</u>

There are currently two emergency telecommunication projects under way.

Haiti does not yet have an integrated emergency telecommunication system. For this reason, it has been decided to establish a sectoral committee on emergency telecommunications (Comité sectoriel sur les télécommuncations d'urgence – COSTU)), charged with coordinating sectoral responses, in accordance with the national disaster and risk management plan. COSTU was set up with a view to using telecommunications and information and communication technologies (ICTs) to enhance the coordination of disaster prevention, preparedness and response.

The creation of COSTU was the outcome of an ongoing commitment, bringing together the Ministry of Public Works, Transport and Communications, through the participation of CONATEL, and the Ministry of the Interior and Local Government Authorities, through the participation of DPC.

Furthermore, its creation demonstrates the will of the Government to strengthen disaster prevention, preparedness and response measures through joint planning and to take advantage of the essential role of telecommunications in this regard.

COSTU's terms of reference include, inter alia, the following elements:

- Mission and functions
- Composition of COSTU
- Operating mechanisms
- Description of COSTU's tasks
- Financing arrangements
- Expected outcomes
- Follow-up and assessment mechanisms.

The World Food Programme and Global System for Mobile Communications (GSMA) contributed to work leading to the establishment of the sectoral working group on emergency telecommunications.

The second project concerns the introduction of an early warning system to issue public alerts in the event of a disaster. The system is designed to operate on mobile telephone operator networks. Arrangements for the installation of the system on the networks of the two mobile operators are under way. The system, which will be provided by Microimage, receives assistance from GSMA and is financed by the World Bank.

A1.1.4 Emergency Telecommunications Preparedness Checklist (World Food Programme)

As disasters continue to increase in frequency and scope across the world, and the ITU-D Study Group 2 Question 5/2 considers the critical role of how communication policymakers can help enable emergency telecommunications in disaster preparedness, mitigation, response and relief, this Emergency Telecommunications Preparedness Checklist, jointly developed by the Emergency Telecommunications Cluster (led by the United Nations World Food

Programme) and the ITU Telecommunication Development Sector (ITU-D), examines key thematic areas that could be considered for inclusion in a National Emergency Telecommunication Plan (NETP), and provides a simple scoring approach to assess status of progress in each decision point or action over time. It primarily supports the establishment and refinement of NETPs, with a focus on understanding national readiness to enable response communications in a disaster, together with identifying targeted areas which may require attention. For a more detailed listing of potential questions that communications authorities may ask when drafting an NETP, please refer to the Emergency Communications Checklist (produced by ITU-D Question 5/2 in 2017).

A1.1.5 CAP-based early warning (New Zealand)

(1) Governance

New Zealand CAP Working Group is chaired by the Ministry of Civil Defence & Emergency Management (MCDEM), and is open to anyone with an interest in promoting the general uptake of CAP, using CAP for registered alerting authorities' alerts[11], and developing software or supplying hardware to support the dissemination of alerts in New Zealand.

Due to CAP's flexible definition of hazard levels and nomenclature, the Working Group maintains a technical standard[12] to assist with the implementation of CAP in the New Zealand alerting context. It aims to provide clarity for Alerting Authorities on the formatting and categorisation of alerts, and how those alerts should then reach the public via various alerting end-points. This document is the Common Alerting Protocol (CAP-NZ) Technical Standard [TS 04/18], and it encompasses the Working Group's decisions, recommendations and lexicons to ensure consistency within New Zealand's alerting environment. The document is reviewed annually.

MCDEM coordinates associated task groups and working groups who implement information systems and alerting end-points utilising any of the concepts of CAP, such as its schema, its alert gradings of certainty, severity or urgency, its distribution through alerting end-points, and the New Zealand-specific lexicons to provide common understanding of the message contents. It also coordinates the development of best-practice messaging in New Zealand for the various end-point technologies.

The Working Group does not have any decision-making capacity; instead it makes recommendations to the Public Alerting Governance Committee. They consider and approve the specification documents produced by the Working Group.

The Public Alerting Governance Committee was established by the Hazard Risk Board (HRB), one of the governance boards of the Officials' Committee for Domestic and External Security Coordination (ODESC)[13]. The Committee consists of senior officials responsible for public alerting as well as

11 Register of WMO Members Alerting Authorities

12 Common Alerting Protocol (CAP-NZ) Technical Standard [TS 04/18]

13 ODESC is a committee of Chief Executives which manages national security in New Zealand, and is chaired by the Chief Executive of the Department of the Prime Minister and Cabinet.

representatives from the New Zealand mobile operators and the scientific organisations that monitor natural hazards.

(2) New Zealand CAP feeds

New Zealand currently has three public live feeds of alerting information in CAP format, and one under development.

Earthquakes:

GNS Science, through the GeoNet system, maintains a CAP feed of earthquakes occurring in the last seven days of Modified Mercalli (MM) intensity 'moderate' (MM5) or higher in the New Zealand region and of a suitable quality for alerting.

See https://api.geonet.org.nz/cap/1.2/GPA1.0/feed/atom1.0/quake

Severe weather:

The Meteorological Service of New Zealand Limited (MetService) maintains a CAP feed of severe weather warnings and watches for rain, wind, snow and thunderstorms.

See https://alerts.metservice.com/cap/rss

Civil defence emergencies:

New Zealand has sixteen regional Civil Defence Emergency Management Groups who have adopted the Red Cross Hazard App as their preferred mobile device application for notifying multiple hazards in their region. The Storm CMS is used to prepare these alert messages and their impact zones, and these are published as a CAP feed.

See https://api.preparecenter.org/v1/org/nzl/alerts/rss

Emergency Mobile Alert (EMA):

New Zealand's public alerting technology is cell broadcasting. A CAP feed is currently under development by the system provider, One2many BV, to publish these alerts in order to allow their uptake by multiple other channels, such as apps, websites and digital signage. It is expected to go live by the end of 2019.

(3) High-priority alerts

New Zealand's registered alerting authorities have agreed to use CAP to share and disseminate their alerts and warnings. But CAP is not just a data protocol, it is also a way of classifying alerts. Its classification criteria were used to define the acceptable scenarios for use of New Zealand's Emergency Mobile Alert (EMA) system. The cornerstone attributes of urgency, certainty and severity enable agencies to grade their alerts and make them comparable.

New Zealand has also adopted the unofficial, but widely accepted, definition of high-priority alerts. These are defined to be at level (a) or (b) within each of the following three CAP criteria:

Certainty:

a. **Observed**: determined to have occurred or to be ongoing
b. **Likely**: probability of occurrence greater than 50%

Severity:

a. **Extreme**: extraordinary threat to life, health or property
b. **Severe**: significant threat to life, health or property

Urgency:

a. **Immediate**: responsive action should be taken immediately
b. **Expected**: responsive action should be taken soon

(4) Interpretations of 'certainty', 'severity' and 'urgency'

When designing the protocol[14] for use of the EMA system, decision makers with the responsibility for issuing EMA messages requested further guidance to the CAP definitions of certainty, severity and urgency in order for them to be more useful in an operational environment.

Certainty:

Likely should consider that a qualitative estimate of probability may vary by up to 30%, and erring on the side of caution may be preferable in some circumstances. The desire to wait for certainty is a trade-off against allowing sufficient time for action.

Severity:

Extreme applies to an emergency affecting a town, city or a region:

- Life: widespread deaths are possible; or
- Health: widespread permanently incapacitating injuries or illness are possible; or
- Property: widespread destruction (or rendering uninhabitable) of buildings is possible.

Severe applies to an emergency affecting rural dwellers, or a small part of a suburb in an urban area:

- Life: limited deaths (i.e. individuals or small groups) are possible; or
- Health: limited permanently incapacitating injuries or illness are possible; or
- Property: limited (i.e. few or very localised) destruction (or rendering uninhabitable) of buildings is possible.

Urgency:

Expected: *soon* must include time for action - the minimum amount of time people could reasonably be expected to carry out the instructions in the alert. For example:

- 5 minutes: "Do not take personal belongings other than critical medication and personal documents";
- 30 minutes: "Bring in outdoor objects such as lawn furniture, toys and garden tools, and anchor objects that cannot be brought inside".

(5) Optimal warning and guidance messages

The Working Group considers the social science around public messaging to be a logical extension of its terms of reference.

A consequence of the EMA system was the need for short warning messages of 90 characters or less, in effect the **headline** element of CAP. A report[15] was

14 Emergency Mobile Alert Protocol for User Agencies
15 Recommendations for New Zealand agencies in writing effective short warning messages

commissioned that provides best practice for writing short warning messages for the public to achieve a desired behavioural response. It was based on an international literature review and some preliminary results from primary New Zealand research. It focussed on warnings for regional tsunami, and with additional examples for a volcanic eruption and a flood event.

In order to permit a future relaxation of the 90 character limit, and for other channels featuring short messages, the guidance is useful for up to 930 characters, the technical limit for EMA messages in New Zealand under the most favourable conditions. This upper bound typically also covers social media, short emails and electronic billboards.

Another messaging initiative has been to support the Red Cross “What Now” service[16]. This involved an adaptation of standard multi-hazard key action messages to a New Zealand setting to ensure consistency, clarity, and safety. For each hazard, and for up to six stages of an emergency, several short, clear action messages are promoted as being the key ones for dealing with the hazard.

(6) Trigger levels matrix

New Zealand has been using the concept of a Hazard Intensity Metric (HIM). This is one or more measures that can be calibrated against their potential impacts, including causing death, injury or illness, or property damage.

The Working Group is aiming to set thresholds for the three critical CAP elements (certainty, severity and urgency) that work across a variety of hazards and their HIM metrics in the setting of the broadcasting and messaging end-points through which they should be distributed. For each hazard, its responsible alerting authority is consulted on the intensities that might trigger different alerting end point behaviours[17]. For example, as discussed earlier, EMA is only issued for high-priority alerts.

(7) New Zealand events and event codes lexicon

Like other nations, and in line with the current OASIS (Organization for the Advancement of Structured Information Standards) CAP initiative to provide a consistent set of event codes, New Zealand is also creating a table of event codes that provide more specificity to the nature of the emergency. At this time it is restricted to those alerts available on public feeds, primarily weather and earthquakes.

With the EMA system soon to be providing its alerts as a CAP feed, it is necessary to agree further event descriptions and event codes to cover situations such as boil water notices, flooding, biotoxins, hazardous substances and criminal activities. New Zealand has looked to previous work by Australia[18] and Canada[19] for guidance, but with this topic being considered at a global level, we are pausing now to ensure we are aligned with the future direction for these elements. At this time the **event code** element is not used in New Zealand.

16 WhatNow Service

17 For weather, wind speed can be measured in km/h, or rainfall in mm/hour. For tsunami, it could be wave height in metres, and for earthquake, Modified Mercalli intensity. It is less clear for perils such as pandemic.

18 Australia event codes

19 Canada event codes

(8) Package names

Although work has not commenced, the Working Group has identified a need to work on the standardisation of “package names” describing alerts (e.g. watch, warning, bulletin, outlook). Many of these terms are long-standing within the alerting authorities that issue them, and may even have legislative implications should change be deemed desirable.

Nevertheless, it is the sentiment of the Working Group that the use of these terms should be defined more clearly and align more consistently across the impacts of hazards they describe.

(9) Conclusion

Since 2015, New Zealand’s CAP Working Group has been an active committee of approximately sixty members across national and local agencies, as well as industry members from the geospatial community, alerting apps and warning system hardware manufacturers. It has provided technical guidance to its members, an opportunity for networking and collaboration, and enjoys official recognition by government of the importance of this standard to the alerting environment.

It remains committed to supporting the worldwide CAP community and following the initiatives being led by other nations in order to ensure that CAP is a truly global, trusted and consistent alerting protocol.

A1.2. Disaster Communications Technologies

A1.2.1 Integration of space and terrestrial emergency communications network resources (China Telecommunications Corp., People’s Rep. of China)

(1) Introduction

Many governments around the world have recognized the use of cell broadcast technology as a means of delivering emergency alert notifications. Currently, China has developed its public emergency alert notifications standards based on cell broadcast technology, which support global roaming and are compatible with the standards of Europe and the U.S.

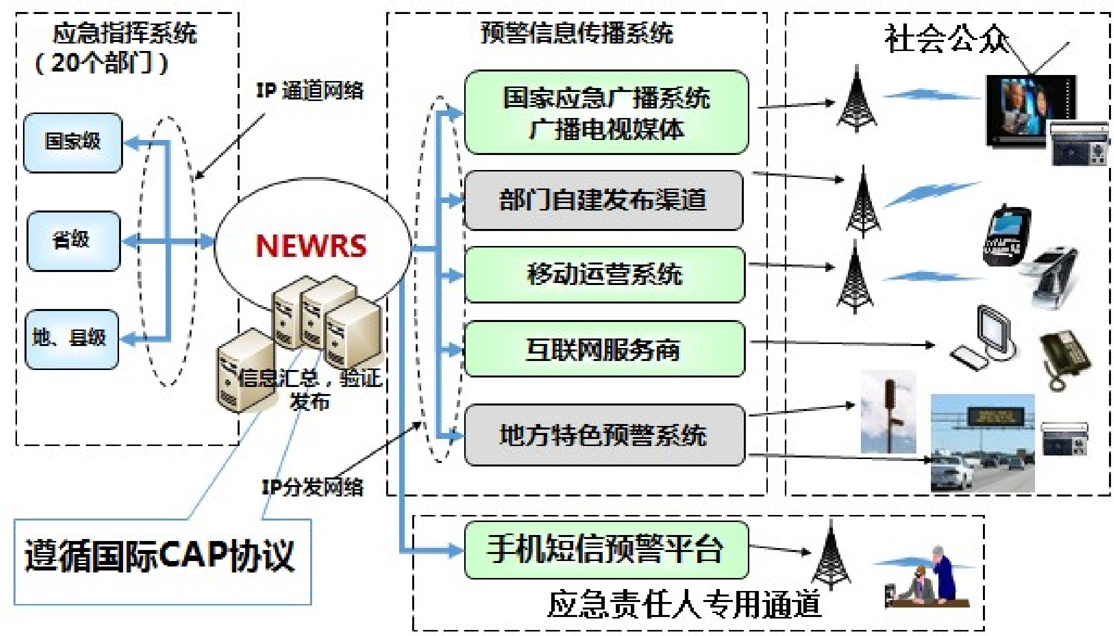


Figure A1- 1 Emergency alert system in China

Legend:

应急指挥系统（20 个部门: Emergency command system(20 departments)

国家级: National level

省级: Provincial level

地、县级: Prefecture and county level

IP 通道网络: IP-based channel network

信息汇总、验证、发布: Information summary, verification and distribution

IP 分发网络: IP-based delivery network

遵循国际 CAP 协议: Compliance with international CAP protocol

预警信息传播系统: Emergency alerting system

国家应急广播系统广播电视媒体: National public alerting system
Broadcasting and TV media

部门自建发布渠道: Self-built departmental dissemination channels

移动运营系统: Mobile operation system

互联网服务商: Internet service providers

地方特色预警系统: Local specialty emergency alert system

手机短信预警平台: Mobile phone SMS alerts platform

应急责任人专用通道: Dedicated channel for emergency management chief

社会公众: The general public

With 4G networks being continuously improved, making efficient use of 4G networks to ensure that mobile subscribers can receive vital emergency alert messages in time is particularly important. It is highly recommended that, for the benefits of the general public, efforts be made to develop emergency cell broadcast alerting systems based on 4G networks against the possibility of major natural disasters and other public safety incidents such as earthquakes, typhoons and mudslides, and achieve interconnections between 4G emergency alerting management platforms with existing interfaces of emergency alert management organizations.

To meet the needs of disaster mitigation and prevention, China Telecom has researched and developed the LTE cell broadcast technology-based multi-channel emergency alerting system, and has realized dissemination of emergency alert messages by concurrent mode in the shortest possible time, rendering it a vital component of the national emergency communications assurance plan. The system will be widely used in various scenarios and applications, including disaster prevention and emergency alerting, and etc.

China Telecom will further optimize its emergency alerting strategies to facilitate the inclusion of next generation cell broadcast in the network entry standards for telecommunications equipment and will support the use of social media including mobile Internet as dissemination channels with a view to increase emergency alerting capabilities.

(2) Detection and monitoring of natural disasters and other emergencies

With the benefits of Internet of Things (IoT), real-time monitoring and emergency alerting can be achieved for abrupt natural hazards such as earthquakes and mudslides, and monitoring data can be transmitted in time to emergency management and command centres for issuance, thereby increasing disaster prevention and mitigation capabilities. 3GPP has already launched a set of LTE-based narrowband IoT technologies, i.e., NB-IOT and eMTC, which have expanded the LTE technology portfolio, hence supporting the broader application of the more energy efficient IoT services.

To operate, conventional IoT must rely on terrestrial communications networks, and under conditions of a severe natural disaster, terrestrial communications networks can be easily damaged or destroyed so that the IoT applications are hindered. Satellite IoT can just compensate for such a weakness of terrestrial communications networks. Extensive coverage, resistance to destruction and flexibility in network construction combined have made it irreplaceable in real-time monitoring of large areas impacted by any natural hazard.

China Telecom has already gained the ability of real-time monitoring and reporting of various natural hazards based on 4G IoT, and can provide end-to-end solutions from data collection in earthquake zones to 4G-network coverage and transmission, and then to back office processing and analysis. In 2017, in partnership with China Earthquake Administration, China Telecom uploaded seismic data of an impacted region to a cloud platform via China Telecom's IoT Link card from the earthquake zone. The monitoring data are mainly obtained from the measurements of the earthquake intensity, which are then used to analyse the earthquake's vibration process and its real-time scenarios. As a supplement to the data collected by professional seismic stations, such monitoring data provide a basis for supporting decision-making in earthquake monitoring and predictions.

In addition, based on the satellite mobile communications system platform exclusively operated by China Telecom, China Telecom has been providing satellite IoT application solutions and services and have expanded the coverage of IoT's monitoring applications with the use of satellite IoT terminal devices. The focus of monitoring and detection operations mainly include the following: river water level, river discharge, sediment concentration, environment and atmospheric conditions, cereals pests and diseases, forest fires, seismic data, production and operations such as mine gas and water leakages, mudslide, avalanche, wind speed and direction, rain and snow precipitations, and etc.

(3) Emergency communications exercises

It is recommended that more efforts be made to conduct trans-sector and cross-regional emergency communications exercises by various means and approaches including tabletop exercises, full-scale exercises and functional exercises so as to increase synergy and interconnection, operability and continuity, and build a specialized emergency communications support team characterized by professionalism, dedication and supportiveness.

Featuring a national specialized emergency communications support team, China Telecom has conducted quite a number of special emergency communications exercises against various disaster recovery scenarios, including such programmes as "Building a Frontline Command System", "Emergency Relief Communications Support", "Public Network Communications Support" etc., which had demonstrated China Telecom's integrated air/ground ITC applications as well as cross-sector emergency communications capabilities in times of natural disasters or other emergencies. Apart from deploying in the exercises conventional services related to emergency communications such as Tianyi (Skywings) Walkie-Talkies, satellite phones, 4G individual communications and a variety of emergency vehicles, new services such as new generation of narrowband IoT (NB IoT), big data and visual dispatch systems were also deeply integrated into the exercise programmes. In addition, new equipment including helicopters, mooring unmanned aerial vehicles (UAV) and airborne balloons are being deployed in the exercises.

(4) Emergency communications command and control capabilities

Emergency communications command and control system is an integrated emergency command and control platform that integrates such functions as presentation, dispatch, deployment, dial testing and intelligent analysis.

(5) Building airborne emergency communications platforms

Built to meet the needs of three-dimensional wireless coverage, airborne emergency communications platforms consist of mooring UAVs, wireless broadband access systems, 3G/4G trunked emergency communications systems, air safety protection systems, HD video live broadcast systems, airborne lighting and call systems, etc.

Airborne emergency communications platforms are used in emergency zones to facilitate disaster recovery and assistance in major public safety incidents, important events, and etc. to set up wireless broadband access and 4G mobile communications and trunked communications services network, provide users in the field with mobile and data communications services, and transmit dynamic information to back-end command and control centres. China Telecom has already developed its airborne emergency communications platform specifications and can provide the relevant solutions and services, the application scenarios of which include the following:

1) Emergency communications in isolated areas without access to communications: in areas devastated by natural hazards including earthquakes, typhoons, floods or fires where emergency operations are going on, satellite communications access systems, MESH ad hoc networks and portable 2G/4G mobile communications access systems are established and launched into operation speedily to provide government and corporate customers as well as the general public with emergency mobile communications and natural disaster surveillance services.
2) Emergency communications at hotspots: at communications hotspots including cultural and sports events or business events where emergency operations are going on, satellite communications access systems or optical transmission access systems, MESH ad hoc networks and portable 2G/4G mobile communications access systems are established and launched into operation speedily to provide the press media, government and business customers as well as the general public with emergency mobile communications and data communications services.
3) Emergency communications for emergency command and control: at the sites of cultural and sports events or business events or major public safety incidents where emergency operations are going on, satellite communications access systems, MESH ad hoc networks and portable 800M digital trunked communications access systems are established and launched into operation speedily to provide the police forces and public safety agencies with critical digital trunked communications services.

A1.2.2 Intelligent emergency telecommunications management (People’s Rep. of China)

(1) Upgrading emergency telecommunications command and control system utilizing Internet+ cloud computing and big data

In many parts of China, attempts have been made to varying extent in applying "Internet+" to the development of emergency telecommunications command and control system. For instance, Shanghai communications industry have used "Internet+" to reinforce its development of the command and control system which covers emergency communications vehicles, emergency support supplies and response teams. In combination with digital maps, emergency-related data such as statistics of emergency support missions, emergency telecommunications vehicles utilization rate, emergency services statistics, emergency response teams and emergency support equipment and etc. have been included in the command and control system, and by means of the system, closed-loop management has been achieved with respect to satellite resource applications as well as allocations and approvals of material reserves. Meanwhile, the command and control system can be operated handily and speedily via mobile apps, significantly increasing the efficiency of emergency response.

(2) Analysis of people flow and network traffic in hotspot areas with the help of big data

Through the integrated use of Internet and big data processing technologies, valuable information can be drawn from massive, scattered, unstructured and constantly changing data relevant to the emergency incident, so that the macro environment of the emergency incident can be analysed and understood, and a full knowledge of the incident's development profile is obtained in a timely and efficiently manner to support scientific decision-making.

In public safety incidents, emergency alerts can be issued utilizing data analytics as well as the Internet, and big data can be used for analysing network access modes and transportation modes of mobile subscribers during major conferences and exhibitions, as well as on holidays and festivals, in order to predict and identify areas with high moving crowd densities and areas with large-scale of people flow during peak hours, detecting the gathering of large crowds and trends of people flow to be used as reference information by responsible organizations, and meanwhile, notify the people in areas with a high risk of safety-related incident via mobile Internet to avoid human stampedes and crushes.

In Shanghai, against the backdrop of the flourishing mobile Internet, people flow monitoring and mobile Internet perception in key areas as well as an analytical platform were built based on big data analytics of 2G/3G/4G cell level service statistics with the relevant analytical results being displayed in graphics, offering powerful means for emergency command centres in terms of allocation of resources, dispatch of personnel and trouble shooting. In case of abnormal situations in the field, the platform can identify problems before mobile subscribers can perceive them, hence providing strong support for the safety control of mass gatherings. Currently, similar systems have been developed to perform analytics of mobile service data targeting at key areas and hotspots, from which the total number of people (mobile subscribers), popular Apps and people flow etc. can be known.

(3) Supporting emergency response with Internet communications tools

Recent years have also seen the wide application of Internet instant messaging tools in China such as Wechat and QQ, which feature high efficiency, swiftness and convenience of use with respect to emergency task assignment and reporting and delivery of information, etc.

In the rescue operations and donation activities in aftermath of a major disaster in Japan, social media such as Twitter and Facebook were widely used. According to a survey conducted after the disaster, social media have demonstrated outstanding effects in the transmission of information. Compared with traditional communications channels, social media can disseminate information about disaster recovery facilities and materials in a much faster, accurate and reliable manner. The widely distributed cell broadcast as well as dedicated message recording phones, etc. launched during the emergency had played a significant role in providing locally generated information including emergency food and beverage supplies or delivery time and locations of the disaster recovery supplies, as well as in providing psychological counseling services.

In addition, another example is the Facebook disaster maps. When people use the Facebook app with the location service enabled, they will receive their longitude and latitude information on a regular basis. When gathered and de-identified, such geological location data can render post-disaster information. The Facebook data set types may include movement of people and crowd density, as well as Facebook Safety Check information collected after the disaster.

(4) Increased smart city capabilities facilitate the development of intelligent emergency telecommunications

Apart from introducing new generations of ICTs to emergency telecommunications by the conventional telecommunications industry, in an effort to build smart cities, countries around the world have shown great enthusiasm about the application of ICTs in the emergency management sector of cities. The world-renowned consulting firm McKinsey & Company noted in a 2018 report entitled "Smart Cities: Digital olutions for a More Livable Future" that one key aspect of building smart cities is about using digital technologies to improve emergency telecommunications. With more comprehensive, real-time and dynamic data, emergency response services are able to follow the development of emergency incidents closely, understand the changing models of needs and hence can implement emergency response plans more speedily and more cost-effectively in the management of emergencies. Emergency technological systems and emergency efforts that can be linked to the development of smart cities include at least the following: disaster early warning systems, emergency response optimization (i.e. back-office call processing and field operations such as the strategic deployment of emergency vehicles), personal alert applications (transmit emergency alerts such as location and voice data to emergency response services, or loved ones, etc.), smart monitoring of the operation zone, etc. According to McKinsey & Company's analysis of research data of a big number of city samples around the world (in the selection of city samples, emphasis was placed on overall representativeness that reflects geographic coverage, differences in income levels, population density and infrastructure quality, etc., and the global sampling survey has researched 50 cities around the world which have already developed or announced ambitious smart city development plans), after deploying new types of smart applications (e.g. smart systems can optimize call centres and field operations, while traffic signal pre-emption gives emergency vehicles a clear driving path), the cities could cut emergency response times by 20 to 35 percent on average. More mature cities with an already low response time of eight minutes could shave off almost two minutes after doing the smart city upgrades and retrofits. Those less developed cities starting with an average response time of 50 minutes might be able to trim that by at least 17 minutes after introducing new types of smart applications.

(5) Accelerated integration and development of new generation of ICTs and emergency telecommunications

The future will see an accelerated integration of new generations of ICTs such as big data and AI into emergency telecommunications systems. With the expedited restructuring and rapid iterations of core technological systems including new generations of hardware, software and services, future emergency telecommunications technological applications will experience an increasingly manifest trend of integration and innovation. Through the accelerated convergence of emergency telecommunications networks and edge computing technologies that promote and support self-perception, self-decision making, self-optimization and self-execution, the blockchain technology that supports multiple party and reliable data storage and exchange capabilities as well as virtual/enhanced reality technologies that support three-dimensional intuitive display, new types of emergency telecommunications which feature such newly emerged key elements as emergency status perception, data processing and immersive telepresence, will expedite the realization of smart command and control, network control and maintenance, smart dispatch of work order tasks and smart reserves, etc., and will help deliver opportunities of a new industrial ecosystem.

In the new development stage, with new features including physical integration of information, ubiquitous intelligence and computing, resilient platform components, data-centered operations, emergency telecommunications will enter into a completely new track of smart development, embracing a historic turning point marked by capability upgrades in all dimensions. As an integral part of emergency management system, emergency telecommunications provide important tools for disaster mitigation and prevention. In the past, people's concerns over emergency communication were more about response time and capabilities of emergency telecommunications demonstrated in the aftermath of a disaster. To a great extent, however, emergency telecommunications services should focus more on emergency preparedness. Turning disadvantages into strengths, building highly efficient emergency alerting systems, delivering emergency alert messages to the public in a timely and effective manner, enhancing disaster prevention and mitigation capabilities and improving emergency response capabilities at all levels of emergency management agencies – these will shape the future trends in emergency telecommunications.

A1.2.3 Emergency communications services and networks (China (People’s Rep. of))

(1) Overview

As one of the countries with frequent natural disasters, China has a severe form of natural disaster prevention and response. On the other hand, state-level super-large-scale activities, sports events and so on have been held successively, which makes the task of emergency communication increasingly onerous. Regardless of natural disasters or public incidents, the importance and urgency of emergency communication support has become increasingly prominent from the frequency and impact of emergency incidents, which puts forward higher requirements for the development of emergency communication services and networks.

(2) Current networks for emergency management in China

At present, the existing network of emergency communication mainly includes public communication network, private network, satellite network, and so on.

1) Public communication network: the existing public fixed telephone network and mobile network play important role in emergency communication support, but it is difficult to meet all the needs in emergency situations.
   For example, voice communication in public network is difficult to ensure call priority, and calls increase sharply in emergency, resulting in network congestion. Under special circumstances, it is difficult for public networks to guarantee the need for efficient cluster scheduling capabilities in emergencies.
2) Private network: emergency communication has strict and special requirements. In the process of critical emergency response, when the public network could not meet the requirements of emergency

communication, emergency communication capability must be realized through private wireless communication network.

At present, the international community has basically reached a consensus that the emergency response command and dispatch communications of the government mainly rely on dedicated wireless systems to protect. Currently, private wireless network technologies include:

- Analog narrowband technology: analog voice technology, only providing voice services;
- Digital narrowband technology: using digital speech coding and channel coding, can provide voice services and narrowband data services, cannot provide real-time video, integrated data query services;
- B-TrunC technology: LTE-based wireless broadband trunking technology can provide broadband data services such as voice services, real-time video, positioning, etc.;
- At present, in the long run, digital narrowband network and wireless broadband B-TrunC network will coexist and interconnect for a long time.

3) Satellite communication network: the communication technology of transmitting radio waves from artificial satellite to relay station has the characteristics of not being damaged by natural disasters. Satellite communication is not damaged by natural disasters. Satellite communication technologies such as Tiantong and Beidou positioning satellites are currently used in emergency communications.
4) Ad hoc network technology: emergency communication technology with mesh capability. Although ad hoc networks do not have large-scale networking capabilities, they have unique mesh capabilities, which can be used as a supplementary technology for emergency rescue when covering wilderness, temporary basement and high-rise routes.

In addition, although China's telecommunication network has matured, its coverage is still relatively limited. Many areas prone to natural disasters and emergencies have not yet achieved ground network coverage, such as oceans, mountains, deserts and so on. Therefore, other communication modes, such as satellite and private communication network, also play a very important role in emergency communication and emergency support.

<u>(3) Analysis of key service requirements for future emergency communications</u>

Future emergency communication services mainly include the following key needs:

1) Key voice: the business that emergency communication must guarantee;
2) Real-time video: real-time video from cameras or through UAV transmission can show the scene in real time;
3) Multimedia message: transmission of drawings, maps, etc. for the scene, such as transmission of multimedia information for the fire, etc;
4) Remote database access: can query emergency materials information, vehicle information, personnel information, plans and so on remotely;
5) Indoor and outdoor positioning and flow tracking: realizing real-time situational awareness of personnel, vehicles and materials;
6) Interconnection: interconnection with broadband trunking, narrowband trunking and other networks.

In order to meet the above requirements, emergency communication network is required to have broadband, security/isolation, ad hoc network, priority guarantee, fast trunking communication capability, high reliability, portability, unified dispatch and command characteristics.

(4) Research on the development of new emergency communication technologies

In the future emergency communication system will be a comprehensive communication information system which integrates many network technologies such as private network, public mobile network and satellite network, and can realize unified dispatching and command, and coordinate various departments to play an effective emergency role. Fusion of wide and narrowband, satellite, ad hoc network and other network technologies to achieve multi-department interconnection, unified dispatch and command is the direction of comprehensive emergency communication support development.

Recent research and development hotspots of new communication technology emergency communication applications are as follows:

1) In order to meet the growing demand for mobile broadband for emergency personnel, we should take advantage of the mature technology of LTE in public network and the obvious advantages of user scale efficiency in reducing costs, promote the standard research and development of LTE technology supporting key tasks, and promote LTE-based technology support.
2) In order to solve the problem that the mobile power of emergency communication cannot reach the safeguard area in time due to the damage of ground public infrastructure, and meet the requirement of large-capacity critical mission communication support in the incident area, the solution of regional emergency communication system based on low-altitude platform near the ground is studied and developed.
3) In order to solve the problem of providing priority services for key tasks in the public network after the IP architecture network evolution of the ground public network is completed, the standards and solutions for emergency priority services in the next generation network are studied and developed.
4) Based on the advantages of 5G wide bandwidth, low delay and high reliability, the application of 5G emergency communication scenario is studied. At present, the 5G standard is constantly improving. There are still many key technologies that need to be improved urgently in ensuring reliable access of emergency communication anytime, anywhere, multimedia multicast broadcasting service, enhanced security capability, end-to-end network visualization and integrated emergency command and dispatch capability, as well as base station non-core network working mode in emergencies.

5G plays a very important role in promoting the development of emergency communication towards broadband and intelligence. The three major application scenarios of 5G, enhanced Mobile Broadband (eMBB), Ultra Reliable Low Latency Communications (URLLC) and massive Machine Type Communications (mMTC), meet to a great extent the business needs of emergency communication for large bandwidth, low latency and high reliability. It is of great significance to enhance emergency communication rescue capability, enhance comprehensive emergency support capability and achieve a new level of emergency management.

At present, relevant research has been carried out in several emergency scenarios to further explore the potential demand, business model and technical support of 5G in the field of emergency response. A batch of 5G+emergency characteristic applications have been deeply excavated and incubated, including 5G+monitoring and early warning, 5G+safety production, 5G+fire prevention, 5G+emergency dispatch, etc. to fully tap 5G in the field of emergency response. In addition, some operators have equipped 5G emergency communication vehicles.

It is anticipated that in the future, private network and 5G public network will work together to provide communication guarantee services for emergency management. The combination of public network and private network will realize the three-dimensional emergency communication guarantee network of space-Earth integration and interoperability sharing, and jointly adapt and match the emergency communication guarantee system in the whole process of emergency management.

A1.2.4 The role of social media platforms (India)

(1) Artificial intelligence for disaster response

Real-time information generated through crowd sourced data sharing are voluminous with the help of data analytics using Artificial Intelligence (AI) may predict important outcomes required for response and relief. AI is the simulation of human intelligence processes by machines, especially computer systems. These processes include learning (the acquisition of information and rules imbibed in form of algorithms for using the information), reasoning (using rules to reach approximate or definite conclusions) and self-correction. Several new and recent smart phones also have hardware optimized for AI. Machine learning is defined as ability of machines to learn automatically by using AI. Machine learning is involved with the creation of algorithms which can modify itself without human intervention or without being explicitly programmed to produce learning output. This is achieved through analysis of structured data fed to such machines algorithms. Thus the genesis of learning process involves data observation, processing and analysis and take actions accordingly.

The potential opportunities and benefits of machine learning and AI has been leveraged by Artificial Intelligence for Disaster Response (AIDR)[20]. AIDR uses machine learning to automatically analysis real time tweets data collected for natural and man-made disasters. This tool is accessible for all who are involved in disaster response.

(2) Social media platforms and disaster management

Social media analysis is the process of collecting information or data from social media sites. Huge volume of data collected which is mostly semi-structured or non-structured, is analysed for getting important results outcome. Several machine learning algorithms such as decision tree, support vector machine, random forests, Naive Bayes, logistic regression, AIDR, etc. can be applied to the data for analysis. These algorithms do analysis of data and present requisite outcomes from the data and also help in visualizing the outcome in a precise and desired way. This information can be effectively used for search-and-rescue function during response and for post disaster triage, relief and rehabilitation. Many Artificial Intelligence and Machine Learning

20 http://aidr.qcri.org/

(AI&ML) tools focus on how social media updates are indication to some incident and have contributed efficiently for situational awareness.

(3) Utilization of social media platforms for managing disasters in India

Case 1: Kerala flood

Kerala, the state from south India faced the worst flood of the century on 16 August 2018, due to unusually high rainfall during the monsoon season. All 14 districts of the state were placed on red alert. Around one million people were evacuated, mainly from Chengannur, Pandanad Edanad, Aranmula, Kozhencherry, Ayiroor, Ranni, Pandalam, Kuttanad, Malappuram, Aluva, Chalakudy, Thrissur, Thiruvalla, Eraviperoor, Vallamkulam, NorthParavur, Chellanam, and Palakkad. National Disaster Relief Force along with Indian army and the navy were deployed for intense search and rescue operation. During this flood thousands of people took to social media platforms to co-ordinate search, rescue and food distribution efforts and also to reach out to people who needed help.[21] Thousands of citizens were using mobile phones and national disaster management authority and state government used Common Alerting Protocol (CAP) based warning system to give alerts to mobile users of Kerala. Social media were extensively used to provide information about those were stranded in different parts of Kerala who needed access to relief.

As part of its coordinating efforts, the Kerala Government took to social media to share information about donations to the Chief Minister's Distress Relief Fund.[22] As the scope of the disaster became clear, the state Government of Kerala reached out to software engineers from around the world. They joined hands with the state-government-run Information Technology Cell, coming together on Slack, a communications platform, to create website. The website allowed volunteers who were helping with disaster relief in Kerala's many flood-affected districts to share the needs of stranded people so that authorities could timely respond to the situation. These volunteers were hand holding in emergency operation centres. People joined social media groups with hundreds of members who were coordinating rescue and relief efforts. These people were able to reach people marooned at home and faced with medical emergencies. A team of volunteers called Kerala Designers Collaborative to compile vital information in the form of infographics. These graphics involved topics ranged for how to assess your car after floods (check for lizards, venomous snakes and remove moisture content from the lights) to burying animal bodies to prevent the spread of disease. These infographics were very useful and were translated into five Indian languages.[23]

A fraternity of mechanical engineering students at a government-run engineering college at Barton Hill in Kerala created a group Inspire. The group built over 100 temporary power banks and distributed the devices among those unable to contact their families in flood-affected areas and relief camps. A power bank could boost a mobile phone's charge by 20 percent in minutes,

21 https://www.bbc.com/news/world-asia-india-45218556

22 https://scroll.in/article/890699/as-kerala-battles-flood-social-media-helps-connect-anxious-relatives-coordinate-relief-efforts

23 https://www.cpr.org/2018/08/22/how-social-media-came-to-the-rescue-after-keralas-floods/

which could be critical for people without access to electricity. Authorities agreed to distribute the power banks, wrapping them in bubble wrap and airdropping them to areas where people were marooned.[24] As the waters receded, ordinary citizens tweeted about where to go for free medical care and other services.[25] Further, charity organizations also used their website to collect donations for relief kits.

Case 2: Use of social media in Chennai Flood

In the year 2015, in the months of October-December, rainfall in Tamil Nadu a southern state of India exceeded the normal monsoon by 90 per cent. This excessive rainfall was due to the El Nino phenomenon. This was the worst rainfall that the capital state of Tamil Nadu, Chennai had witnessed in this century. The flood caused severe damage and the poor urban planning and drainage system made it even worse. It was estimated that over 500 people were dead and 1.8 million people were displaced with huge economic loss in the estimated range of thousands of millions of rupees. The Army and Navy were deployed in the city for search and rescue operations, Chennai airport had been shut and several other transport facilities in the city had come to a standstill.[26] During this testing time of Chennai flood, people extensively used social media to connect to the outer world. The calamity, brought out thousands of helping hands. Chennai residents took to social media to offer their homes to strangers seeking shelter from the rain and floods. #ChennaiFloods and #ChennaiRainHelps were equally being used by victims and helping hands. These hashtags in India, utilised to offer shelter, food, transport, and even mobile recharges sharing of government helpline numbers, details of NGO offering helps etc.

Case 3: Fighting drought with the help of Internet of Things (IoT)

A Hyderabad-based startup has offered technology-based solutions in crucial sectors such as agriculture, water management, education and smart city planning, using new-age technologies such as machine learning and Internet of Things (IoT).[27] The startup has built a water resources information and management system for southern states of India and its website enables the public to view information on rainfall, ground water, reservoirs – major, medium and minor, soil moisture, rivers and streams, irrigation canals, environmental factors like temperature, humidity, sunshine, wind speed etc. The technology solutions offered is powered by IoT devices like automatic weather stations, ground water sensor, reservoir and canal level sensors it is substantiated with satellite-based imagery and manual data through mobile apps. This has brought all data relevant to water to one platform and is presented in real time to all the water related assets for a large state, county, district or block. They also offer knowledge about handling water stress mitigation. Artificial Intelligence-based system is being trained to learn and produce effective results through water resource information system. This application is also

24 https://www.news18.com/news/india/engineering-students-develop-power-banks-for-those-unable-to-contact-families-due-to-kerala-floods-1849233.htm

25 https://www.npr.org/sections/goatsandsoda/2018/08/22/640879582

26 https://scroll.in/article/773058/chennairainshelp-how-a-flooded-city-is-using-twitter-to-lend-a-hand-to-strangers

27 https://economictimes.indiatimes.com/small-biz/startups

using technology for utilization of the same data to do village level water budget using water supply and demand at a village level. The water budgeting makes villagers aware of their water sources, impending water crisis and water stress mitigation which helps in fighting droughts.

Case 4: Use of AI for enhancing crop yield

A non-profit, non-political agricultural research organization for development in Asia and sub-Saharan Africa has developed an AI sowing app. This application with the help of artificial intelligence (AI), cloud machine learning, satellite imagery and advanced analytics are empowering small-holder farmers to increase their income through higher crop yield and greater price control.[28] This provides help to farmers on adequate time of crop-sowing period; which is based on AI-based study of historic climate data spanning over 30 years, for the Devanakonda area in Andhra Pradesh. Moisture Adequacy Index (MAI) is the standardized measure used for assessing the degree of adequacy of rainfall and soil moisture to meet the potential water requirement of crops. The real-time MAI is calculated from the daily rainfall recorded and reported by the Andhra Pradesh State Development Planning Society. The future MAI is also calculated from weather forecasting models. Accordingly sowing advisories are initiated and disseminated containing optimal sowing date, soil test based fertilizer application, farm yard manure application, seed treatment, optimum sowing depth etc. This AI-based sowing advisory lead to 30% higher yields and it also helps farmers in getting better price control for their yields.

A1.2.5 The delivery of communications services to disaster zones (People’s Rep. of China)

(1) Integration of UAV and Wireless Communication Technology

In the past decades, wireless communication rapidly migrated from voice-dominated 2G era to data-dominated 3G and 4G era and is now entering the 5G era characterized by the Internet of Everything. In the past, wireless signals mainly covered people and objects on the ground, without aerial coverage specifically designed for UAVs, therefore, low-altitude digitization is a treasure to be explored. The networking of UAVs has been partially implemented in 4G networks.

While continuing to offer people greater choices of means of communication and daily life, the mobile network also enables digital transformation of all industries, in the interest of improving their operational efficiency and service quality. The brand new 5G network architecture provides over 10Gbps of bandwidth, millisecond latency and ultra-high density connection, contributing to a new leap in network performance. ITU proposed three 5G scenarios: Enhanced Mobile Broadband (eMBB), Ultra-Reliable Low-Latency Communications (uRLLC) and Massive Machine-Type Communications (mMTC). Compared with 4G network, the 5G network is capable of better and more efficiently meeting the communication needs of most UAV application scenarios, and networked UAV will drive the application upgrade of multiple scenarios.

The integration between 5G cellular mobile technology and UAVs makes the previously inconceivable come true. To satisfy the future needs for more

28 https://news.microsoft.com/en-in/features/ai-agriculture-icrisat-upl-india/

automated and intelligent UAV applications such as autonomous flight, flight in formation, etc., greater demand will be placed on mobile communication network capabilities.

(2) Demand Analysis of UAV Emergency Scenario

1) In case of natural disasters, UAVs can quickly put high-altitude base stations in place to restore the communication service functions (voice and data).
   The traditional Emergency Communication Vehicle (ECV) has been the main force in ensuring temporary communication after large-scale communication interruption caused by earthquake, flood, mud flow and other natural disasters. The ECV, however, is relatively small in service coverage and weak in signal stability due to the limitation in technology, hardware and other factors, and may even not be able to reach the central disaster area as a result of road collapse and congestion, thus unable to provide timely emergency communication service. Therefore, relying on the traditional way to set up emergency communication stations and restore base stations is inefficient, costly, difficult and time-consuming. The maturity of UAV technology and its integration with emergency communication provide a new, faster and more convenient way for operators to restore communication in disaster areas.
2) In case of major sport events when there is sharp increase in traffic, UAVs help ensure uninterrupted communication and in a networked way build networks and provide aerial video among others to serve the events.

(3) UAV Emergency Communication Mode

1) Tethered UAV + high-altitude base station

The tethered UAV system is powered from the ground and raised to UAV take-off platform by a tethering cable, capable of uninterrupted flight. When a UAV aerial base station is working, the ground power supply devices supply power to the tethered UAV systems and the onboard RRU devices. The onboard RRU devices communicate with the emergency communication vehicles via the ground BBU devices through the fiber optic line of the tethered UAV systems, and the emergency communication vehicles can connect with the nearby base station tower through microwave devices, optical fiber or satellite communication vehicles, and then connect the signal to the core network to achieve mobile signal coverage, thus effectively dealing with the impact of terrain on electromagnetic wave and guaranteeing continuous communication coverage in a certain area.

A UAV emergency high-altitude base station can cover up to about 50 square kilometers and provide instant messaging service to thousands of mobile phone users simultaneously. Capable of quickly climbing up to 50-200 meters, it now can provide 24-hour uninterrupted VoLTE and other data services to disaster areas.

In case of natural disasters such as earthquake, flood and mud flow followed by large-scale communication interruption, the tethered UAVs + aerial base stations can quickly restore on-site communication, address the problem of signal coverage in emergency situations and effectively improve the emergency communication support capability of the government and operators in response to natural disasters.

Featuring long air-stay and large payload, the tethered UAVs, in conjunction with high-altitude searchlights and loudspeakers, are able to provide high-altitude illumination over large areas to support rescue operations at night. The loudspeaker facilitates the command and coordination of people on site, message broadcasting and other similar work, and improves the level of hardware support on site. The UAVs, using a mount-and-drop mechanism, carry rescue items into areas too difficult and dangerous to access at short notice and with heavy load.

When the trapped people carry their mobile phones into the coverage of a UAV base station, the phone will be automatically connected to the onboard base station, which will send the user's IMSI number and the current geographic information in graphical form to the search and rescue clients in real time.

This all new emergency communication method aims to solve the problems of slow deployment, high cost and poor environmental adaptability of the device, featuring quick response, easy operation, flexible coverage, long air-stay and strong scalability.

2) Fixed-wing UAV + high-altitude base station

By flying to the target area a large fixed-wing UAV carrying mobile communication base stations and satellite communication systems, it is possible to provide a long time (not less than 24 hours) stable continuous mobile signal coverage in an area of more than 30 square kilometers, which restores communications in no time and reduces the loss of life and property of the people in the disaster area.

It is possible to obtain Geographic Information System (GIS) data through a networked fixed-wing UAV equipped with an orthographic camera and a photoelectric pod, to achieve rapid data transmission and efficient generation of a three-dimensional map of the earthquake area, providing a basis for rescue decisions.

During the single-soldier system drill, the ground advance team can report key rescue information, send back real-time video and image information, and quickly dispatch rescue personnel and equipment based on the geographic information system data provided by GIS, effectively improving the timeliness and accuracy of emergency rescue information transmission to ensure the precise implementation of emergency rescue operation.

(4) Research Direction of UAV Emergency Communication

Standard-setting is one of the challenges to be solved urgently for UAV emergency communications. China is developing technical requirements for emergency communications of high-altitude base stations based on tethered UAVs. Besides, since the ordinary base stations mainly provide ground coverage, the UAVs need special base stations for aerial coverage; moreover, 5G UAVs now rely on the general 5G CPE (Customer Premise Equipment, which is currently used to convert 5G signals to WiFi signals) for communication, while in the future, dedicated terminals and 5G communication modules are needed to improve the integration and make further improvements in the light of the characteristics of 5G UAVs.

Meanwhile, China has issued a successive series of regulations on UAV production, sales and flight. Regulations concerning the transaction process include *Regulations on the Management of Real-name Registration of Civil*

Unmanned Aircraft, *Interim Regulations on the Management of Unmanned Aircraft Flight* (Draft for Comments) and so on. The difficulties related to flight plan application process, the complicated procedures involved and other issues are expected to be resolved following the establishment of a comprehensive UAV regulatory platform. In terms of corporate operations, the *Management Measures for the Operational Flight Activities of Civilian Unmanned Aircraft* (Interim) has greatly simplified the entry requirements for unmanned aircraft operating licenses, and only retained the basic licensing requirements including corporate legal persons, real-name registered unmanned aircraft, certified training capabilities (for enterprises in training category), and ground third party liability insurance.

A1.2.6 Locally Accessible Cloud System (LACS) (Japan)

<u>(1) Background</u>

Global society faces lots of disasters including the earthquake, typhoon, flooding and others every year. In the case of disaster, social infrastructures like telecommunication networks, electric power distribution networks and transportation systems often suffer damage, and this causes severe damage to the lives of people.

When disasters occur, telecommunication networks may be damaged. Base stations for mobile communication services, access network cables, communication equipment and even communication buildings can be damaged in large-scale disaster. The damages cause the outage of telecommunication services including not only fixed/mobile telephone services, but also Internet services and any other services delivered over the Internet. To address this issue, movable and deployable information and communication technology (ICT) resource units have been proposed and standardized. The objective of the resource units mainly focuses on the restoration of fixed/mobile telephone services. With the popularization of smartphones, people heavily use Internet based services such as social networking, information search, and e-commerce services. The restoration of Internet based services is becoming an important issue for making solutions more feasible in disaster situation nowadays.

The Japanese Government has endorsed research and development projects on disaster management technologies following the Great-East Japan earthquake and tsunami in 2011. As one of the projects related to the above, the Strategic Innovation Program (SIP) in Cabinet Office has conducted several disaster management solutions including Movable and Deployable ICT Resource Units (MDRU), and aims to implement the research and development results throughout society. The MDRU can provide telephone services and file exchange functions by using Wi-Fi and IP-PBX when telecommunication infrastructure is damaged during a disaster. Similar to MDRU, one of the SIP solutions is Locally Accessible Cloud System (LACS), which instantly provides Internet-based service functions within local areas in the case of disaster.

SIP aims to implement research results throughout society, and the LACS feasibility study project was held in the Philippines in December 2019. The project examined the use of LACS for e-education and e-health in island areas.

<u>(2) Introduction of Locally Accessible Cloud System (LACS)</u>

As a countermeasure for the outage of telecommunication services, especially Internet-based services, in disaster situations, a portable and local networking system was developed as one type of SIP. The system called Locally Accessible Cloud System, LACS, is comprised of a Wi-Fi access point, a small PC server, a battery and other peripheral devices. These components are assembled in a portable carry case so that it can be carried to disaster affected areas easily. The server acts as a web server and offers basic communication functions demanded in disaster situations. LACS offers basic communication functions including information broadcasting, information sharing, and bi-directional communication among users, although service delivery is restricted to small areas, namely, the surrounding area of the LACS. LACS can handle demand for local communication that is generally a major demand for communication services. Users access the service using his/her network device like a smartphone over Wi-Fi. They are able to deliver and collect information and to communicate with people in local areas like family members, friends and neighbours through LACS. With LACS, users can use large size contents in the form of text, voice, moving pictures, and still images. LACS is able to collaborate with other systems like a system for disaster countermeasures on the Internet once the access to the Internet from the LACS is restored.

Figure 1 shows the outlook of the LACS system developed as a pilot product. The product is structured by integrating a LACS server, a Wi-Fi access point, a battery and peripheral devices in an orange carry case.

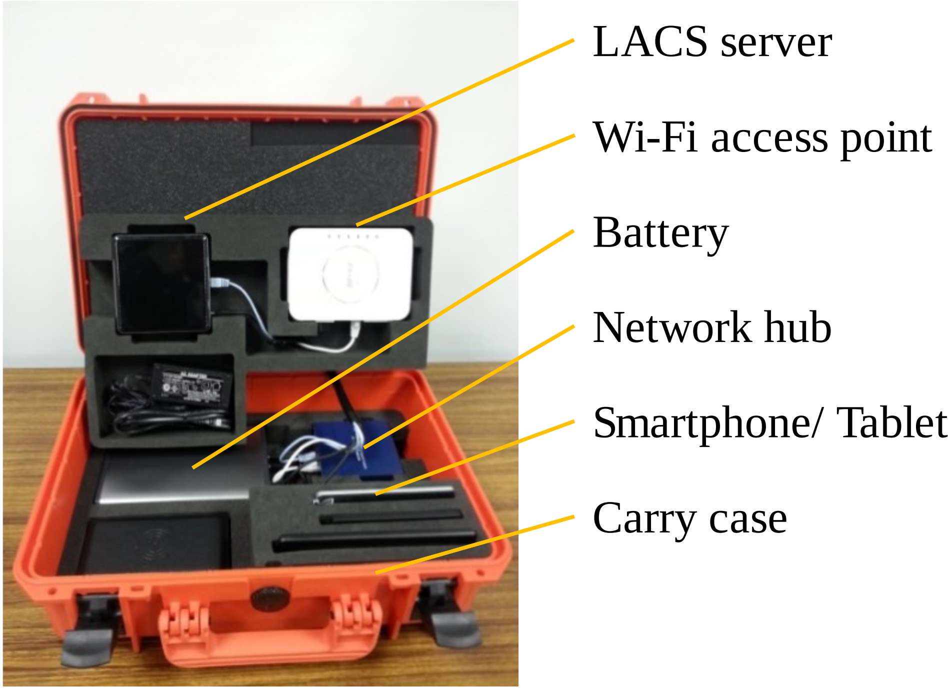


Figure A1- 2 Outlook of LACS pilot product

A user can access the top page of the LACS server over the web browser, as shown in Figure 2. By tapping the icons under the top page, users can access the functions the system offers. The pilot product offers three basic functions: “Important notice” function acts as a tool for delivery of important information from authorized organizations like local governments and hospitals; “Bulletin board” function is used for sharing information among users of LACS; and “Messaging” function enables users to exchange messages, still images and videos between users like friends, family members. The “Registration” is a management function for user registration to the LACS system. Users who upload information to the important notice and/or bulletin board or who use messaging functions are required to register themselves to the system to be identified in the system.

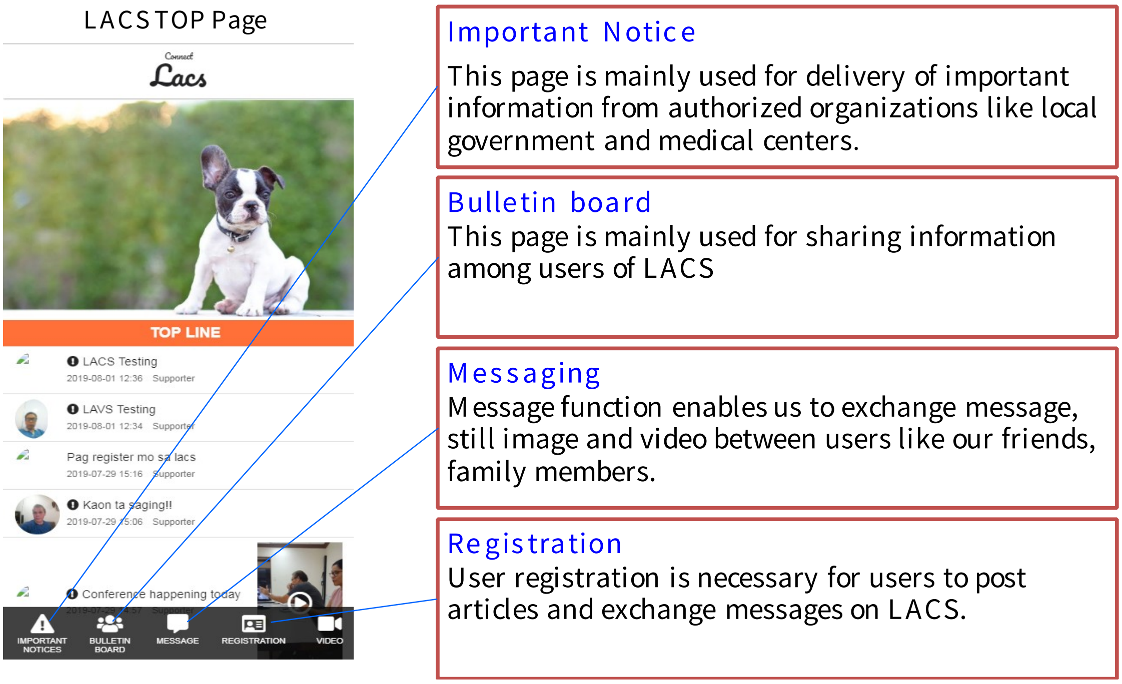


Figure A1- 3 Basic functions provided by LACS

(3) Case study in Philippines

LACS is not only a solution for implementing countermeasures for communication difficulties in disaster situations, but can also be used during ordinary, non-disaster situations. Expected users of the system are relief workers in disaster situations like government, police and hospital staff, as well as citizens in disaster areas, and people in developing countries. LACS is expected to possibly play an important role in developing countries where the networking infrastructure is not sufficient.

In order to confirm the feasibility of the LACS concept, an experiment was conducted in the Philippines, with the cooperation of the Cordova municipality in Cebu, located in the central part of the Philippines. Figure 3 shows the place and experimental setup for the LACS feasibility study. In the Cordova municipal office, a LACS server and Wi-Fi access point equipment were installed to form a locally accessible cloud environment. The local area was extended to the fire station which was 100 metres away from the municipal office by using point-to-point fixed wireless access equipment and a Wi-Fi access point installed in the fire station.

The LACS field experiment was conducted for both the community residents of Barangay Poblacion, a part of the Cordova municipality, and students of Cordova Public College. In the first experiment, as a demonstration of e-education, students downloaded an educational video file from LACS using its file sharing function to their smartphones, and then watched the video using their smartphone and uploaded their comments to the LACS bulletin board so that their teacher could check their comments later. In the next experiment, as a simulation of a disaster, residents of Barangay Poblacion were asked to use the LACS bulletin board to take pictures of supposed disaster areas and upload them back to the LACS server, so that officials in municipal offices could confirm the status of disaster areas by checking the pictures in the LACS bulletin board. As a healthcare demonstration of e-health, selected residents consulted medical professionals for health consultation using LACS's video communication function.

The participants of the experiment, the number of which reached 32, were asked to evaluate the LACS system. The results indicated 100% of the participants valued LACS usefulness during both disaster and non-disaster times. Another evaluation showed 99% of participants found LACS easy to use.

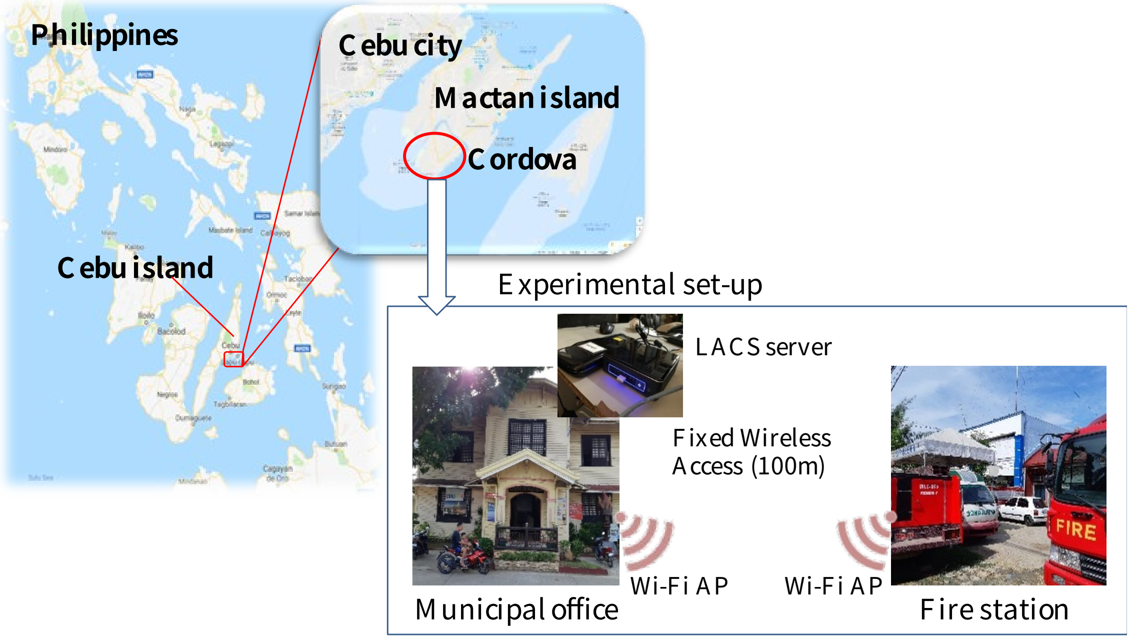


Figure A1- 4 Experimental setup constructed in Cordova, Cebu.

A1.2.7 Balloon-enabled preparedness and emergency telecommunications solutions (Loon LLC, United States of America)

(1) Overview

The network of high-altitude balloons is designed to deliver stratospheric Internet connectivity to unserved and under-served communities around the world. The network aims to connect people everywhere by inventing and integrating new and emerging technologies and concepts.

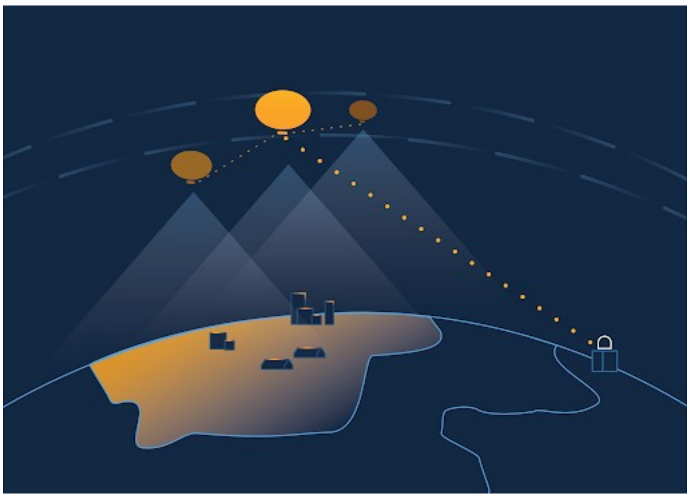


Figure A1- 5 Illustration of stratospheric Internet delivery

Loon is a network of high-altitude balloons flying in the stratosphere that provide Internet access to unconnected and underserved populations. Each balloon carries a payload with a long-term evolution (LTE) base station connecting users to the network of the local mobile operator. With the advantage of height, one balloon can transmit service over an area 20-30 times greater than a traditional ground-based system. Unlike cell-on-wheels or satellite technologies, each balloon can connect directly to LTE/4G smartphones, including remote and hard-to-serve areas (including islands, mountains, jungles). The network (including mesh links between balloons) operates above the ground weather and is therefore weather resilient, with independent solar power for each balloon, minimal ground logistics, and can be deployed quickly when infrastructure and network integration is prepared ahead of a crisis and the vehicles are properly positioned.

The most effective communications system is one that can expediently provide basic Internet connectivity to the public and emergency response providers after natural disasters, and offer disaster preparedness service to mobile network operators to quickly reconnect people on the ground. Therefore, preparedness and related training activities are the most effective ways to be ready for disasters, natural or man-made.

It is imperative to work in close partnership with local aviation and telecommunications authorities, and partnering with a local mobile network operator(s), to ensure integration with existing network equipment before disaster strikes. On regulatory matters, we work with the local partner(s) to obtain all necessary approvals for spectrum use, aviation overflights, and other operating requirements. With the local carrier partner, we will pre-install ground equipment in-country or in the region, preposition fleet resources, and perform network integration and testing with the telecom partner.

(3) Disaster Preparedness Service Description

Loon develops extensive experience in preparedness planning, recovery communications operations, as well as developing a robust set of tools to assist in non-disaster communications. In collaboration with local mobile network operators, regulators, and other stakeholders, the service involves three phases: (Phase 1) initial set-up and integration; (Phase 2) ongoing “stand-by” operations; and (Phase 3) emergency service activation.

(3.1) Phase 1: Set-up - In the initial integration phase, we will work to:

- Coordinate regional ground station certification with regulators
- Complete assessment of installation, operation and maintenance considering geographic diversity
- Work with local cable operators to secure reliable, high-speed internet protocol (IP) connectivity from the ground station locations to the Loon evolved packet core (EPC)
- Integrate the balloon-based network and Loon EPC components with a local mobile operator, IP exchange (IPX) provider, or through a Telecom Roaming Sponsor
- Work with mobile network operator and local telecom authority to secure authorization for Loon-compatible LTE spectrum bands (e.g., Band 28), and authorization for millimeter wave (mmWave) spectrum for backhaul and balloon-to-balloon links (E-band, 71-76 GHz and 81-86 GHz)
- Conduct end-to-end ground to balloon to LTE user testing

- Secure overflight approvals from local aviation authorities to operate the balloons over each country

(3.2) Phase 2: Stand-by - After integration, we will prepare the fleet and network for expedient emergency response by performing the following activities, including:

- Monitor weather patterns, providing guidance for locations where telecom networks may be impacted by weather
- Pre-position a balloon fleet to expediently navigate to impacted areas, with expected time to destination 24/7 air traffic and radio coordination

(3.3) Phase 3: Service Activation - In the event of an emergency, we will:

- Make reasonable, best efforts to provide a balloon-based LTE radio access network for local operator subscribers at designated locations and times. This may be impacted by the severity of the disaster, other location factors, weather, and coordination with the local carrier partner.
- Customize each coverage area's network availability capacity by monitoring demand levels and areas of determined need
- Coordinate with carrier partners to provide network outage reporting as required or needed to regulatory agencies

<u>(4) Regulatory Requirements to Enable the Stratospheric Internet</u>

Meeting regulatory mandates is critical for successful deployment of stratospheric Internet for preparedness and emergency communications.

(4.1) **Equipment homologation**: The ground station equipment is certified to national regulatory requirements before use. This includes equipment type approval, electromagnetic compatibility, safety, and demonstrating equipment has met national radio spectrum requirements.

(4.2) **Streamlined import process:** Ground stations, which are compact systems measuring 1.3 meter diameter with a height of 1.6 meters, connect the mmWave backhaul service to the LTE service. Typically, two ground stations are deployed to cover a service area with options for both roof and tower mounting. The number of ground stations are dependent on the geography, the local carrier partner's network, and the area needing to be covered.

(4.3) **Spectrum authorizations, both for mmWave and LTE**: There are two spectrum bands being used to enable Loon technology. The first is mmWave spectrum in the E-band (71-76 GHz/81-86 GHz) that is used between the balloons, and with the ground station, to provide backhaul service. The second access spectrum is the local operator partner's LTE spectrum to provide connectivity between the balloons and the user equipment.

Enabling us to use E-band for backhaul is a critical piece for providing the stratospheric internet. The E-Band is 71-76 GHz up link, paired with 81-86 GHz downlink. A channel bandwidth of 750 MHz is used to ensure sufficient capacity of the system. We also use two frequency pairs per site, with center frequencies of 71,500 MHz / 81,500 MHz and 74,000 MHz / 84,000 MHz). The backhaul service is integrated into the local carrier partner's network.

To transmit the LTE spectrum, the local carrier partner will identify spectrum bands between 700 and 900 MHz. We ensure that our technology will meet any national licensing requirements. Regulatory bodies should be aware that we work with local agencies and do testing with the local carrier to ensure there are no interference issues that could disrupt other services within a country.

(4.4) Cross-border coordination: The technology can geofence areas to mitigate interference. The Loon carrier partner also has done previous work and achieved regulatory approvals to operate in an area under its licensing terms.

(4.5) Other non-telecommunications regulatory considerations:

- Overflight authorizations: The balloons require overflight authority from each country's civil aviation authority that the balloons may fly over.
- Business registration: we are not a direct customer facing entity; the local mobile operator still represents the service and handles all billing and related customer-facing operations.

(5) Recommendations/Lessons Learned

To enable our stratospheric Internet, the following recommendations should be considered to allow innovative solutions like these to occur.

(5.1) Consider an overall spectrum strategy, including mmWave and 5G applications

- Members States are encouraged to consider spectrum licensing in a larger context of technology evolution and what applications they would like to enable. We are using E-Band spectrum for backhaul services because it has wide channels to enable long range, very targeted communications between directional antennas. Member States have different ways of licensing E-band, from license exempt, to self-coordinated, to flexible licensing. In the United States, there is a "flexible licensing" scheme for E-Band that allows for innovative uses of mmWave spectrum. Flexible licensing still requires that users seek licensing from the Federal Communications Commission, that entails coordination across the Government and registering individual links in a third-party database. This transparency also allows for efficient and innovative use of the spectrum to spur competition in the industry.
- In countries like the United States, having a database of spectrum license holders has assisted in understanding the market potential and ways to use spectrum more efficiently. Member States should also consider ways to assess their spectrum assets and make spectrum holdings and usage transparent to enable future thinking about how to use spectrum more efficiently, particularly as new technologies are developed and deployed.
- A complementary strategy to enable innovation is to consider how experimental licenses would allow for proof of concept ideas to move to commercialization. In many cases, companies apply for an experimental license to test technologies over the airwaves, but after the license expires, there is no clear regulatory path to be able to transition to a commercial license.

(5.2) Streamline homologation procedures and timeframes

- Support innovative technologies by developing streamlined national or regional processes to certify equipment that can be used to supply preparedness or emergency communications services. These requirements should be made publicly available such as on the regulator's website.
- In most cases, it mighe be possible to utilize the supplier's declaration of conformity (SDOC) to show that our equipment meets a country's technical specifications. If a country does not allow for SDOC, countries and regions

should consider developing a common set of homologation requirements for emergency communications equipment to facilitate speed and availability.

(5.3) Streamline equipment import processes

Countries could support innovative technologies by making it easier for local providers to partner with companies like Loon to deliver services. While a country may have emergency procedures to allow the import of equipment to provide communications in times of disaster, the focus on preparedness means that equipment procedures should be predictable and timely.

(5.4) Encourage cross-border coordination for innovative services

It may take very seriously the ability to protect communications services from interference. Countries can encourage all carriers to coordinate in a timely and effective manner to effectively operate systems that serve communities in times of need. This may include network management opportunities like using facilities across borders, as long as it is compliant with related telecommunications regulations.

(5.5) Partner with civil aviation authorities to approve overflight authorizations

In most countries, overflight authorization is approved by the national civil aviation authority. To ensure that aerial connectivity solutions are available during and after emergencies, Telecommunications Regulators should work collaboratively with civil aviation authorities to support necessary overflight authorizations.

A1.3. Early Warning and Alerting Systems

A1.3.1 Common alert protocol based Earth Quake Early Warning system in North Region of India (India)

(1) Disaster management framework in India

India, due to its unique geo-climatic and socio-economic conditions, has been vulnerable in varying degrees, to various disasters like floods, droughts, cyclones, tsunamis, earthquakes, landslides, and forest fire. Out of 35 States and Union Territories (UTs) in the country, 27 are disaster prone. Almost 58.6% landmass is prone to earthquakes of moderate to very high intensity; 12% land is prone to flood and river erosion; out of 7,516 km coast line, 5,700 km is prone to cyclones and tsunamis; 68% of the cultivable land is vulnerable to drought and hilly areas are at risk from landslides and avalanches. Fire incidents, industrial accidents and other manmade disasters involving chemical, biological and radioactive materials are additional hazards, which have underscored the need for strengthening mitigation, preparedness and response measures.

(1.1) National policy on disaster management

In pursuance of Disaster Management Act, 2005, the National Policy on Disaster Management (NPDM) has been issued. It envisages building a safe and disaster resilient India by developing a holistic, proactive, multi-disaster oriented and technology driven strategy through a culture of prevention, mitigation, preparedness and response.

Detailed India National framework on disaster management is as per Annex 1.

Earthquake: Earthquakes produce vibrations known as seismic waves which travel in all directions through the earth. They carry the huge energy released during an earthquake. The three types of waves are the:

i. P-waves compress and expand the ground like an accordion, travels through solids and liquids, fast moving and longitudinal.

ii. S-waves vibrate from side-to-side as well as up and down, travel through solids only, slow moving and transverse.

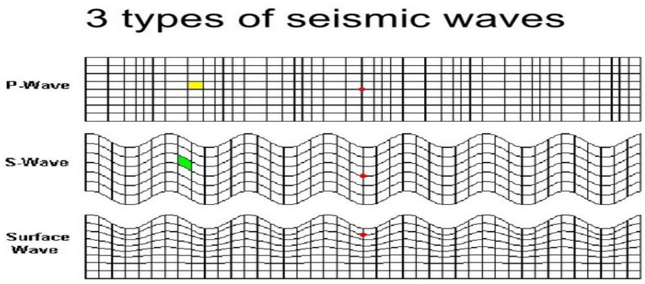


Figure A1- 6 Types of seismic waves

iii. Surface waves move up and down like ocean waves, slowest travelling, movement greatest at earth's surface and least beneath the surface. Manmade disaster stem from human negligence, chemical/oil spills, ground water contamination, fire in work places, non-adherence of safety norms during construction, war, transport accidents, nuclear radiation, industrial accidents, etc., resulting in huge loss of life, property, environment and severe setback to the economy.

(2.1) Earthquake Early Warning (EEW) system

During an earthquake, seismic waves radiate from the epicenter. It is these waves we feel as earthquake shaking and cause damage to structures. The technology exists to detect moderate to large earthquakes so quickly that a warning can be sent to locations outside the area where the earthquake begins before these destructive waves arrive. Data from a single station or from a network of stations form the basis of earthquake early warning. In a "single station" warning system, data is not sent to a central processing site. The single station alert is more prone to false alarms. Using a combination of alerts from single stations and a regional seismic network, the accuracy warning time are enhanced. The on-site and regional warning alerts are combined in the CISN Shake Alert demonstration system for the desired performance during a moderate to large earthquake. The future of earthquake early warning systems may be contained in smart phones and vehicles, and "smart" appliances and the increasing number of everyday objects embedded with sensors and communication chips that connect them with a global network.

Single-station approach: A single sensor located at the site to be protected detects the arrival of the P-wave and warns before the arrival of the S-wave. This method though simple, is less accurate and gives rise to false alerts as well as less warning time.

Network approach: Many seismic sensors distributed over a wide area where earthquakes are likely to occur are networked. A central site receives the data from these sensors; analyses ground motion signals, detects earthquakes and issues suitable warnings. The system maintains a higher level of readiness all the time and is more accurate in predicting the quakes. Earthquake Early warning (EEW) would be most effective in a case where the earthquake begins on a fault far from your location and the rupture propagates toward your location. EEW messages are being sent quickly to all public with the help of every available ICT and IoT technology. The public is periodically educated through various messages and tutorials on how to understand and respond during the alerts.

EEW alerts warn people to take protective action and also triggers automatic responses in places like factories, dams and transit systems. EEW examples include: transportation, utilities, offices, industrial, medical, restaurants, schools, cars and trucks, and emergencies.

(2.2) Common Alerting Protocol (CAP) based Earthquake Early Warning (EEW) system

ITU-T X.1303 Common Alerting Protocol has common standard oriented platform instead of separate public warning system for each particular type of Emergency and for each particular Communications medium. Common Alerting Protocol (CAP) is an XML-based data format for exchanging public warnings and emergencies between alerting technologies. CAP allows a warning message to be consistently disseminated simultaneously over many warning systems to many applications. CAP increases warning effectiveness and simplifies the task of activating a warning for responsible officers/officials. Standardized alerts can be received from many sources and configured for their applications to process and respond to the alerts as desired. By normalizing alert data across threats, jurisdictions and warning systems, CAP can also be used to detect trends and patterns in warning activity or hostile act. From a procedural perspective, CAP reinforces a research based template for effective warning message content and structure.

The CAP data structure is backward-compatible with existing alert formats including the Specific Area Message Encoding (SAME) (the protocol used to encode the Emergency Alert System (EAS) and NOAA Weather Radio (NWR).), the Wireless Emergency Alerts (WEA) etc., while adding capabilities such as the following:

- Flexible geographic targeting by using latitude/longitude “boxes” and other geospatial representations in three dimensions;
- Multilingual and multi-audience messaging;
- Phased and delayed effective times and expirations;
- Enhanced message update and cancellation features;
- Template support for framing complete and effective warning messages;
- Digital encryption and signature capability; and,
- Facility for digital images, audio, and video.

Central and State government agencies can all receive information in the same format for the same type of application that can sound different alarms, based on the information received. CAP also detects trends and patterns in warning activity, such as trends that might indicate an undetected hazard or hostile act. From a procedural perspective, CAP reinforces a research-based template for effective warning message content and structure. International organizations such as United Nations Development Programme (UNDP), International Telecommunication Union (ITU), and the World Meteorological Organization (WMO), among others, are urging nations to implement the CAP as an essential communications formatting step as countries address this worldwide challenge.

Principle idea of EEW: Velocity of electo-magnetic waves >>> Velocity of seismic waves Seismograph, Propagation of seismic waves (s-waves), Propagation of seismic waves (p-waves), instantaneous data transmission, e-warning-broadcast to public as depicted in figure 2a and 2b.

(2.3) EEW for Northern India

In seismic gap of Indian Himalayas, there is possibility of frequent large sized earthquake which can rock several cities of India (including Delhi) and several industrial hubs having large population density at 100 to 300 km from this region with a lead time of 25 to 80 seconds available at these places. Thus EEW is very useful for Northern India. More than 100 sensors are deployed in Himalayas to cater to the need of earthquake early warning system to the cities of Northern India for event detection and location identification, estimation of magnitude and issue of alert notification.

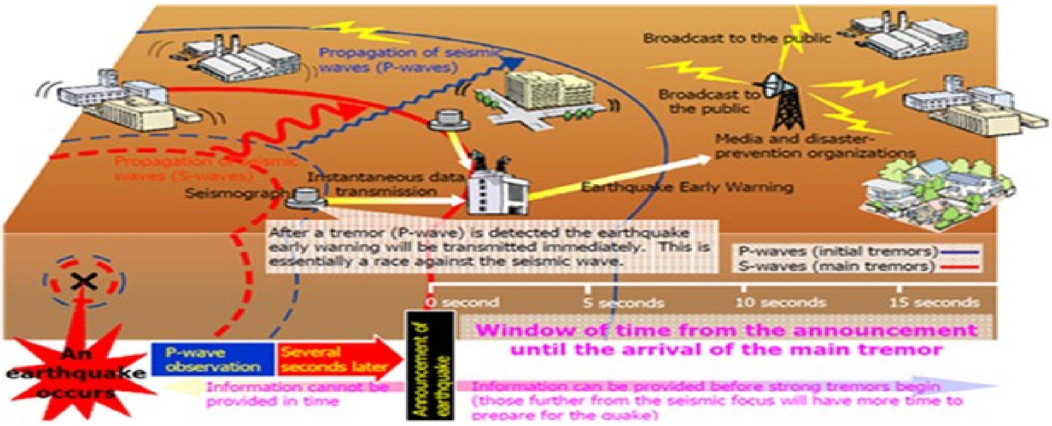


Figure A1- 7 Earthquake Early Warning (EEW) systems

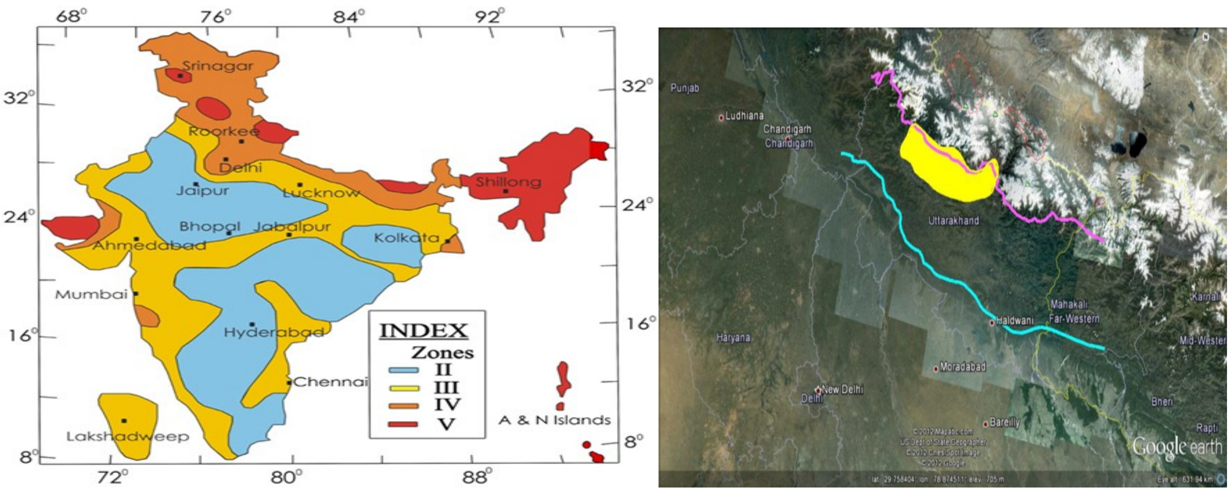


Figure A1- 8 Earthquake Early Warning for Northern India. About 100 sensors have been deployed in Himalayas to respond to the need for EEW systems in cities of Northern India

(2.4) Common Alerting System based on Common Alerting Protocol comprises

i) Information sharing by alerting agencies such as Indian Metrological Departments, Geological Survey of India, Central Water Commission, Ministry of Home Affairs, Indian National Centre for Ocean Information services. Information in the same format can be received by all Central and State Government Agencies and that can sound different alarms, based on the information received.

ii) Alert forwarding media agencies: telecom operators, all India radio and other radio stations, Doordarshan or other television broadcasting agencies, National Highway Authority of India for Road Site display), internet and other related organizations. Citizens need to get the warning alerts of earthquake, cyclones, and heavy rain floods in advance.

Figure A1- 9 Common alerting media agencies

iii) Management Platform for Collection (CAP Compliant input Message in XML/JSON format through web portal/mobile app/SMS in standard message format from alerting agencies), Processing (SMS/Email Notification being sent to the First level Alert Generating Authority i.e. NDMA), Storing (BTS data is stored), Transmission, control (for state/regional Level Warning Issuing Authority and feedback (Response from) evaluation of warning alerts.

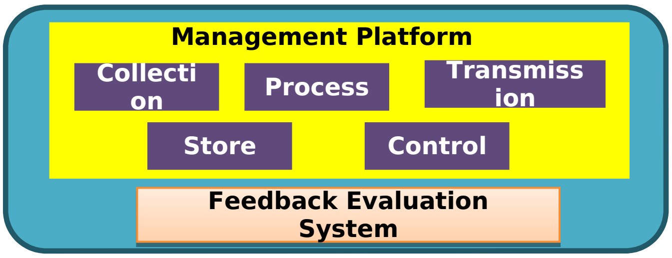


Figure A1- 10 Management platform

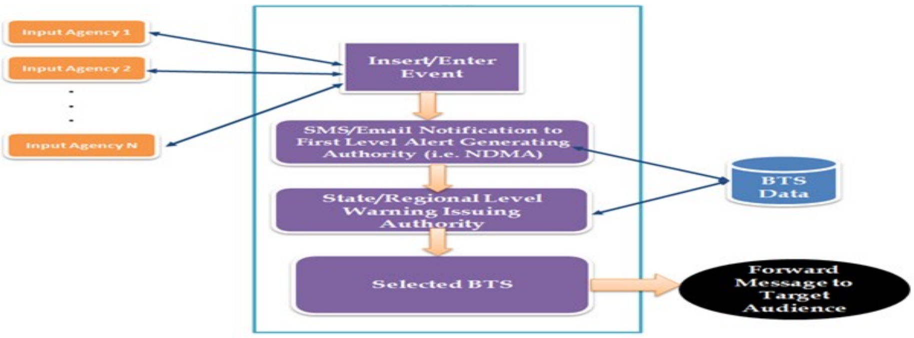


Figure A1- 11 Management platform

Static Disaster Management Software Platform frame work has been integrated with nationwide Network and provisioned for integration with NDMA. Disaster areas have also been identified with Geo fencing. Manual alarm have been pushed with 2 tier approach to nationwide Telecom Network to send SMSs automatically to marked areas.

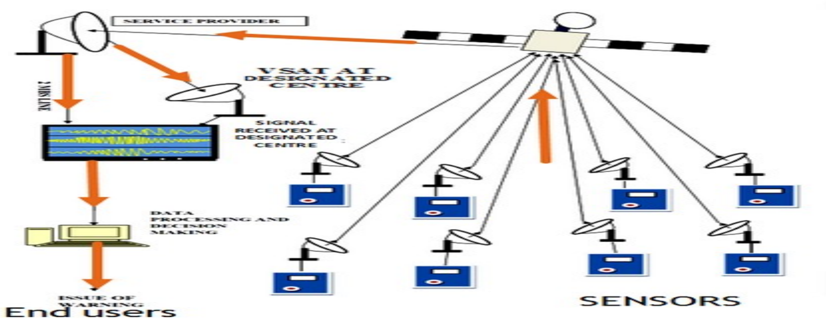


Figure A1- 12 Common alerting system – Flow of information

Along the arrow: Sensors Signals Receiving at designated centre, data processing and issue of warning to end user.

A1.3.2 Implementing a trial of a Common Alerting Protocol (CAP) (India)

(1) Common Alerting Protocol (CAP) and its use in Early-Warning Systems

ITU-T X.1303 Common Alerting Protocol (CAP) has common standard oriented platform instead of separate public warning system for each particular type of emergency and for each particular communications medium.

The trials on usage of CAP for EWS are continuously being carried out in India. The document X.1303 provides a detailed description on different features of the CAP, however the contextual features have been summarised below:

- CAP allows a warning message to be consistently disseminated simultaneously over many warning systems;
- Standardized alerts can be received from many sources and configured for their applications to process and respond to the alerts as desired;
- Flexible geography targeting by using latitude/longitude box(es) or polygon(s) or circle(s) and other geospatial representations in three dimensions;
- Facility for digital images, audios and videos.

International organisations such as the United Nations Development Programme (UNDP), the International Telecommunication Union (ITU) and the World Meteorological Organisation (WMO) among others are urging nations to implement the CAP as an essential communications formatting step as countries address this worldwide challenge.

(2) Recent trial run of implementation of CAP carried in India

The conceptual block diagram of using CAP in various trial runs in different states in India is given in Figure 1:

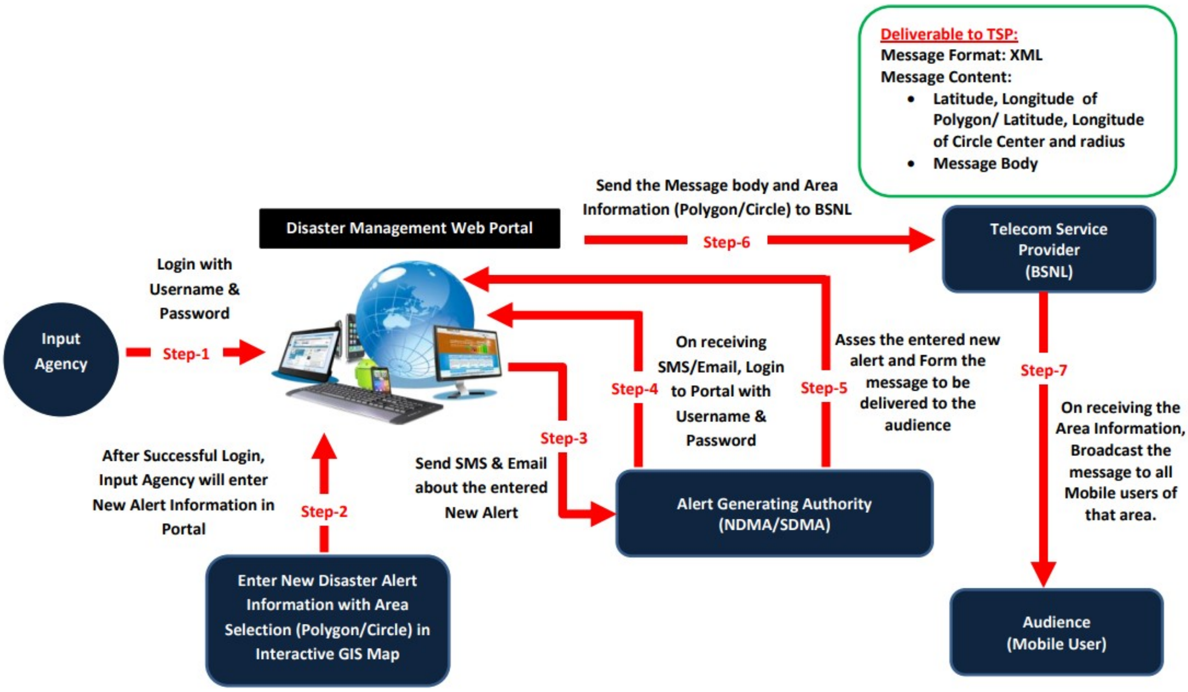


Figure A1- 13 Workflow of use of CAP for EWS during trial run

The trials on the CAP in India are being run through the portal developed by the Centre for Development of Telematics (C-DoT), a government-owned telecom R&D centre.

The access of the portal has been extended to alerting agencies, the National Disaster Management Authority (NDMA), the State Disaster Management Authorities (SDMAs) of different states (provinces) in India, the State Governments and the Department of Telecommunications. The portal is presently connected to TSPs through the Internet or MPLS-VPN so that the required alert may be passed on to the users of telecom services. The customers are identified through the CDR (last six hours) or attached VLR in the network and the warning SMSs are sent to these customers. Additionally, the SMSs are also being sent through cell broadcast from the base stations lying in the identified polygons.

Summary of the trial runs carried out using CAP is given in Table 1:

Table A1- 1 Trial runs carried out using CAP

Date	**Area selected**	**Number of recipients**
07-06-2018	Small area of Marina Beach Chennai	5181
08-06-2018	Nungembakkam, Chennai	2768
08-06-2018	Idduki, Kerala	883

Date	Area selected	Number of recipients
13-06-2018	Vijaywada, Andhra Pradesh	4125
13-06-2018	Begumpet Airport, Hyderabad	3796
14-06-2018	Dehradun, Uttarakhand	1386
18-06-2018	Civil Secretariat Srinagar and Amarnath Yatra Route	1001
20-06-2018	Secretariat, Dispur, Assam	2295
29-06-2018	Bhopal, Madhya Pradesh	4474
03-07-2018	Guwahati, Assam	7252
25-07-2018	Dharamshala, Nahan, Reckon Peo, Chota Shimla, Himachal Pradesh	56772

Telecom Service Providers involved in trial run: BSNL, Airtel, Reliance Jio

Agencies involved in trial run: NDMA; SDMAs of Tamil Nadu, Kerala, Andhra Pradesh, Uttarakhand, Jammu and Kashmir, Assam, Madhya Pradesh and Himachal Pradesh; Indian Meteorological Department (IMD); State Governments; Department of Telecommunications; C-DoT.

During Amarnath Yatra, a total of 200,399 SMSs were delivered in six different events between 28.06.2018 and 25.07.2018 to the customers of BSNL and Reliance Jio through C-DoT CAP-early-warning platform informing the condition of weather so that the pilgrims and the government authorities may timely take suitable and necessary precautionary action. These messages were also delivered to all the Airtel customers using cell broadcast.

<u>(3) Conclusion: experience gained and way forward</u>

The activities carried out during the trial run as mentioned in the previous section have been carried out in two ways: firstly, experimental and secondly, on actual run. The following are the observations:

- During the actual run of EWS using CAP at the time of Amarnath Yatra, there was a very good and motivating response from the Government Authorities, agencies and pilgrims suggesting for the regular deployment of this system for future needs.
- It was observed that sending SMS from the mobile networks using 2G /3G takes considerably longer time (20 minutes to 60 minutes) as compared to the 4G networks which took 3 to 5 minutes.

- Efforts are being made for optimization of the above response time especially in 2G (as it prominently covers the rural areas) than for 3G network which is gradually being replaced by 4G network.
- Smartphones have feature of clubbing of message parts in case the size of the message exceeds the prescribed limit. However, the normal feature phones don't have this facility. Efforts are being made to overcome the issue.
- The trial runs have been carried out for the messages only in English language. Efforts are being made to introduce vernacular language for better and effective reach to the masses.

A1.3.3 ICT disaster preparedness (China Telecommunications Corporation, People's Republic of China)

<u>(1) Disaster preparedness</u>

Publishing early warning information: before the occurrence of disasters, it is necessary to have the ability and means to publish disaster warning information. When necessary, the warning against imminent danger should quickly reach every customer in the designated area within 10 minutes.

Making suggestions on the LTE SMS cell broadcasting network, terminal support and deployment, researching the specifications and requirements already in place and deployed on both network and terminal sides of the LTE SMS medium and small cell broadcasting, and putting forward relevant requirements in network planning and construction.Sending disaster early warning information to users through various means of just-in-time mobile Internet communication (such as WeChat, etc.). The operators' networks interconnected with related just-in-time mobile Internet communication systems promptly send early warning information via the Internet just-in-time Internet communication systems.

Carrying out multiple optical cable route deployment, formulating plans to transform the optical fibre cable lines along single route or vulnerable routes in the light of the damages sustained in recent years. Employing in emergency communication repairs optical fibre cable fast recovery technology such as the erbium-doped fibre amplifiers.

Satellite transmission: the scenarios and recommendations regarding the application of Ka high throughput satellites, Ku, C band satellites, various middle and low orbit satellites in emergency communications. Using Ka high throughput broadband satellites to provide 4G services to mobile emergency communication vehicles, islands and remote base stations, and engaging in research of using Ku, C band satellites for HD video transmission and low orbit satellites for satellite IoT.

Miniaturization and portability of VSAT devices as well as the scenarios and suggestions concerning their application in emergency communications. Keeping track of the development of miniaturized and portable VSAT devices in various frequency bands and making it possible for a single person to carry the devices on foot to the disaster areas to open up services.

The application scenarios and recommendations regarding short wave transmission in emergency communications. Studying the application of short wave in emergency communications on account of its long transmission distance and strong damage resistant characteristics.

Deployment and test of 4G/5G in emergency communication vehicles. Researching the deployment of 4G equipment and the application of some 5G technologies in emergency communication vehicles. The application of spherical antennas and various new antennas in emergency communication resulted in a multi-fold increase in capacity or directional transmission distance to adapt to the inauguration of 2G/4G emergency communication services under different circumstances. Research was also conducted on the emergency communication vehicle-supported IoT applications, namely deploying NB-IOT equipment in emergency communication vehicles to support IoT applications.

Studying the use of various satellite telephones and the application of satellite telephone positioning, data and SMS in emergency communications. The positioning information return, data service and SMS functions of satellite telephone are used to position and rescue people and vehicles in distress beyond mobile signal coverage.

Researching unmanned aerial vehicle (UAV)-borne base stations and the results of application scenario study, testing and field operation of tethered UAVs, wingspan UAVs, airships, helicopter-borne LTE base stations and other equipment in emergency communications. In the research of providing 4G services with the LTE base stations on board tethered UAVs, the wireless ad hoc network devices (MESH) carried by tethered UAVs were used in the study of applying transmission relay to provide fixed and vehicle-borne base station services that are able to recover the damaged transmission and promptly access current networks to deliver 4G services during disaster. The LTE base station satellite transmission or microwave equipment on board stratospheric airships is able to connect with the current networks to offer 4G services to remote areas.

The wireless ad hoc network (MESH) devices enable an application scenario of quickly opening up the last 10 kilometers. Researching the use of MESH technology to rapidly re-establish network connection damaged by disaster and the joint employment of MESH and UAV to commence 4G service offering.

Studying the specifications of emergency command and dispatch system based on "Internet + emergency communication", with the system applied in vehicle positioning, disaster warning, resource scheduling, command and dispatch, task management and so on. The emergency vehicle location and tracking function, through the information on real-time vehicle location monitoring and control, vehicle status, etc., mobilizes as necessary vehicles and personnel in the vicinity to participate in disaster relief efforts. Based on the specific information concerning wind, rain, haze and other weather disasters as well as typhoons and earthquakes collected from professional Internet websites at high frequencies, the system is able to display the disaster information on the GIS map at different levels, providing in advance the personnel in the affected areas with targeted early warning information. Flat, streamlined and close-looped, the emergency task command has put in place the process monitoring to keep track of the task execution. With the implementation of vehicle/personnel location and tracking as well as the adoption of command and dispatch visualization, the system takes overall responsibility of managing emergency personnel, vehicles, equipment/supplies, spare parts, circuits, satellite bandwidth and so on, thus achieving intensive emergency resource management and optimization of resource allocation, dynamic tracking of resource distribution, fully controlled and visualized resource allocation process and whole process management of equipment and other resources.

Conducting the research of sending the disaster scene video back to the command centre or accessing the video via Internet. By way of satellite, 4G and other means, the video of the disaster site is returned to the command centre or accessed through online terminals, PCs, mobile phones and so on.

Based on the examination and analysis of the quality of video service transmitted by satellite, we have studied the indices of the time delay and jitter of the image transmission.

The storage and allocation of emergency supplies such as generators. Keeping in reserve all kinds of fuel generators, such as 5kW light generators, 10-12kw generators, 30-50kw generator vehicles, and 100-500kw large generator vehicles catered to different application scenarios.

Drills organized on the basis of real emergency situations. Based on real and simulated emergency scenarios, drills of rapid relief team assembly and dispatch at short notice were conducted to launch all kinds of emergency services in designated areas, building a well-trained and skillful relief personnel contingent.

Training: Establishing training requirements for emergency response personnel. Developing for them graded training contents and materials.

Studying the emergency plan preparation. Formulating emergency plans in response to various disaster scenarios, defining the types and focuses of the plans and conducting drills according to the plans. Testing the contingency plans for the command system, circuit scheduling, line repairs, emergency power supply, service launch on board emergency communication vehicles, etc. in the wake of disasters such as earthquake, typhoon, flood, mud slide and others in the totally cut-off areas.

(2) <u>Disaster mitigation</u>

Mitigation of flood disaster: Moving low-lying machine rooms to higher grounds, elevating the generators and other equipment, adopting protective measures for outdoor equipment before rainstorms.

Typhoon: Delivering in advance generators and other emergency materials and equipment to disaster areas.

Building a robust disaster fighting network based on the disaster damage data over the years.

(3) <u>Response</u>

The process of making use of the mobile phone positioning function to rescue trapped people. Selectively calling and positioning mobile users in the disaster areas, sending the relevant information to the rescue team to facilitate relief efforts.

Conducting big data analysis through mobile network related network management and based on customer information, i.e. the analysis of the locations of damage, number of victims and/or damage/impact/repairs, and informing the relevant government agencies of the results for use in disaster relief command.

Following the emergency plan to rapidly recover communication services in disaster-stricken areas.

A1.3.4 Implementation of emergency alerts (Brazil)

<u>(1) Model implemented</u>

In the working group that involved the main stakeholders in the process (regulatory agency, telecommunication operators and civil defense organizations, represented by national and some state bodies), it was decided to prioritize the delivery of alerts to mobile phone consumers, in view of the greater scale, in comparison with pay-TV consumers.

The regulation does not limit the technological possibilities that can be used in emergency situations, and the group understood that the technology of greater reach, considering the terminals used by the Brazilian population, would be the Short Message Service - SMS, for faster implementation and smaller costs, without prejudice to future developments for other technologies such as cell broadcasting.

The first step of the group was the establishment of the process, which can be summarized in Figure 1:

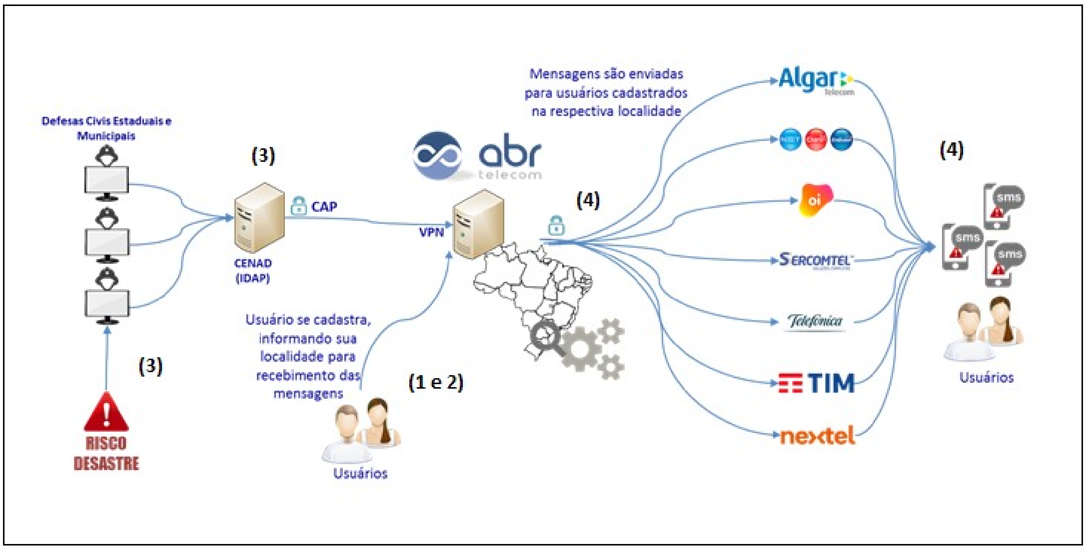


Figure A1- 14 Establishment of the process

As observed, the procedure consists in the identification of the imminence of disaster, mapping of area at risk and the content of the message to be sent. Then, such civil defense organizations access a web portal to record the occurrence and request the delivery of the message. This system platform receives the request and identifies operators in the region at risk, as well as the consumers enabled to receive the messages, which are then triggered by a concentrator agent (ABR) contracted by the operators for such activity (Broker).

The process is divided into 4 major steps:

1) The campaign: inform the population that the alert service will be available in a given region, and make available to the interested parties the option of joining the service.
2) Registration and Emergency Database (BDE): form a database with the cell phones numbers of the citizens interested in being notified, in the case of

issuing alerts by civil defense, related to the ZIP code(s) of the places of interest informed in the registration process.

3) Civil defense alert: determine a region of risk, the period for submission and the text of the alert message to be forwarded.
4) Population´s alert message: the IDAP system and the WEB portal automatically send the registered alerts to the solution, which, with the help of the BDE, will convert the georeferenced polygon into a list of terminals for the alert message (based on the ZIPs contained in that polygon), indicating, also, the respective mobile operator of each user.

Before the national implementation, it was considered important to carry out previous tests on the platform and in the communication protocols between the various civil defense agents and the telecommunications operators.

Thus, the solution has undergone functional tests in 20 (twenty) municipalities of the State of Santa Catarina since 07/Feb/2017 and in 5 (five) municipalities of Paraná since 13/Jun/2017.

As of 16/Oct/2017, the service began to be expanded to all the municipalities of these two states, following the other states according to the schedule below:

Table A1- 2 Schedule

Initial data	State/province/federation unit
16/Oct/17	SC and PR (other municipalities)
16/Nov/17	SP
18/Dec/17	RS, RJ and ES
15/Jan/18	MG, MS and GO
19/Feb/18	DF, MT and TO
19/Mar/18	BA, SE, AL, PE, PB, RN, CE, PI, MA, PA, AP, AC, AM, RO and RR

One of the aspects of great importance in the success of the implementation was the way of disseminating the steps for the population, with the active action of the regulatory agency in informing the schedule and forms of operation to the population, through national and local media. Whenever the service was about to expand to a particular federation unit, the agency reiterated its communication with the local media with impact on the entire population.

The service is free, so messages can be sent and received without credit and without internet access, and only depends on the registration of the citizen with interest in receiving the emergency alerts.

One of the limitations of the project implemented with SMS is the need for prior and active registration of citizens. In order to register the user must respond to the SMS of the civil defense (number 40199), or send the SMS to the civil defense (number 40199), with only the eight-digit ZIP code number, with or without hyphen, with or without a dot.

Figure 2 illustrate the registration and the sending of alerts to citizens:

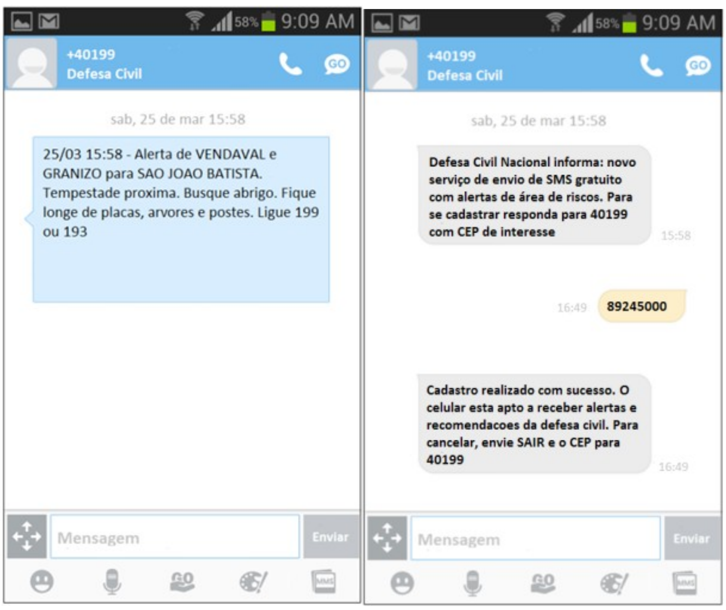


Figure A1- 15 Registration and sending of alerts to citizens

Registration can be done in two ways:

1. When the service is provided in a municipality, the users of that municipality will receive a text message (SMS) of the number 40199 inviting them to register. In this case, the user simply responds to the message with the ZIP code(s) - postal address code - of the regions of their interest. There is no limit to the number of individual ZIP codes per user.
2. If, for any reason, the user does not receive the text message (SMS) informing about the start of the registration phase, he may, at any time, send a text message (SMS) to the number 40199 with the ZIP codes of interest.

In both cases, the user will receive a reply via text message (SMS) indicating if the registration was successful.

(2) Civil defense organizations

From the point-of-view of monitoring and preparing for disasters in Brazil, we have as head of the Ministry of National Integration, which through its National Center for Risk and Disaster Management (CENAD) receives and consolidates information from various federal government bodies responsible for prediction of time and temperature; assessment of geological conditions in hazardous areas; monitoring the movement of tectonic plates; monitoring of river basins; control of forest fires and fires; and transportation and storage of hazardous products.

This information comes from a number of bodies, including the National Center for Natural Disaster Monitoring and Alerting (CEMAD), the Brazilian Geological Survey (CPRM), the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA), the National Agency of Water (ANA), the Brazilian Intelligence Agency (Abin), the Center for Weather Forecasting and Climate Studies (CPTEC/INPE), the National Institute of Meteorology (INMET), the Center for Amazonia (CENSIPAM), the Armed Forces and other organizations of the Federal Executive Branch.

The data are evaluated and processed in the CENAD and forwarded to the Civil Protection and Defense Organizations of the states and municipalities with risk of disasters.

We should also add that Law No. 12,608/2012 established the National System for the Protection of Civil Defense (SINPDEC) and established the various competencies of the union, states and municipalities related to the National Protection and Civil Defense Policy. This creates a trustful ecosystem of public institutions, as well as a set of voluntary initiatives that should integrate the common goal of preventing and mitigating effects of natural disasters.

In disaster situations, the coordinator of the efforts is, in general, the local civil defense, and the others involved must act jointly, demonstrating the need for local bodies to be well structured.

This contribution detailed Brazil’s implementation of emergency alerts using telecommunication services. Brazil suggested that further study also includes contributions or suggestions from Q5/2 participants on the types of early warning systems in use by developing countries, and consider how to provide services to citizens and visitors (international and regional), so that they may receive early warning messages.

A1.3.5 Early warning and the collection of disaster information (NICT, Japan)

(1) Torrential rainfall short-term using phased array weather radar

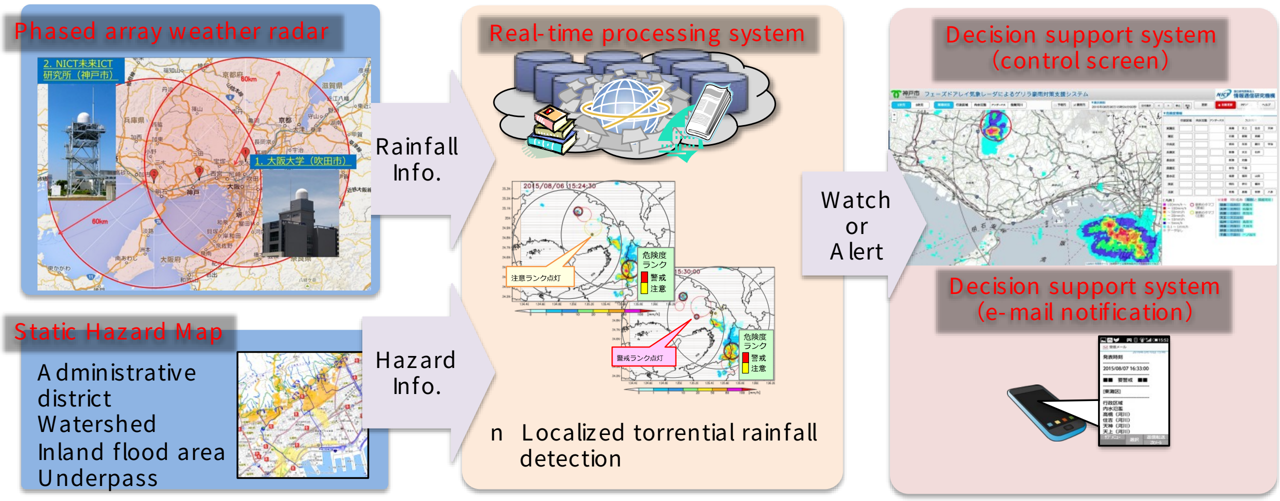


Figure A1- 16 Example of dynamic hazard map by using PAWR

Recently, increase in occurrence of localized torrential rainfall events has been recognized in urban areas in Japan. To prevent damages from this kind of events, NICT developed the Phased Array Weather Radar (PAWR). The PAWR can observe three-dimensional rainfall information (radar reflectivity and Doppler velocity) every 30 seconds. Therefore, the PAWR can detect locally and rapidly developing cumulonimbus in the early stage. NICT also developed the monitoring system of localized torrential rainfall that utilized the early detection algorithm of baby rain cell. Firstly, baby cells are extracted using three-dimensional radar reflectivity. The target area of this system is covered with two PAWR, so it is less susceptible to rain attenuation. Secondly, the vertical vorticity in the baby cell is calculated using the Doppler velocity. Finally, a cell with the vertical vorticity above a threshold value is determined to grow up to heavy rainfall on the ground. For the decision support system, the dynamic hazard map with location-dependent degree-of-risk information is provided by integrating the early detection of baby rain cell in the localized torrential rainfall and the local static hazard map. The dynamic hazard map is displayed on the control screen and the warning information is also distributed by e-mail for a limited number of the authorized staff. Real time demonstration test was conducted in Kobe city from August to October 2016.

The contribution proposed to add texts regarding recent developments in early warning and the collection of disaster information in Japan, which were presented at the panel session on Early Warning Systems held in May 2018.

India asked for clarification on how the system technically works on social networks, and NICT provided clarifications. India further asked if there is any challenge with user privacy with the data collected. NICT clarified that they buy SNS data without any privacy information from a third party.

The Co-Rapporteurs noted the document and encouraged further contributions as these systems evolve.

(2) Disaster information utilization system with SNS

NICT has developed the world's first system, Disaster-information SUMMarizer (D-SUMM), which automatically extracts disaster reports from Social Network Systems (SNS) and organizes, summarizes, and presents the content in a user-friendly way. DISaster information ANAlyzer (DISAANA) outputs the extracted disaster reports as they are (e.g.: "there is an earthquake!" or "we are still having aftershocks!"), but D-SUMM gathers reports that are very similar and summarizes them into one report to present a more compact output. By making summaries of disaster report for each sub-area comprising the specified area (e.g.: local governments in Kumamoto Prefecture if it is specified), this function enables users to quickly understand what is happening where. Multiple categories can also be specified and displayed on a map, and the number of times an item was reported can be displayed, making it easy to have an overview of disaster conditions on the map below.

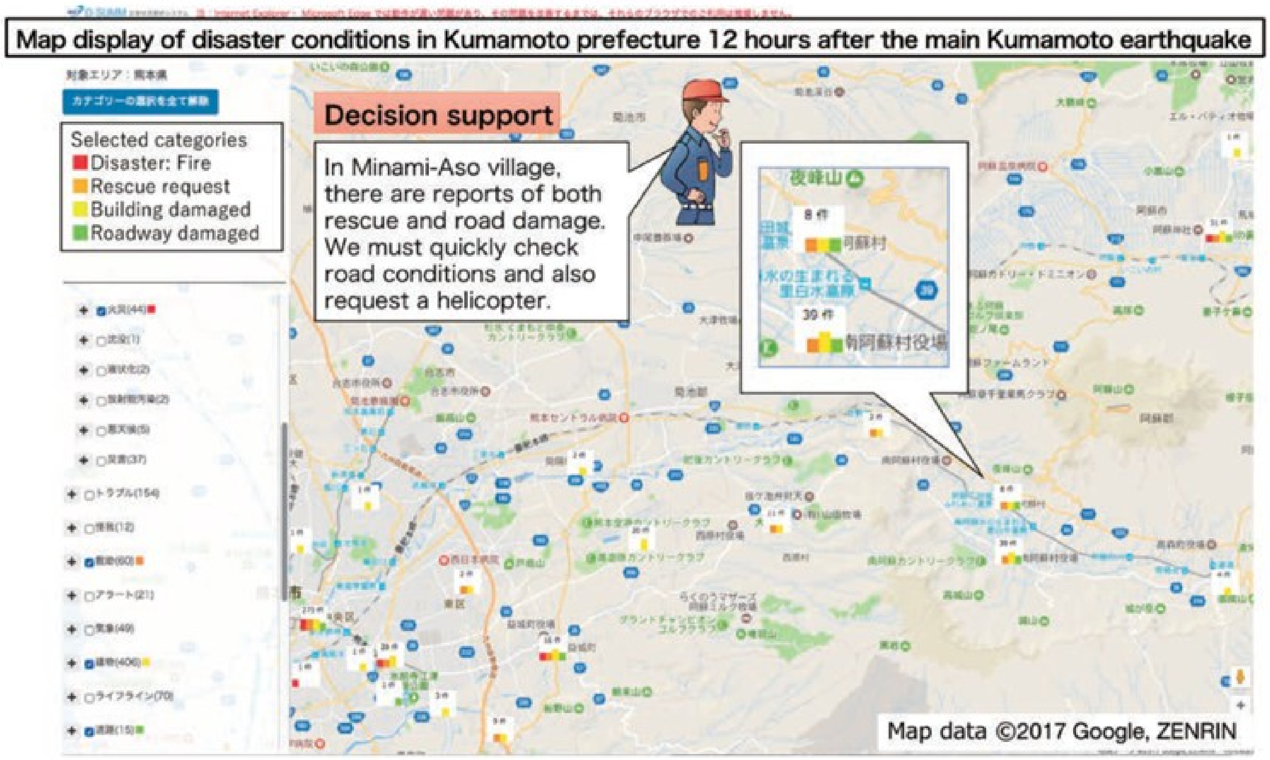


Figure A1- 17 Example of evacuation map generated by D-SUMM

A1.3.6 Advanced early warning technologies (Japan)

(1) Background

In 2000 the Shiojiri municipality started to build the autonomous optical fiber network of 90 km, later a total of 130 km and 75 public facilities in the city are connected by gigabit ether network. The network is interconnected with upper layer service providers. The municipality then established the information and incubation plaza for the purpose of nursing the IT literate population. Low power wireless area network deploying 429MHz frequency spectrum was built with ad-hoc network configuration. 640 distributed wireless repeater stations are powered by solar panels and self-sustained by low cost and efficiently interconnected IoT sensors. The beginning of a decline in the population and birth rate in Japan is a serious social issue. Japan was among the first countries in the world to experience this and in recent years this has been progressing rapidly. In the coming 50 years the age group composition will change further, which is causing great social concern. The effect of such social phenomena is remarkable in rural municipalities of the country. Building a smart society using ICT in such circumstance aims at improving the life of community dwellers and making it easier to live, which could be expected to contribute to suppress the migration of population from rural to urban or even to promote adverse migration from urban to rural. The IoT sensor network is built by the partial government subsidy and Shiojiri promoted development of ICT related device and application software by SMEs and academia (the university, college and technical high school) in the region. Shiojiri has established an incubation plaza where SMEs and the academia gather for collaboration of ICT development. In recent activities for ICT development Shiojiri Municipality invested for the building network of various IoT sensors in every corner of the region to automatically collect the environmental data and exchange the obtained data among concerned organization for the benefits of the community dwellers. For the purpose of independent power grid in the municipality to respond to the demand of individual households and ICT networks of the region, Shiojiri invested for the biomass power plant to supply low cost, eco-friendly and carbon neutral power to the 67000 population of the region. It will contribute to the regional socio-economic development in the forestry, lumbering, related industries and creation of job opportunity. This investment is expected to improve remarkably the quality of life of dwellers in the region for coming years.

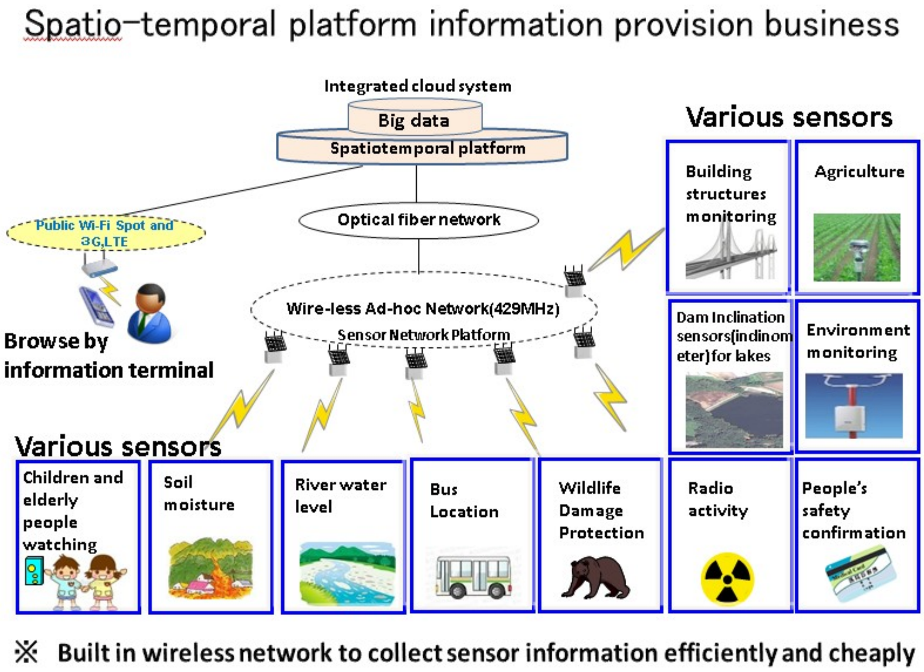


Figure A1- 18 Shiojiri's environmental information data collection platform and its IoT sensor network

a) Children and elderly people watching system

Children going school and back home and elderly people walking outside in the remote community are watched and located for their safety by the sensor network to detect the signal from the active tag with embedded button battery carried by them.

b) Soil moisture sensors

The sensor device detects moisture content of the soil at 20 cm depth increments to predict landslides or mudslides and sends out alert when the moisture level exceeds the threshold or send out safety announce when the level go down the threshold.

c) River water level sensors

The sensor device measures the water level of lakes and rivers and sends out alert when the water level exceeds the threshold to let the community people evacuate to the shelter before the floods or the debris flows.

d) Bus location sensors

The sensors inform users of location of buses on routes through the city every 30 seconds. In the remote areas of Shiojiri city bus is scheduled every one or two hours. So this service is for the convenience of citizens in remote areas.

e) Wildlife damage protection sensors

The sensors are used for protecting the villagers or farmers from the wildlife such as boar and monkeys in the rural and remote areas in the suburbs of Shiojiri city. The sensors detect wildlife and watch the movement of wildlife or capture them for reducing the damages caused by the animals.

f) Radio activity sensors

Sensor network protects citizens from radioactivity pollution by detecting the level of aerial radioactivity of the city to maintain the environmental safety of people's life.

g) People's safety confirmation sensors

Sensors locate the citizens when they evacuate during disaster to the community shelters and to grasp the number of people in each shelter and confirm their safety to their family and relatives, etc.

h) Building structures monitoring sensors

Sensors monitor the aged deterioration of public building structures in particular bridges by detecting abnormality of characteristic vibration of structures which is useful to take measures to suppress further deterioration.

i) Agricultural sensors

Sensors track the long term behavior of diligent farmers and its information together with the analysis of their expert knowhow and environmental data such as temperature, humidity and solar radiation, etc. which may be useful for prediction of huge outbreak of pest insect and storage of the digitized agricultural knowhow and easily pass down high level agricultural knowhow obtained from the analysis to fresh farmers.

j) Dam inclination sensors (inclinometer) for lakes

Sensors detect the micro inclination of dam of lakes for the long term and the digitized difference may indicate the dangerous change to result in the break of dam.

k) Environment monitoring sensors

The environmental data such as temperature, humidity, wind direction, wind speed, solar radiation, rainfall, etc. obtained from the sensors may be digitized and stored in the cloud for the use of many purposes in combination with other data.

(2) Platform for analysis of unique data collected from various IoT sensors

The unique data collected may be analyzed in combination with other data in consideration of time and location for new valuable information which will be of importance for development of regional economy.

(3) Case studies

a) The data such as temperature, humidity, and solar radiation may be used for predicting the pandemic of pest insect and reduce the amount of agricultural chemicals. The reduced spray of pesticide will avoid the unnecessary use of chemicals to the minimum of one fifth (1/5) which accordingly resulted in the cost reduction and relief of environmental destruction.

b) The conventional method of alerting the mudslides or landslides was to predict them from the rainfalls and raining duration based on the expert knowledge. After achieving the digitization of level of soil moisture detected by the IoT sensors, the alert may be sent out automatically to risk manager of Shiojiri municipality when threshold level of soil moisture exceeded according to the digital value in the IoT sensor network. On/Off of alert signals in the safety network may be automatic and accurate based on the digitized alert level.

c) In the past it was difficult to predict the serious frost damage to the crop, however, after the implementation of the IoT sensor network, the frost warning may be issued according to the level of temperature and the moisture of the sites to protect the crops from the frost damage.

A1.3.7 The concept of emergency alerts (People's Rep. of China)

(1) Background

Featuring the widest coverage and most effective means of reaching subscribers, mobile intelligent terminals provide the most important channels and means for delivering emergency alert messages. As major methods of reaching audience via terminal devices, "SMS" and "Push Notifications" still pose some problems. While presenting such features as high reliability and real-time messaging, SMS can only transmit text messages in a limited number of characters without audio-visual contents in distributing emergency alerts; at the same time, SMS also features deep service entrance and it comes with a high probability that emergency alerts be buried in large amounts of junk text messages. While push notifications can initiate the relevant application, pushing information with more added value such as excavation maps or weather trends to subscribers, they do have issues such as low reachability and a low rate of real-time delivery, so that the dissemination of emergency alerts is affected to some extent.

Developed jointly by CAICT with China Unicom, China Mobile and China Telecom, "Tuibida" service delivers the push experience through highly reliable signalling pathways provided by telecom operators. "Tuibida" is based on the signalling network and features such capabilities as "Quick Apps" (Click-to-Run services, including Google's instantApp/PWA, etc.) installed on the terminal device. If the terminal device has not installed such an App, the service offers the Click-to-Run function instead, ensuring that subscribers can invoke the relevant service by pushing the "Tuibida" notification on the terminal device.

(2) "Tuibida" helps the delivery of emergency alerts

Integrating "Tuibida" with the distribution of emergency alerts can be a fix to enduring problems in the delivery of emergency alerts such as monotonous text messaging, a lack of interaction and follow-up service, and insufficient use of the capabilities of the subscriber's terminal device, hence realizing the transition from distributing simple text messages to emergency alert services which are based on mutual interactions.

(2.1) Reliability of messages ensured by signalling and pathways

In fulfilling the task of pushing messages, the “Tuibida” service employs highly reliable signalling pathways. In contrast to conventional push notifications, “Tuibida” has some obvious advantages. Meanwhile, in-depth cooperation with telecom operators also can ensure instantaneity of information delivery. Base on classification of information in which emergency alerts enjoy high priority, and with connections to the relevant signalling pathways of telecom operators, the timely distribution of critical/red alerts to the target audience can be well assured.

(2.2) From message delivery to reaching the target audience

Currently, emergency alerts rely mostly on SMS text messaging to reach its audience. One weakness of SMS is that it can only deliver text messages, whereas in the case of emergency alerts distribution, the emergency-related services often will bring more value to the subscriber, e.g., an excavation map in the emergency alerts of an earthquake, the scope of tsunami in the emergency alerts of a tsunami, the typhoon path in the emergency alerts of a typhoon, and etc.

With 100 percent delivery guarantee, and through better integration with instant apps, the "Tuibida" service can invoke the Clink-to-Run function when the App is not installed on the subscriber’s device, so that the subscriber will not only be informed of the upcoming disaster or the emergent event as it happens, but also will be provided with a variety of useful information through the service in real-time. This can have a big impact on maintaining social order and strengthening public confidence in the affected area when a disaster or emergency happens.

(2.3) From one-way broadcast to two-way interactions

At present, the distribution of emergency alerts is mainly based on one-way broadcast. However, in the process of an enduring disaster, it is of great importance to realize two-way interactions, which will not only provide substantial support for more accurate delivery of emergency alerts in follow-up efforts, but will also help subscribers to do something for themselves. For example, during an emergency conventional SMS text messaging cannot provide feedbacks of location information. In contrast, since the "Tuibida" service can invoke the Quick App, it can obtain the subscriber’s location information during an emergency and provide support for rescue efforts by fully utilizing the capabilities of the subscriber’s terminal device. Hence, two-way interactions are of great value and significance with respect to disaster assistance and emergency relief operations.

A1.3.8 The status of remote sensing activities (United States of America)

<u>(1) Early warning and prevention</u>

Early warning and prevention include:

- disaster prediction, including the acquisition and processing of data concerning the probability of future disaster occurrence, location and duration; and
- disaster detection, including the detailed analysis of the topical likelihood and severity of a disaster event.

Meteorological aids, meteorological-satellite and Earth exploration-satellite services play a major role in activities such as:

- identifying areas at risk;
- forecasting weather and predicting climate change;
- detecting and tracking earthquakes, tsunamis, hurricanes, forest fires, oil leaks, etc.;
- providing alerting/warning information of such disasters;
- assessing the damage caused by such disasters;
- providing information for planning relief operations; and
- monitoring recovery from a disaster.

These services provide useful if not essential data for maintaining and improving accuracy of weather forecasts, monitoring and predicting climate changes and for information on natural resources. The frequencies used by those services and their associated applications are summarized in Table 1 of Recommendation ITU-R RS.1859.

On-the-ground, at-the-spot (in situ), at-the-time measurements or observations are usually more precise and more accurate than similar observations made from space. These kinds of observations are known as “ground truth” and are used to calibrate spaceborne instrumentation. However, when in situ instrumentation or the supporting infrastructures necessary to use such instrumentation are not in place or have been disabled by the disaster, or the ground measurements are not accurate enough, spaceborne observations can provide useful information helpful in alleviating the effects of disasters. Spaceborne observations are particularly useful when the areas are vast, the population densities low, and the technical infrastructure is vulnerable or not well developed.

(2) ITU-R activities

Recommendation ITU-R RS.1859 has been revised to add additional examples of how space borne sensors can help identify areas at risk by using synthetic aperture radar (SAR)-generated digital elevation models (DEMs) to locate low areas subject to flooding, or by using SAR-generated bathymetry to identify ocean bottom structure that might worsen an incoming tsunami or storm surge. It also demonstrates how satellite-based remote sensors have proven useful in providing an overall assessment of drought conditions, and have on occasion identified nearby, previously unrecognized areas having much better than average crops. Such information enabled quick yet inexpensive relief to be provided since transportation time and costs were minimized (i.e., using nearby trucks instead of distant airplanes). After a major earthquake has occurred, the sooner an accurate damage estimate is made, the sooner the appropriate rescue assets can be mobilized. Interferometric SAR (InSAR) observations pinpoint the location of earthquake epicenters far more accurately than remote seismographs, thus enabling more precise damage estimates upon which to define relief efforts. The recent launches of fleets of SAR-equipped satellites (COSMO-SkyMed (ASI), TDX and TSX (DLR), the Sentinel–1 series (ESA), and the upcoming RADARSAT constellation (CSA) have made these assessments more readily available than in the past. Precipitation radars flown on NASA's Global Precipitation Mission (GPM) provide 3-dimensional images of the rainfall from severe storms. This mission includes passive instruments which provide complimentary storm information extending beyond the swath of the radar.

The table in Annex 1 to this contribution indicates for which type of disaster a particular technology may provide useful data.

(3) Obtaining remote sensing data

To gain the maximum benefit from remote sensing data, a local emergency management agency is needed to direct the appropriate information to people in the field who need it. The United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) is focused on helping nations develop the capacity to manage disasters. While UN-SPIDER helps organize relief organizations and train their personnel, other organizations are more data oriented.

The World Meterological Organization (WMO) provides an Observing Systems Capability Analysis and Review Tool (OSCAR) that includes a table showing all known past, current and future satellites for meteorological and earth observation purposes. It is available here: https://www.wmo-sat.info/oscar/satellites. This can be used to identify additional sources of data.

Another source of analyzed remote sensing data is UNOSAT, a United Nations programme created to provide the international community and developing nations with enhanced access to satellite imagery and geographic information systems services.

Table A1- 3 Satellite-based technologies helpful in managing natural disasters

Technology / Objective	**SAR Imagery**	**InSAR Imagery**	**Active MW Imagery**	**Radar Altimetry**	**Radar Scatterometry**	**Precipitation Radar**	**GPS Radio Occultation**	**Passive MW Imagery**	**Passive MW Sounder**	**Geo. Visual and IR Imagery**	**Optical Imagery**	**Multispectral Optical Imagery**	**IR Imagery**
Coastal Hazards	X										X		
Drought	X		X	X	X			X		X	X	X	
Earthquakes	X	X					X				X		
Extreme Weather					X	X	X	X	X	X	X		

Floods	**X**		**X**		**X**	**X**	**X**	**X**	**X**		**X**		
Landslides	**X**	**X**									**X**	**X**	
Ocean Pollution	**X**											**X**	
Pollution											**X**	**X**	
Sea/Lake Ice	**X**							**X**			**X**		
Volcanoes	**X**	**X**						**X**			**X**	**X**	**X**
Wildland Fires								**X**			**X**	**X**	**X**

A1.3.9 Monitor and accurately predict the path of the cyclones (India)

(1) Background

In case of management of disasters like cyclones, India has adopted a ‘Zero Casualty’ policy. To achieve this objective, the Federal and State Governments are now better prepared in terms of early warning systems, evacuation plans, rescue and rehabilitation. Disaster drills help in getting prepared for disasters, however the real test of preparation takes place only when disaster actually strikes with its fervour and intensity. Recently, an extremely severe cyclone called ‘Fani’ struck the eastern coast of India in the state of Odisha in May 2019. It was almost like the ‘Super-Cyclone’ which struck the same State in 1999 killing more than 10000 persons! In the last two decades, India has prepared well to deal with disasters including cyclones. As a result, and though the intensity of the extremely severe cyclone was similar to that of Super-Cyclone, the total reported deaths were only 64. The United Nations agency for disaster risk reduction has praised the accuracy of India Meteorological Department’s early warnings that helped authorities in Odisha evacuate people and minimise the number of deaths.

(2) Cyclones/hurricanes/typhoons

Cyclone/hurricanes/typhoons are kind of storms, caused by atmospheric disturbances, which wherein the air rotates cyclically around a low pressure centre called ‘eye’. In the Northern-hemisphere, winds rotate counter-clockwise and in the Southern Hemisphere, clockwise. In Indian seas every year, cyclones with various intensities occur almost every year in the month of June-July. However, this year’s cyclone ‘Fani’ occurred in May, which is rare.

Cyclonic disturbances are classified depending upon the wind speed around the circulation centre. Satellite cloud imageries are used along with other meteorological features to estimate the intensities and the wind speed associated with these intense systems. The satellite cloud configurations, expressed by ‘T' numbers, have unique relationship with wind field of a cyclonic disturbance. The table below expresses the categories of cyclones. The strong winds, heavy rains and large storm surges associated with tropical cyclones are the factors that eventually lead to loss of life and property.

Table A1- 4 categorization of cyclonic disturbances

S. No.	Intensity	Strength of wind Satellite	'T' No.	condition of Sea	Wave Height (m)
1	Depression (L)	31- 49 kmph (17-27 knots)	1.5	Moderate to Rough	1.25-2.5 2.5-4.0
2	Deep Depression (DD)	50 – 61 kmph (28-33 knots)	2.0	Very Rough	4.0-6.0
3	Cyclonic Storm (CS)	62 – 87 kmph (34-47 knots)	2.5-3.0	High	6.0-9.0
4	Severe Cyclonic Storm (SCS)	88-117 kmph (48-63 knots)	3.5	Very High	9.0-14.0
5	Very Severe Cyclonic Storm (VSCS)	118-166 kmph (64-89 knots)	4.0-4.5	Phenomenal Over	14.0
6	Extremely Severe Cyclonic Storm (ESCS)	167-221 kmph (9--119 knots)	5.0–6.0	Phenomenal Over	14.0
7	Super Cyclonic Storm (SuCS)	222 kmph and more (120 knots and more)	6.5 and more	Phenomenal Over	14.0

Source: http://www.rsmcnewdelhi.imd.gov.in

(3) Early warning models adopted by IMD based on past experiences

Indian Meteorological Department bases on the observational data to translate it into numerical weather prediction models. Through tie-ups with other countries, the information is collated and analysed. IMD refers to 10 different numerical models every day. These models ingest the current observations and are applied in different physical principles and mathematical equations. With the help of high-powered computing systems, experts solve these equations and analyse it for actual observation. The prediction is then made for different days. Forecasters go through all these models that are developed every day to find out whether any low pressure system is developing anywhere in the sea. Based on observation, several scientists discuss the models and arrive at a consensus and then decide to go ahead with issue of warning and predictions. There are the following components of warning: 1. Warning Generation; 2. Warning product presentation; 3. Warning dissemination; 4. Coordination with emergency response units; 5. Post-event review, 6. Pre-season exercise; 7. Public education and reaching out.

(4) 4-stage warnings for States

The warning for the affected states is done in 4 stages:

The first-stage warning known as "**Pre-Cyclone Watch**" is issued 72 hours in advance. It contains early warning about the development of a cyclonic disturbance in the Indian seas/ocean.

The second-stage warning is known as "**Cyclone Alert**", which is issued at least 48 hours in advance of the expected commencement of adverse weather over the coastal areas. It contains information on the location and intensity of the storm, likely direction of its movement, intensification, coastal districts likely to experience adverse weather and advice to fishermen, general public, media and disaster management agencies. This is issued by the Area Cyclone Warning Centres (ACWCs)/Cyclone Warning Centres (CWCs) and Cyclone Warning Divisions (CWD) concerned.

The third-stage warning, known as "**Cyclone Warning**", is issued at least 24 hours in advance of the expected commencement of adverse weather over the coastal areas. Landfall point is forecast at this stage. These warnings are issued by the ACWCs/CWCs and CWD at three-hour intervals giving the latest position of the cyclone and its intensity, likely point and time of landfall, associated heavy rainfall, strong wind and storm surge along with their impact and advice to general public, media, fishermen and disaster managers.

The fourth stage of warning known as "**Post-Landfall Outlook**" is issued by the centres at least 12 hours in advance of the expected time of landfall. It gives likely direction of movement of the cyclone after its landfall and adverse weather likely to be experienced in the interior areas.

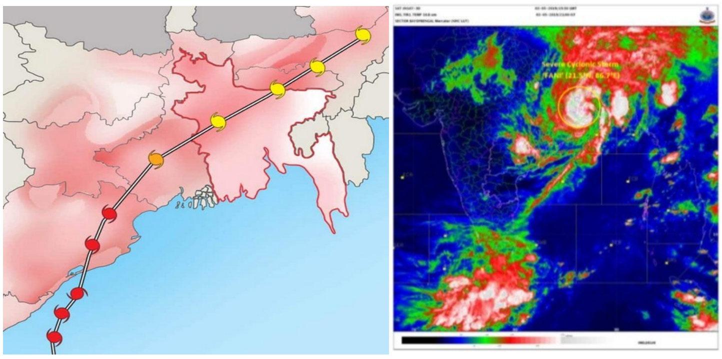
Different color codes are also used to denote the different stages of the cyclone warning bulletins. Cyclone alert is denoted by **yellow**, cyclone warning by **orange** and post landfall by **red** color.

(5) use for early warning dissemination in India

Following ICT technologies are used for dissemination of warning information: Mobile phones, VSATs (Very Small Aperture Terminals), satellite phones (Inmarsat), IVRS (Interactive Voice Response Systems), LAN & VPN, radio, press, TV, web media, loudspeakers and national knowledge network.

(6) Cyclone Fani

Cyclone **Fani,** a rare summer cyclone in the Bay of Bengal, hit eastern India on May 3, 2019. It is one of the strongest cyclones to have hit India in the last 20 years. 'Fani' was an Extremely Severe Cyclonic category storm. It crossed the temple town of Puri in Odisha State at the speed of 175-185 km/hr and gusting to 205 km/hr, resulting in widespread loss of property. However and due to effective early warning system, adequate infrastructure availability and timely evacuation of millions of people, better coordination between Federal and State Governments and deployment of national disaster relief forces have resulted in significant savings of human life and livestock. The saving of lives is due to the 'Zero Casualty' approach adopted by India and IMD has improved its model of predicting cyclone path and its land fall timings accurately with minimum error in predictions.



(a) Path of cyclone Fani (b) Winds along the path

Figure A1- 19 Cyclone Fani

(7) Steps taken to reduce loss of lives during Cyclone Fani

As mentioned above, the Government's "Zero Casualty" policy for natural disasters and the near accuracy of the India Meteorological Department's early warning system have helped reduce the possibility of deaths from Cyclone Fani.

A record 1.2 million people (equal to the population of Mauritius) were evacuated in less than 48 hours, and almost 7,000 kitchens, catering to 9,000 shelters, were made functional overnight. This mammoth exercise involved more than 45,000 volunteers. Due to several steps taken timely, the total casualty due to Fani was about 60.

(8) Comparison with other cyclones/hurricanes

The statistics are striking when compared to the impact of big weather events around the world. When Hurricane **Maria** hit Puerto Rico in 2017 with wind speeds of 175 miles per hour, it caused a death toll of **2,975**. The same year, Hurricane **Harvey** struck Texas with winds of 130 mph and caused devastating flooding. There was $125 billion in damage and at least 68 direct storm-related deaths reported in Texas. Cyclone **Idai** hit Mozambique in March 2019 and ripped through Madagascar, Malawi, and Zimbabwe, with more than 1,000 people feared dead.

So the Indian State of Odisha’s ability to put such an effective disaster management plan in place and save thousands of lives is a template that the world can learn from.

(9) Key success factors in dealing with ‘Fani’: key takeaways

(9.1) Build a relief infrastructure and clear command-and-control structure

Until 1999, when Super-Cyclone hit Odisha coast, it did not have a well laid-out plan for disaster management. Two months after the cyclone hit, the Odisha State Disaster Management Authority (SDMA) was set up and plans put in place. Around 900 cyclone shelters have been built in vulnerable pockets of the state, with systems in place for the evacuation of hundreds of thousands of people.

There is a clear command-and-control structure for disaster relief and there are clear protocols in place for carrying out relief operations. These were successfully used in managing Cyclone ‘Phailin’ in 2013 (a storm five times the size of Hurricane ‘Katrina’), Cyclone ‘Hudhud’ in 2014, and Cyclone ‘Fani’ in 2019.

(9.2) Accuracy of early warning systems

The India Meteorological Department has built an effective service to predict accurate timings of cyclone formation in the Bay of Bengal and when it will make landfall along India’s coastline. This early warning system enables the state to be disaster ready and minimise loss of lives. It is then crucial that people follow the protocols in place when the warnings come in.

(9.3) Clear communication plan

Roughly 6.5 million text messages were sent to locals and farmers in clear language before Cyclone ‘Fani’ hit, keeping in alert those potentially affected. People were repeatedly advised over all forms of media not to panic and given clear “do and don’ts”. This helped in the record evacuation of 1.2 million people to safe buildings.

(9.4) Effective coordination of groups

Preparations to fight the onslaught of Fani involved a number of government agencies, as well as local community groups and volunteers working together. The government’s disaster response forces were pre-positioned in vulnerable locations, food packets for air-dropping were made ready for air force helicopters to drop to people. Senior state officials and police officers were sent to the affected districts to co-ordinate efforts of various agencies.

A1.3.10 Alert and Warning Systems (United States)

(1) Introduction

Mitigation is the effort to reduce loss of life and property by lessening the impact of disasters[29]. Timely and effective alert and warning (A&W) strengthens mitigation and community resilience by informing citizens of risks they may face, threatening situations and recommended actions to save lives and protect property. Development of better A&W capabilities helps to mitigate hazards and lessen the impact of disasters.

Proper authorities, policy and governance as foundational elements are critical in the development of an A&W system, especially to prioritize personnel and resource justifications. The United States established the Integrated Public Alert and Warning System (IPAWS) as a unique, multi-hazard, multi-user A&W infrastructure that the Federal Emergency Management Agency (FEMA) makes available for use by Federal, state, local, tribal, and territorial[30] entities across the United States. The IPAWS uses technology and information standards to join multiple private sector communications technology infrastructures providing an **ability to deliver a single emergency message simultaneously to multiple public dissemination pathways; for example, radio, TV, mobile devices, and internet connected systems, websites, and applications.** Authorized public Alerting Authorities (AAs) draft tailored messages to send A&Ws to citizens, residents and visitors in their jurisdiction. Using the IPAWS assists the constituent AAs in communicating information about an emergency situation to the greatest number of people in the shortest amount of time by leveraging local private sector ICTs to disseminate A&Ws. Distributing the same message across multiple sources increases the reliability that people receive A&W messages; and the likelihood that recipients will take timely actions consistent with the threats or emergency situation.

FEMA's IPAWS Program Management Office (PMO) works to sustain and enhance the platform's unique abilities by continuously interfacing with industry to track and ultimately develop or interface new and emerging ICT to expand **the number of systems available for distribution of A&Ws using the same standards-based format (such as electronic road signs, sirens, smart kiosks, etc.)**. This is done by working hand-in-hand with the Federal Communications Commission (FCC), a U.S. regulatory body, and private industry partners. To date, this alliance structure has enabled the IPAWS to support over 1300 AAs to send emergency messages to the public using radio, TV, and cell phones in the United States.

(2) The IPAWS architecture

The IPAWS architecture was and is designed to support interoperability with any A&W system in the nation that employs the same standards. The Integrated Public Alert & Warning System Open Platform for Emergency Networks (IPAWS-OPEN) is the infrastructure that routes authenticated A&W messages to the public using the radio and television systems in the Emergency Alert System (EAS), Wireless Emergency Alerts (WEAs) to cell

29 https://www.fema.gov/what-mitigation

30 The phrase "Federal, state, local, tribal, and territorial" is hereafter referred to in this paper as "constituent(s)".

phones, National Oceanic and Atmospheric Administration (NOAA) Weather Radios, and other communications systems.

The first critical step in initiating the design solution for the U.S. national system was to use the Common Alerting Protocol (CAP) and other technical standards. When A&W services are made CAP-compliant and integrated with IPAWS, the platform acts as a mediator by authenticating messages from authorized users disseminating authentic emergency information to people in a specific geographic area quickly through multiple dissemination pathways. This way information from a single source about a single incident can reach the public via radio, television, wireless phones, Internet services, and future CAP-compliant IPAWS connected technologies. The standards-based technology approach enables a national A&W architecture to adapt to and leverage future technologies. Making use of multiple dissemination pathways for public alerts significantly increases the likelihood that the messages will successfully reach the public. In addition, disseminating a single CAP alert message simultaneously via multiple pathways reduces the time and workload required by emergency managers, compared to preparing and sending multiple separate channel-specific formatted alerts. IPAWS' standards-based approach speeds the delivery of critical, lifesaving information.

Use of the open CAP standard enables industry partners (i.e. Internet, carriers, software vendors, broadcast) to develop technology and/or devices that can be used by individuals with disabilities and others with access and functional needs, to receive A&Ws. Due to standards-based interoperability, CAP enables the transport of rich multi-media attachments and hyperlinks in all A&W messages. IPAWS adopted the Emergency Data Exchange Language (EDXL) CAP, which is developed and maintained by the Organization for the Advancement of Structured Information Standards (OASIS). FEMA IPAWS continues to work with the OASIS Standards Committee to adapt changes to the specifications on the CAP standard for IPAWS-OPEN. The current system utilizes the CAP v1.2 Standard and the CAP v1.2 IPAWS USA Profile v1.0. IPAWS does not provide an Alert Origination Tool, however, FEMA IPAWS works with more than 25 different alerting origination tool vendors to ensure their products are compliant with the CAP v1.2 standard and USA profile specification. Constituent AAs can find the tool that best fits local operations. IPAWS engages and provides training to AAs and tool vendors and encourages them to adopt IPAWS for their A&W needs.

IPAWS participated with the Alliance for Telecommunications Industry Solutions (ATIS), a US based technical and operational standards and solutions development organization for the ICT industry, to develop and adopt standards used for WEA in the United States. ATIS addresses common, critical priorities and sharing of resources, effort, and costs to develop large-scale, interoperable solutions. ATIS is accredited by the American National Standards Institute (ANSI). IPAWS actively participates in ATIS meetings with cellular service providers and partners to continuously update WEA capabilities.

FEMA IPAWS maintains liaison and collaboration with relevant professional associations including the National Association of Broadcasters, the NCTA Internet & Television Association (formerly the National Cable & Telecommunications Association) the National Emergency Management Association and the International Association of Emergency Managers. In addition to working with standards institutes and various associations, FEMA

IPAWS in coordination with FEMA headquarters, actively engages with the FCC and Congress to update laws and regulations to facilitate improving A&W capabilities. FEMA IPAWS supported committees of the National Research Council and The National Academies Press in development of published workshop reports on the "Public Response to Alerts and Warnings on Mobile Devices"[31] and "Geotargeted Alerts and Warnings."[32]

FEMA IPAWS' regular use and development of standards, and participation in associations, results in proactive participation in operational tests, training, exercises and evaluations of new and emerging technologies. These activities enable progress toward the integration of additional and new technologies into the national A&W interoperability backbone; as well as encouraging industry and other private sector innovators to meet the mitigation risk reduction and risk management needs of the emergency management community at large. The IPAWS architecture is shown in Figure 1. More information about this architecture can be found in Annex 1.

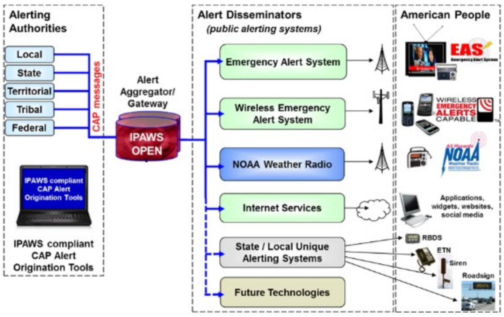


Figure A1- 20 IPAWS architecture

(3) Uses of IPAWS' capabilities

Even though the original requirement for IPAWS was to provide the President a means of warning the public of impending disasters and attacks, currently the national IPAWS plays a daily role including usage by local emergency managers in a very wide variety of situations that threaten public safety and property. Local authorities have used IPAWS to issue emergency messages related to chemical spills, child abductions, dam failures, information on availability of disaster recovery resources, earthquakes, evacuations, flash floods, gridlocked traffics, hurricanes, large power outages, law enforcement operations, nuclear facility accidents, roadway closures, shelter-in-place orders, snowstorms, tornados, toxic plumes, volcano eruptions, wildfires, and water contamination. Details on uses of IPAWS can be obtained from the IPAWS web site at www.fema.gov/ipaws.

(4) Alerting Authorities (AAs)

Over 1,300 constituent AAs use CAP based Alert Origination Tools for creating A&Ws that are compatible with the national architecture. In the United States, depending on constituent policies, AAs can include, but are not limited to, all levels of government organizations, fire and police departments, military

31 Sub-title: "Summary of a Workshop on Current Knowledge and Research Gaps", Computer Science and Tele-communications Board, National Research Council, The National Academies Press, Washington, D.C., 2011

32 Sub-title: "Report of a Workshop on Current Knowledge and Research Gaps", Computer Science and Tele-communications Board, National Research Council, The National Academies Press, Washington, D.C., 2013

bases, colleges and universities, nuclear power plants, hospitals, and other entities. All AAs requesting use of the IPAWS platform must independently acquire software compatible with the IPAWS CAP specifications and sign a MOA with FEMA. Each MOA dictates the development of effective local alert and warning practices and procedures, requires completion of FEMA IPAWS training, and monthly training to demonstrate the AA can react and send a properly formatted A&W in a test environment. All emergencies are local, and each area threatened by a disaster or emergency is unique, which is why AAs have the freedom and autonomy to determine message content and when to send A&Ws.

(5) Success stories

- Wildfires: During the Southern California wildfires of 2017, the Governor's Office of Emergency Services warned seven counties to stay alert and listen to authorities during periods of strong winds. Winds did in fact spread fires, at times over more than one acre per second. Wildfires burned over 307,900 acres and forced evacuation of over 230,000 people, but only one civilian death was recorded, due in part to advance notification. In 2018, many WEA and EAS alerts were sent during a wildfire that burned in four counties for 54 days. Media reports indicate that many people evacuated on time as the public seemed very receptive to the alerts.
- Bomb threat: New York City Emergency Management sent a WEA as an electronic wanted poster to identify the suspect in connection with bombings in Manhattan and New Jersey in 2016; the suspect was captured within hours. This was the first widespread effort to transform the citizens of a major American city into a vigilant eye for authorities. "This is a tool we will use again in the future…This is a modern approach that really engaged a whole community," said Mayor Bill de Blasio.[33]
- Tornado alert: In 2016, the groom at a wedding reception in Ohio received a tornado alert on his phone. The phones of family members in attendance from New York, New Jersey, South Carolina, and even Canada immediately received the same alert. Even though the guests and family member in attendance were from different geographic areas, WEAs can reach any cell phone using a specific tower, including those in moving vehicles.[34]
- Child Abduction / Amber Alert: On December 31, 2016 in Sharpsville, Pennsylvania, an armed and dangerous adult male abducted his eight-month-old daughter. An off-duty security worker in Reading, PA, received an Amber Alert on his phone and noticed a vehicle matching the description provided in the alert. The individual then provided 911 dispatchers with information that allowed police to find the vehicle. The child was found safe less than an hour after the Amber Alert was issued.[35]

33 New York Times (2016). "Cellphone Alerts Used in New York to Search for Bombing Suspect". Retrieved from https://www.nytimes.com/2016/09/20/nyregion/cellphone-alerts-used-in-search-of-manhattan-bombing-suspect.html

34 Reed, S. (2016). Wedding almost a disaster – literally. Retrieved from http://sidneydailynews.com

35 CBS NEWS (2017). Retrieved from https://www.cbsnews.com/news/pennsylvania-man-who-saw-amber-alert-credited-with-locating-infant-ariella-downs-abducted-by-murder-suspect/

A1.4. Drills and Exercises

A1.4.1 Emergency telecommunication drills (People's Republic of China)

This section introduces the purpose, types and requirements of emergency telecommunication drills. It suggests further strengthening emergency telecommunication drills and experience sharing in the field of telecommunication/ICT for disaster preparedness, mitigation and response.

(1) Purpose of emergency telecommunication drills

Exercises are a great method to:

1) Evaluate the preparedness program and identify planning and procedural deficiencies. Some preparedness program has not been tested by the unexpected incidents, or not been updated in time, and maybe couldn't adapt to new situations. Through the emergency telecommunication drill, we could find the deficiencies of the emergency preparedness program, verify the adaptability of the plan in dealing with unexpected situations, and find out the plan need to be modified and improved.
2) Improve capabilities to respond to real events. It could help to verify the new technology application and information communication resources, new equipment capabilities, and enhance emergency telecommunication support capability. Emergency telecommunication drill assess the capabilities of existing resources and identify needed resources.
3) Improve coordination between internal and external teams, organizations and entities and improve the level of cross-regional support. It is necessary to strengthen the coordination ability of multi-department cooperative operations and rapid response operations. It improves the communication and coordination between emergency organizations and personnel.

Figure A1- 21 Emergency telecommunication drill 1

4) Train emergency telecommunication team. It could help improve the leader's ability of analysis, decision-making, organization and coordination. It could help improve telecommunication personnel clarify roles and responsibilities on-site. In addition, emergency drills can also help increase awareness and understanding of hazards and the potential impacts of hazards, reduce panic, and cooperate with the government and departments, to improve the overall social emergency response capacity.

(2) Types of emergency telecommunication drills

There are different types of drills that can be used to evaluate program plans, procedures and capabilities.

(2.1) According to the organization form, emergency telecommunication drills include tabletop exercises and actual-combat drills

Tabletop exercise refers to team members' use of maps, sand tables, flowcharts, computer simulation, video conferencing and other auxiliary means to discuss their roles during an emergency and their responses to a particular emergency situation. The tabletop exercise usually is done in rooms.

The actual-combat drill refers to the process that the participants complete the real emergency response by making use of the equipment and materials involved in emergency disposal, aiming at the pre-set emergency scenarios and the subsequent development scenarios, and through actual decision-making, action and operation. The actual-combat exercises are usually done in specific locations.

(2.2) According to the content, emergency telecommunication drill includes single drill and comprehensive drill

A single drill refers to a drill activity that involves only a specific emergency response function in the emergency plan or a series of emergency response functions in the on-site disposal plan. It focus on the examination of specific units and functions as one or a few participating units.

Comprehensive exercise refers to the drill activities involving multiple or all emergency response functions in contingency plans. Emphasis should be laid on the testing of various links and functions, especially the testing of emergency mechanism and joint response capability among different departments.

(2.3) According to the purpose and function, emergency telecommunication drill includes test drill, demonstration drill and research drill

Test drill is a drill organized to test the feasibility of emergency plan, the adequacy of emergency preparation, the coordination of emergency mechanism and the emergency disposal ability of relevant personnel. Demonstration drill is a kind of performance drill which is carried out strictly according to the emergency plan to show the emergency ability or provide demonstration teaching to the observers. Research drill is a kind of drill which is organized to study and solve the key and difficult problems of emergency disposal and to test new schemes, technologies and equipment.

(2.4) According to the notification, emergency communication drill includes notification drill and script free drill

Notification drill follows the script for drills, and check the emergency communication support according to the plan of action. Emergency telecommunication drill or flight inspection without script and notification is carried out in the form of "double blindness" (drill time and place are unknown), and the drill time and place are temporarily deployed. After arriving at the scheduled drilling site, the emergency telecommunication equipment and personnel are assembled and dispatched to carry out the actual combat simulation drill in a certain area.

Different types of drills can be combined with each other to form different types drill: tabletop drill, integrated tabletop drill, demonstration of single drill, demonstration of integrated drill and so on.

The general emergency telecommunication drill is a comprehensive drill, for example, a drill scenario is as follows: a simulation of an earthquake disaster in a certain place, causing business interruption, a group organized with a remote emergency rescue and disaster relief drill scenario in neighboring provinces, seven teams sent 24 emergency vehicles, 24 sets of equipment, 78 drill personnel. There are two stages of pulling and drilling, which include the coverage of UAV base station, the WiFi coverage of Ku portable station and Ka portable station, C network base station with satellite circuit, optical fiber fusion, emergency power supply and other 14 business subjects.

Figure A1- 22 Emergency telecommunication drill 2

A1.5. Others

A1.5.1 Global disaster statistics (Japan)

Global Centre for Disaster Statistics (GCDS) was established in partnership with the International Research Institute for Disaster Science (IRIDeS) at Tohoku University, Fujitsu and other organizations, with the objective of support to achieve the SFDRR and SDGs. In our project, the following outputs are expected:

i) National capacities for disaster statistics are strengthened,
ii) Global information platform for the analysis of disaster statistics is developed, and
iii) Independent scientific analysis of progress towards the achievement of the global targets of the SFDRR and the SDGs is carried out.

As for academic contributions, the GCDS is going to publish a special issue of the Journal of Disaster Research towards the development of disaster statistics.

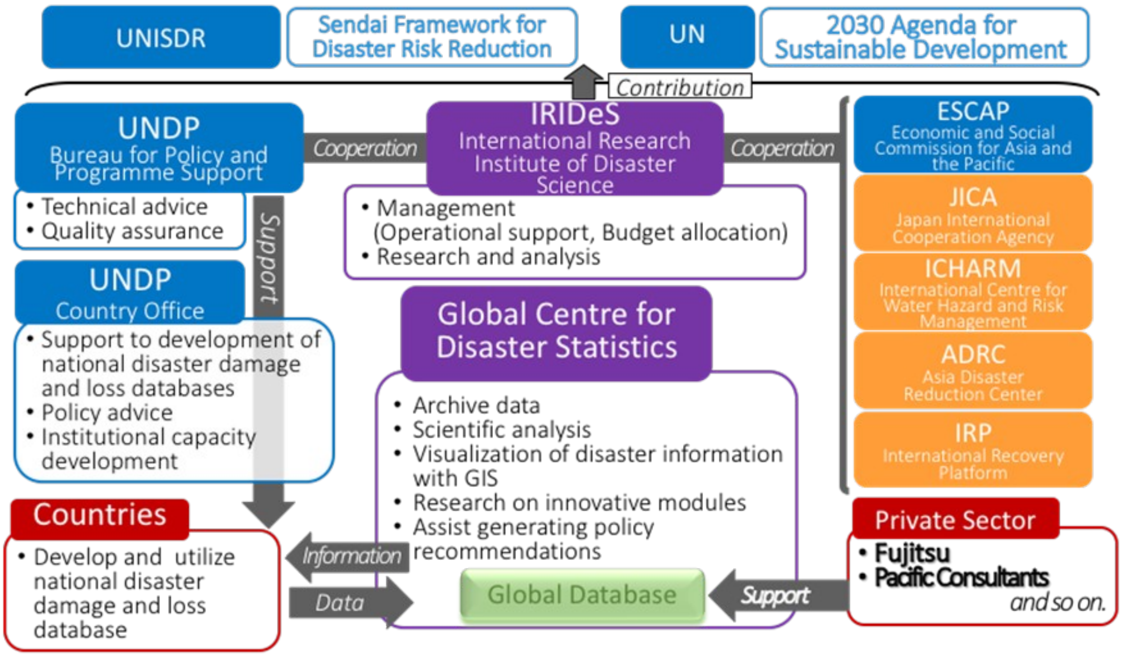


Figure A1- 23 Detailed scheme of the GCDS

Pilot phase started in 2017, where UNDP and IRIDeS have supported Cambodia, Indonesia, Maldives, Myanmar, Philippines, Sri Lanka, and Nepal, which are selected by UNDP Asia-Pacific Hub, to increase their capacities in disaster statistics and have convened regular meetings to share experiences. In terms of ICT, Fujitsu has developed a Global Database (GDB) to store disaster loss and damage data. GCDS commenced to collect and store the data into the GDB from the government of pilot countries. Table 1 shows the progress of our project to collect and store disaster loss data into the GDB for each pilot country.

Table A1- 5 Progress of data collection

Indonesia	API* developed by BNPB** is stored in the GDB (22,442 data)
Myanmar	GCDS has commenced proceeding to collect data to store into the GDB
Philippines	GCDS has commenced proceeding to collect data to store into the GDB
Cambodia	GCDS has commenced proceeding to collect data to store into the GDB
Sri Lanka	GCDS has commenced proceeding to collect data to store into the GDB
Nepal	Within this fiscal year, GCDS plans to commence proceeding to collect data to store into the GDB
Maldives	Within this fiscal year, GCDS plans to commence proceeding to collect data to store into the GDB

*API: Application Programming Interface

**BNPB: National Agency for Disaster Management in Indonesia

For other countries, through consultations with UNDP regional hubs, the following countries are nominated as priority countries for GCDS implementation as shown in Table 2.

Table A1- 6 Priority countries for GCDS

Africa	Uganda, Mozambique, Rwanda, Niger, Angola
Arab States	Djibouti, Egypt, Iraq, Lebanon, Palestine, Somalia, Sudan, Tunisia
Central Asia	Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Georgia, Armenia
Latin America and the Caribbean	Peru, Paraguay, Chile, Cuba, Ecuador, Mexico, Nicaragua, Dominican Republic

Especially, the GCDS is now planning to take advantage of Fujitsu's Cloud Service K5. Needless to say, Information Communications Technology (ICT) is vital to connect numerous stakeholders. We can expect to achieve the mission of the GCDS more effectively and efficiently in that it goes beyond the various restrictions of resources.

A1.5.2 Pre-positioned emergency telecommunication systems (Japan)

In the case of a disaster, telecommunication blackout due to damaged telecommunication equipment, or telecommunication traffic congestions may occur. In such a case, emergency telecommunication systems which were prepared in advance can rapidly restore important telecommunication services, like for police, fire department, local government and hospitals. In addition, the systems can handle safety confirmation messages among citizens in disaster areas. The use of properties of emergency telecommunication systems in ordinary situation, i.e. not in a disaster case, can avoid some troubles such as system unavailability. In addition, emergency telecommunication systems can provide **communication services for rural areas** where telecommunication services are not sufficient.

The Cabinet Office in the Japanese Government has conducted a Strategic Innovation Program (SIP) to implement research results society wide. The following field trial of MDRU was held in Nepal in February 2019, as an SIP projects.

Nepal is a mountainous country with over 60% of its land covered with hills and mountains. Many schools in remote villages in the hills and mountains have poor resources and materials for learning. Schools stay closed for a long time during monsoon and winter seasons because teachers and students cannot reach the school. Remote education can be one solution to overcome the barriers of geographical conditions of Nepal to serve the areas difficult to access and encourage participation of students and other stakeholders in education.

With the assistance of Japan, Educating Nepal, a non-governmental organization in Nepal, conducted a field trial to test MDRU, movable and deployable ICT resource unit, which was initially designed as disaster communication tools in the case of an emergency situation, for remote education in rural hilly areas of Nepal. Rural communities in the hilly region of Sindhupalchowk District were selected as the location for testing remote education.

MDRU enabled connection between the elementary school and two nearby villages as shown in Figure 1. The school was named as Main Venue while the two other locations were Remote Venue A and Remote Venue B. Figure 2 shows the geographical conditions on the trial. The project was tested in the rural community of Jholunge, Indrawati Rural Municipality in Sindhualchowk District of Nepal, which is roughly around 85 km away from Kathmandu.

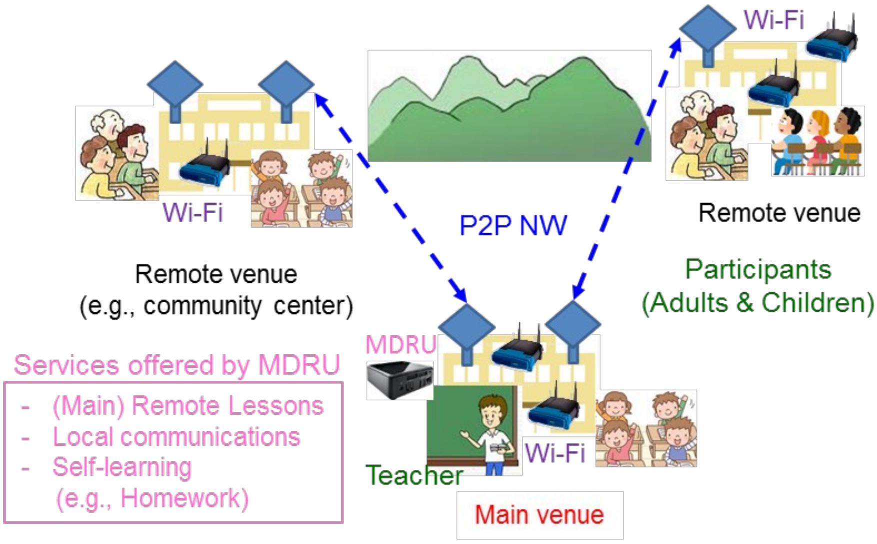


Figure A1- 24 Remote education testing in Nepal

Figure A1- 25 Geographical conditions of Jholunge Village

In the remote education trial, remote teaching and learning of elementary education were demonstrated to students, and remote consulting and learning of agricultural support were tested for adults, especially farmers.

Results of the trial were evaluated through a questionnaire, and an interview of key informed participants and observers. The analysis of results showed that MDRU was very effective for remote education at a general level. Adult remote learning received the highest scores, followed by overall self-learning and then student remote learning. The user experience of MDRU, effectiveness, relevance and innovation of using MDRU received higher scores and convenience of using MDRU and suitability of MDRU for daily use received lower votes in comparison. The above results expressed that MDRU was an effective tool for remote education and thus can be installed in various places to provide effective education through distant learning or e-learning.

The results also showed that redesigning for dedicated user application or interface for remote learning can attain the best utility in remote education, since the current application was fully tailored for disaster communication which at some point makes it a little inconvenient to be used in remote education. Apart from that, MDRU has shown commendable test scores for its effective use in remote education.

Disaster management solutions such as emergency telecommunication systems can be utilized for **remote education in rural areas without enough telecommunication infrastructures in ordinary situation**. It is expected that children and farmers have skills for using emergency telecommunication systems in the case of disaster, because ordinary use of disaster management solutions could be considered as one of disaster management training. Nepal and Japan have conducted field trials of remote education in rural hilly areas of Nepal by utilizing MDRU. It is expected that children and adults in rural areas who participated in the trial can use the emergency telecommunication system in the case of disaster, since Nepal is one of the countries where many disasters occur.

A1.5.3 Fight against the Ebola virus disease (Democratic Republic of the Congo – DRC)

The telecommunications in the Democratic Republic of the Congo (DRC) was utilized to the fight against Ebola virus disease, which has broken out in the province of North Kivu in the east of the country and is threatening neighbouring countries (Rwanda and Uganda). The DRC is affected by different kinds of disasters, the most common being those related to illness: cholera, Ebola virus disease and so on.

The main participants in the fight against Ebola are:

- the Office of the President of the Republic through the anti-Ebola technical committee;
- the Ministry of the Interior and Security through the DRC National Police which provide security for the sites and centres where affected persons are treated and cared for;
- the Ministry of National Defence through the DRC Armed Forces, which are pursuing the armed groups that operate in the eastern part of the country and regularly attack medical and other healthcare personnel, hospitals, and members of the public;

- the Ministry of Health;
- the Ministry of Humanitarian Affairs and the Ministry of Social Affairs;
- the Ministry of Posts and Telecommunications through the regulatory authority;
- non-governmental organizations active in the field of humanitarian and health services;
- civil society, for public education and outreach campaigns;
- confessional communities, in particular the Catholic church (assistance is provided by the Vatican).

Given that armed groups operate in the area where the Ebola virus epidemic is taking place, in the east of the DRC, and that the epidemic has reached alarming proportions, with more than 2 000 cases, the Government has launched an epidemic response strategy with telecommunications as a key pillar. Telecommunication provides channels for people in affected areas to inform their friends and relatives, the public authorities and humanitarian associations upon the onset of disaster, and for the public authorities to issue alerts and plan relief operations. These channels also allow rescue teams to coordinate their operations from the initial alert to the intervention process.

The telecommunications sector, which was opened to competition under the framework law of 16 October 2002, currently comprises:

- four mobile telephone operators (Vodacom Congo S.A, Airtel Congo S.A, Orange and Africell);
- one wired fixed telephone operator (the public/historical operator);
- one wireless fixed telephone operator (Standard Telecoms);
- about 20 Internet service providers;
- over 150 radio stations and about 60 television channels across the country, in urban and rural areas;
- over 10 national digital terrestrial TV channels;
- private telecommunication networks (operated by private organizations and non-governmental organizations).

Other forms of communication being used in the fight against Ebola include:

- visual communication: banners, streamers, posters, T-shirts etc. with public health advice.

In short, there are two types of telecommunication networks being used in the fight against Ebola:

- **public networks**: mobile telephone networks, fixed telephone networks, radio and television broadcasting networks and Internet access networks;
- **private networks**: private companies, non-governmental organizations, etc.

These various telecommunication networks enable and facilitate:

- early warning for prevention or intervention;
- circulation, exchange and sharing of information and data among the different players involved;
- prompt decision-making so as to reduce the threat of the disease;
- planning and coordination of relief operations on the ground.

Are there specific regulations governing the use of telecommunications in the event of disasters in the DRC?

While the answer to that question is "No", the Government has established provisions in the licensing agreements for telephone operators, inter alia, requiring them to help relief teams to use their networks free of charge in their operations.

To that effect, holders of licenses for a public telecommunication service are required to organize free-of-charge emergency call services, in particular for the national police and relief services in the operating area of the service licensed.

In addition, the general regulations on telecommunications grant favourable terms for the possession, movement and use of satellite terminals such as Thuraya, Iridium, and so on by non-governmental organizations.

Furthermore, non-governmental organizations, by virtue of agreements signed with the Government, are exempt from any and all taxes and levies on telecommunication equipment and materials that they have and use for the fulfilment of their mission.

As may be seen, all these various measures serve to increase and reinforce the relief capabilities of such non-governmental organizations in their relief operations.

The mobilization of significant telecommunication resources has led to an improvement in the management of the Ebola virus disease in recent months, as confirmed by the encouraging results reported by medical sources. As control over Ebola virus disease is established, the number of positive diagnoses is decreasing and there are even cases of recovery.

A1.5.4 Disaster Maps program (Facebook, United States of America)

(1) Introduction

The enormous number of users in social networks such as Facebook provide extensive geospatial information on connectivity that is difficult to capture quickly through conventional methods. Many apps rely on location services data collected via smartphones. In the case of Facebook, people have an option of whether or not to provide this information (2019)[36]. Location data is used to provide a myriad of features such as targeting of alerts and prompts to check-in as “safe” after a hazard event to allay concerns of friends and family. In addition to powering product crisis response features, this location data, when aggregated and anonymized, can provide insights about how populations are affected by crisis events.

Beginning in 2017,[37] the company began providing aggregated geospatial data sets to crisis response organizations and researchers to help fill information gaps in service delivery. These Disaster Maps utilize information about usage in areas impacted by natural hazards, producing aggregate pictures of how the

36 Facebook (2019). Facebook Privacy Basics: Location. url: https://www.facebook.com/about/basics/manage-yourprivacy/location (visited on 03/21/2019).

37 Jackman, M. (2017). Using Data to Help Communities Recover and Rebuild. Facebook Newsroom. url: https://newsroom.fb.com/news/2017/06/using-data-to-help-communities-recover-and-rebuild/ .

population is affected by and responding to the crisis. The maps include insights into evacuations, cell network connectivity, access to electricity, and long-term displacement. Since their launch, Disaster Maps have been activated for over 500 crisis events and made available to over 100 partner organizations. In particular the connectivity maps have proven instrumental in aiding emergency communications efforts.

(2) Case Study: Hurricane Maria

In the aftermath of Hurricane Maria in Puerto Rico in 2017, information was desperately needed by response organizations for rescue operations and aid coordination. The storm had knocked out the majority of communication services, including cellular internet service, on the island. NetHope crews were quickly deployed and worked to restore connectivity for responding organizations to coordinate rescue and aid efforts. Their challenge was how to target efforts to the areas of highest need. As shown in the figure below, Disaster Maps data was used to show drops in connectivity on a daily basis by comparing the aggregate number of users connecting to Facebook before the storm and the number able to connect in the days after the hurricane.[38] This data helped NetHope identify the areas of greatest need and efficiently prioritize its relief efforts.

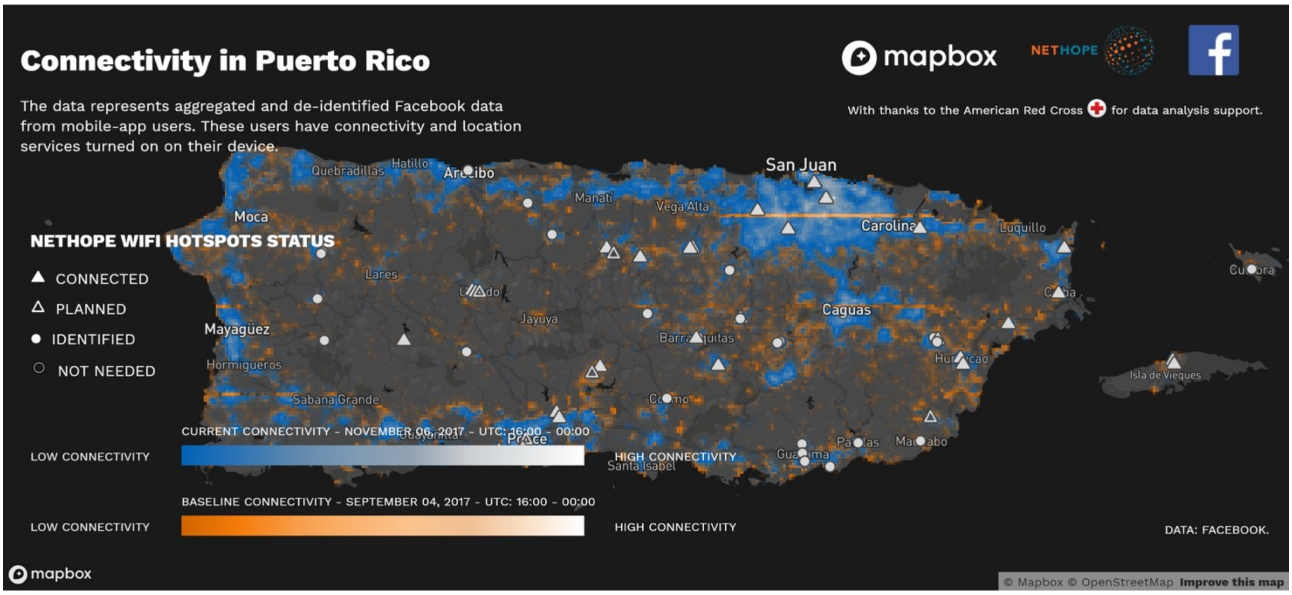


Figure A1- 26 Example Connectivity Map Generated with Facebook Disaster Maps Data by Nethope

Facebook has developed its Disaster Maps program through a cross-functional effort including research, design, engineering, legal, and policy teams to ensure that useful data is reliably provided to vetted NGO and research organizations. The program is ongoing and seeking to reach more people in need after a crisis; increasing the data types surfaced in each Disaster Map; and improving the accuracy of existing Disaster Maps data sets. Of particular note is the emphasis on ensuring that the privacy-protecting methods (such as aggregation and spatial smoothing) used in Disaster Maps are published openly. Companies in the tech sector have a wide range of privacy-protecting methods when considering how to share data, and these must be weighed

38 https://nethope.org/2018/09/10/unlocking-insights-from-data-collaboration-with-private-sector-creates-cutting-edge-maps-for-disaster-response/

against both technical limitations and legal requirements. These considerations take considerable amounts of effort and time. By publishing the solution that works for it, the company has dramatically reduced the barrier of entry for other entities to providing similar data sets in order to create a more complete picture for crisis response organizations.

(3) Facebook's Data Sharing Approach

The company generates and shares Disaster Maps as part of its Data for Good program,[39] which is responsible for sharing data sets externally with humanitarian response organizations while preserving user privacy. In the course of building these efforts, The company developed key lessons and resources that can lower barriers for other companies to participate in similar crisis response data-sharing efforts.

- Facebook published its privacy protection methods used in Disaster Maps in May 2019, which include aggregation, spatial smoothing, dropping small counts, and other techniques as part of the proceedings of the 16th ISCRAM Conference in València, Spain.[40] This open publication represents a critical contribution in order to stimulate other private sector companies to consider providing similar data sets to crisis response organizations. Determining an acceptable privacy protection threshold in geospatial data sets is a complex undertaking, and our hope is that by openly publishing our methods, this will lower barriers to entry for other private sector agencies to move forward with similar data sharing efforts.
- The company launched improved displacement maps at the October 2019 Nethope Global Summit in Puerto Rico[41]. These maps help nonprofit and research partners better understand the volume of people that have been displaced after a natural disaster, as well as which locations they have been displaced to.
- The company launched simplified and improved network connectivity maps in December 2019 based on feedback from existing emergency communications partners about a desire to better understand where network connectivity was completely out following a natural disaster rather than simply reduced. These new network connectivity maps show where users have cellular connectivity at a 2G, 3G or 4G connection type based on the speed and latency of data being sent between a user's device and the servers which host the mobile app.

(4) A Collaborative Approach

The goal of the Disaster Maps program is to empower crisis response organizations and researchers with data that improves delivery of life-saving interventions while preserving user privacy. This work also seeks to drive innovation in crisis response and emergency communications efforts that extends beyond the company. To date it has partnered with over 100 NGO and research organizations through Disaster Maps and a number of its NGO partners also work to share derivative products with broader coalitions of

39 https://dataforgood.fb.com/

40 WiPe Paper – Social Media in Crisis and Conflicts. Proceedings of the 16th ISCRAM Conference – València, Spain May 2019. Zeno Franco, José J. González and José H. Canós, eds.

41 https://solutionscenter.nethope.org/nethope-global-summit-2019-resource-library

response agencies including federal, state and local entities. These crisis response organizations are experienced in engaging government agencies and providing them with geospatial data. The company's program model is to empower such partners with new data sources rather than displace their role in coordinating with governments directly. This has proven very successful and scalable. Its partners all complete a data license agreement in order to be granted access to Disaster Maps data.

When specific crisis response data gaps emerge, the company seeks organizations to work with closely to guide its research and development of new or improved data sets. For example, the methodology for the improved displacement maps released in October 2019 was co-created by Facebook and the Internal Displacement Monitoring Centre (IDMC)[42], which works on measuring internally displaced people. The company's Data for Good team continues to work with IDMC to compare the insights derived from displacement data from recent crises in 2019 such as Cyclone Idai in India/Bangladesh and Typhoon Hagibis in Japan. The company's teams then work with IDMC to compare displacement data to more traditional sources in order to refine and educate ongoing development efforts.

Collaboration with crisis response organizations in the emergency communications space also led to the new network connectivity maps. Specifically, collaboration and feedback from Nethope and its member organizations on the need to simplify the nature of coverage map generation for efficient operational decision making. Critical questions facing these organizations included whether people had cellular connectivity, where drops in cellular connectivity had been observed in disaster impacted areas, and how certain they could be that there had been a drop in cellular connectivity in a disaster impacted area. To answer the first question, Facebook developed a simple coverage map which shows the grid tiles that had network coverage on a given date. To address the second question, it also surfaced a map that shows which grid tiles where we have not yet seen network connections on that date, but where we have observed coverage during the 30-day baseline period. The company's teams addressed the third question by publishing the probability of a grid tile receiving network coverage on that date based on 30-day baseline observations.

(5) Testing and Usability

All Disaster Maps undergo testing with users in order to ensure that new data sets are clear to understand and fit within the workflows of crisis response organizations. The company's Data for Good team has invested heavily in usability research with organizations across a on the spectrum of geospatial experience. For example, research with advanced users was a key part of refining and improving the format of data set files to enable customized analysis methods across a range of GIS applications. This research also included one on one interviews with novice users of Disaster Maps to test early prototypes and determine the best means to visualize complex displacement data in vector format. Based on this feedback, the company's Data for Good team updated visualizations to allow for filtering by outbound or inbound displacement for a given location. In addition, the team improved the depth of

42 http://www.internal-displacement.org/

documentation on the statistical methods used comparing pre-crisis connectivity levels to those observed in real-time.

(6) Creating an Enabling Policy and Regulatory Environment for Sharing Information During a Disaster

We support policies that protect and promote user privacy, especially during times of increased vulnerability such as following an emergency crisis. Facebook recognizes that protecting privacy alongside improving the effectiveness of potentially life-saving response efforts requires concerted time and effort among technical and programmatic teams.

The company and its partners encourage other entities from across the public and private sector to share geospatial data sets that preserve user privacy. A variety of collaborative approaches, including data governance frameworks, should be considered for scaling data sharing efforts across private sector companies so as to avoid overwhelming response organizations with additional data. The Data Collaboratives[43] framework provided by GovLab has proven extremely useful in helping ensure decision-makers are able to be more data-driven and collaborative with the private sector.

Collectively, the emergency response community should advance policies and programs that encourage a transparent approach to privacy protection and afford continued collaboration for improved humanitarian operations.

43 https://datacollaboratives.org/

Annex 2: Collaboration with other guorps

A2.1. Collaboration with Questions in Study Group 2 and in the other Study Group

This section provides the list of matching of ITU-D SG2 Q5/2 to other Questions under ITU-D Study Groups 1 and 2. This list was reviewed and discussed in the Q5/2 meetings. After reviewing these documents, the table below was agreed without any further comments.

Table A2- 1 Matrix of ITU-D Study Group 1 and 2 intra-sector coordination

	Q5/2
Q1/1	X
Q2/1	X
Q3/1	X
Q4/1	X
Q5/1	X
Q6/1	
Q7/1	
Q1/2	X
Q2/2	X
Q3/2	X
Q4/2	
Q5/2	
Q6/2	X
Q7/2	

A2.2. Mapping of ITU-T and ITU-D work

This section provides the list of matching of ITU-D SG2 Q5/2 to ITU-T SGs. Several incoming liaison statements from ITU-T SGs informed their modifications. After reviewing the list in the Q5/2 Rapporteur Group meeting, Tables A2-2, 3 and 4 below were updated.

Table A2- 2 ITU-D SG2 Question 5/2 vis-à-vis ITU-T Questions and Working items

ITU-D SG2 Question 5/2: Utilizing telecommunications/ICTs for disaster risk reduction and management		
ITU-T SG	**ITU-T Question**	**Working items**
SG2	Q3/2: Service and operational aspects of telecommunications, including service definition	E.119 (ex E.rdr-scbm) Requirements for safety confirmation and broadcast message service for disaster relief; E.sup.fdr Framework of disaster management for disaster relief system; E.TD-DR Terms and definitions for DR&NRR
SG5	Q6/5: Achieving energy efficiency and smart energy	L.SES Use of ICT sites to support environmental sensing
SG11	Q3/11: Signalling requirements and protocols for emergency telecommunications	Q.ETN-DS Signalling architecture of the fast deployment emergency telecommunication network to be used in a natural disaster; Q.suppl.Multi_Device_ETS Signalling requirements for VoLTE-based network and GSM/UMTS network supporting Multi-device emergency telecommunications service; Q.Suppl.VoLTE_ETS_Interconnection Signalling requirements for interconnection between VoLTE-based network and other networks supporting emergency telecommunications service (ETS)
SG12	Q4/12 Objective methods for speech and audio evaluation in vehicles	P.1140 Speech Quality Requirements for Emergency Calls
SG15	Q17/15: Maintenance and operation of optical fibre cable networks	L.300series.Sup.35 (ex L.300series.Sup.nrr-frm) Framework of disaster management for network resilience and recovery

SG16	Q8/16: Immersive live experience systems and services	H.ILE-SS Service scenario of ILE; H.ILE-MMT Service configuration, media transport protocols, signalling information of MMT for Immersive Live Experience systems
	Q14/16: Digital signage systems and services	H.DS-ASM Digital signage: Metadata for alerting services; H.DS-CASF Digital signage: Common alerting service framework; H.785.0 Digital signage: Requirements for disaster information services
	Q26/16: Accessibility to multimedia systems and services	H.MD-DiDRR Profile metadata for persons with specific needs as part of disability-inclusive disaster risk reduction
SG20	Q2/20: Requirements, capabilities, and use cases across verticals	Y.4119 (ex Y.AERS-reqts) Requirements and capability framework for IoT-based automotive emergency response system
	Q3/20: Architectures, management, protocols and Quality of Service	Y.AERS-msd Minimum set of data structure for automotive emergency response system; Y.AERS-mtp Minimum set of data transfer protocol for automotive emergency response system;
	Q4/20: e/Smart services, applications and supporting platforms	Y.disaster_notification Framework of the disaster notification of the population in Smart Cities and Communities; Y.smart-evacuation Framework of Smart Evacuation during emergencies in Smart Cities and Communities;

Table A2- 3 Matrix of ITU-D SG2 Question 5/2 and ITU-T Questions

		Q5/2
ITU-T SG2	Q1/2	
	Q3/2	X
	Q5/2	
	Q6/2	
	Q7/2	
ITU-T SG3	Q1/3	
	Q2/3	
	Q3/3	
	Q4/3	
	Q6/3	
	Q7/3	
	Q9/3	
	Q10/3	
	Q11/3	
	Q12/3	
	Q13/3	
ITU-T SG5	Q1/5	
	Q2/5	
	Q3/5	
	Q4/5	
	Q6/5	X
	Q7/5	

		Q5/2
	Q8/5	
	Q9/5	X
ITU-T SG9	Q1/9	
	Q2/9	
	Q4/9	
	Q5/9	
	Q6/9	
	Q7/9	
	Q8/9	
	Q10/9	
ITU-T SG11	Q1/11	
	Q2/11	
	Q3/11	X
	Q4/11	
	Q5/11	
	Q6/11	
	Q7/11	
	Q9/11	
	Q10/11	
	Q11/11	
	Q12/1	

		Q5/2
	1	
	Q13/11	
	Q14/11	
	Q15/11	
ITU-T SG12	Q2/12	
	Q3/12	
	Q4/12	X
	Q5/12	
	Q6/12	
	Q7/12	
	Q8/12	
	Q11/12	
	Q12/12	
	Q13/12	
	Q16/12	
	Q18/12	
	Q19/12	

		Q5/2
ITU-T SG13	Q1/13	
	Q5/13	
	Q6/13	
	Q7/13	
	Q16/13	
	Q17/13	
	Q18/13	
	Q19/13	
	Q20/13	
	Q21/13	
	Q22/13	
	Q23/13	
ITU-T SG15	Q1/15	X
	Q11/15	
	Q12/15	
	Q16/15	X
	Q17/15	X
ITU-T SG16	Q8/16	X
	Q13/16	
	Q14/16	X
	Q21/16	
	Q24/16	
	Q26/16	X
	Q27/16	
	Q28/16	
ITU-T SG17	Q1/17	
	Q2/17	
	Q3/17	
	Q4/17	
	Q5/17	
	Q6/17	
	Q7/17	
	Q8/17	
	Q9/17	
	Q10/17	
	Q11/17	
	Q13/17	
ITU-T SG20	Q1/20	
	Q2/20	X
	Q3/20	X
	Q4/20	X
	Q5/20	
	Q6/20	
	Q7/20	

Table A2- 4 List of ITU-T Questions which could be related to ITU-D Question 5/2 even in the absence of relevant ITU-T working items

ITU-D SG2 Question 5/2: Utilizing telecommunications/ICTs for disaster risk reduction and management	
SG5	Q9/5: Climate change and assessment of information and communication technology (ICT) in the framework of the Sustainable Development Goals (SDGs)
SG9	Q8/9: The Internet protocol (IP) enabled multimedia applications and services for cable television networks enabled by converged platforms
SG12	Q1/12: SG12 work programme and quality of service/quality of experience (QoS/QoE) coordination in ITU-T
	Q2/12: Definitions, guides and frameworks related to QoS/QoE
SG13	Q2/13: Next-generation network (NGN) evolution with innovative technologies including software-defined networking (SDN) and network function virtualization (NFV)
SG15	Q1/15: Coordination of access and home network transport standards
	Q16/15: Optical physical infrastructures
SG16	Q1/16: Multimedia coordination
	Q11/16: Multimedia systems, terminals, gateways and data conferencing
SG17	Q4/17: Cybersecurity

A2.3. Mapping of ITU-R and ITU-D work

This section provides the list of matching of ITU-D SG2 Question 5/2 to ITU-R working parties. After reviewing the list at the Q5/2 Rapporteur Group meeting, the table below was modified.

Table A2- 5 MATRIX OF ITU-R WORKING PARTIES AND ITU-D SG2 QUESTION 5/2

R\D	WP 1A	WP 1B	WP 1C	WP 3J	WP 3K	WP 3L	WP 3M	WP 4A	WP 4B	WP 4C	WP 5A	WP 5B	WP 5C	WP 5D
Q5/2		X	X					X	X	X	X	X	X	X

R\D	WP 6A	WP 6B	WP 6C	WP 7A	WP 7B	WP 7C	WP 7D
Q5/2	X	X	X			X	

Annex 3: Information from other organizations

A3.1. Framework of Disaster Management for Network Resilience and Recovery (NRR) (ITU-T Study Group 15)

The liaison statement informed about the establishment of the supplement ITU-T L.Sup35, Framework of Disaster Management for Network Resilience and Recovery (NRR), which summarized several architectural frameworks for NRR to increase continuity of communications as much as possible in the event of disaster.

A3.2. Informative update in the area of disaster communications (ITU-R Disaster Relief Liaison Rapporteur)

ITU-R Disaster Relief Liaison Rapporteur frequently provided updated information related to disaster communications in ITU-R and other organizations.

Liaison statements provided a comprehensive and informative update of disaster communications activities, reports, resources, deployments, and programs by ITU-R and numerous ITU, Regional and industry partners through October 2017, including a comprehensive update on known Caribbean Hurricane responses. The Rapporteurs thanked the ITU-R Disaster Relief Rapporteur for this helpful information. The Q5/2 meeting noted this liaison statement.

ITU-R Disaster Relief Liaison Rapporteur also provided a comprehensive list of recent disaster related activities noted across ITU Sectors, in regional organizations, and in industry specific groups. It was agreed to draft an outgoing Liaison Statement the Q 5/2 providing an update on the October 7 ICT Drills and Exercises Workshop and requesting interested colleagues across ITU Sectors to consider submitting contributions related to ICT Drills and Exercises and the Enabling Policy Environment for ICT Resiliency and Response.

ITU-R Disaster Relief Liaison Rapporteur also provided information about a revision of Question ITU-R 77-8/5 on the needs of developing countries in the development and implementation of IMT. In response to an intervention from ATDI (France), the Q5/2 team relented and agreed to send a reply liaison statement to ITU-R SG5 to thank them for their liaison statement, with a link to the Q5/2 meeting report.

A3.3. Remote sensing systems (ITU-R Working Party 7C)

ITU-R Working Party 7C for their report on remote sensing systems, which notes that ITU-R is updating Recommendations ITU-R RS.1859 on the use of national remote sensing systems for data collection in the event of disaster, which will be finalized and sent to the parent group, ITU-R Study Group 7, in September 2018.

A3.4. Country national emergency telecom systems (ITU-T Study Group 2)

ITU-T Study Group 2 sought the review and comment of Question 5/2 on the contribution from Benin titled "Improving the emergency Telecom system in Benin, " which proposes creation of a new work item in ITU-T focusing on the developing country national emergency telecom systems that looks at defining norms and practices regarding countries and their level of development, further urging work on developing emergency telecommunications infrastructure. Q5/2 would send a reply liaison statement to ITU-T SG 2 inviting all parties seeking development and capacity building assistance to contact the BDT Director for assistance, further encouraging ITU members to collaborate with, or join the work of Question 5/2.

A3.5. Terms and definitions for disaster relief systems, network resilience and recovery (ITU-T Study Group 2)

This liaison statement informed ITU-T SG2's work on E.TD-DR – "Terms and definitions for disaster relief systems, network resilience and recovery". It was suggested that definitions from this document can be used in the Q5/2 reports.

ITU-T SG2 informed about the finalized ITU-T Recommendation E.102 (ex E.td-dr) "Terms and definitions for disaster relief systems, network resilience and recovery", and E.100-series Supplement 1 (ex. E.sup.fdr). The Q5/2 meeting noted this liaison statement.

A3.6. Framework of disaster management for disaster relief systems (ITU-T Study Group 2)

ITU-T SG2 informed on E.SUP.FDR – "Framework of disaster management for disaster relief systems". It was noted that Section 6 of this supplement ("Overview of early warning and disaster relief systems") can be referred to in the Q5/2 reports.

It was suggested to reply with thanks and provide some comments to their document based on the Q5/2 experience. Further, it recommended that this will help to avoid duplication of work and make use of sent information in this supplement. Q5/2 agreed to send a reply liaison statement thanking ITU-T SG2 for this helpful information, portions of which will be considered for the Q5/2 reports. In addition, ongoing updates and collaboration will be requested.

A3.7. Global broadband Internet access by fixed-satellite service systems (ITU-R Working Party 4A)

This liaison statement informed the progress on ITU-R Recommendation S.1782 – "Possibilities for global broadband Internet access by fixed-satellite service systems". As this is technical document, it was noted and no action was suggested.

A3.8. The fast deployment emergency telecommunication network (ITU-T Study Group 11)

This liaison statement informed the progress of ITU-T SG11 in drafting Recommendation Q.ETN.DS – "Signalling architecture of the fast deployment emergency telecommunication network to be used in a natural", which focused on a number of emerging technologies. Q5/2 agreed to send a reply liaison thanking ITU-T SG11 for this contribution, and with the intention to follow-up with any questions and to use information from this input in the Q5/2 annual report.

ITU-T SG11 informed status of the work on the draft ITU-T Recommendation Q.ETN-DS. It was noted that the corresponding completed work item should be removed from the mapping table between ITU-D and ITU-T. ITU-T SG11 also provided updates on the Recommendation ITU-T Q.ETN-DS "Signaling Architecture for the Fast Deployment of Emergency Telecommunications

Networks to be Used in a Natural Disaster". Q5/2 noted this liaison statement and will consider portions of this study for the Q 5/2 technology report.

A3.9. Fixed Wireless Systems for disaster mitigation and relief operations (ITU-R SG5)

This document informed ITU-R SG5's update of ITU-R Recommendation F.1105 "Fixed Wireless Systems for disaster mitigation and relief operations" providing a summary. The Q5/2 meeting noted this helpful update.

A3.10. Satellite Systems (ITU-R WP4B)

ITU-R WP4B on interrelated activities of ITU-R and ITU-D noted the update of Report ITU-R M. NGAT-SAT on Key Elements for Integration of Satellite Systems into Next Generation Access Activities. ITU-R WP4B also informed the update of Recommendation ITU-R S.1782.0 Possibilities for Broadband Internet Access by Fixed Satellite Service Systems..

Annex 4: Information on workshops and panel sessions

A4.1. Panel Session on Early Warning Systems including Safety Confirmation

Panel Session on Early Warning System including safety confirmation[44]

Geneva, Switzerland

8 May 2018

Panel Session Summary

A4.1.1 INTRODUCTION

As part of the work of **ITU-D Study Group 2 Question 5/2,** with the support of the administrations of Japan and the United States, Q5/2 organized a **Panel Session on Early Warning Systems including Safety Confirmation** on 8 May 2018. The session was an opportunity to present a high level introduction to numerous stakeholders involved in Early Warning, with activities including disaster prediction and detection, alerting, emergency information and safety confirmation. The discussion focused on an identification of lessons learned based on experiences of a diverse group of stakeholders. The discussion results will be considered for further study as the Question focuses on early warning in 2018, with key findings incorporated into the Annual report of Question 5/2 for 2018 on early warning.

A4.1.2 SESSION DETAILS

A4.1.2.1 OPENING: The session was opened by **Dr. Hideo Imanaka, Vice-Rapporteur of Question 5/2 from National Institute of Information Communication Technology (NICT), Japan,** who briefly explained the background and objectives of this panel session as its coordinator.

Cosmas Zavazava, Chief of Department, Project Support and Knowledge Management of BDT delivered opening remarks which included ITU activities on disaster relief. He emphasized that panel sessions and workshops are very important for exchanging information and experience within ITU-D, the other ITU sectors, and with other organizations, noting the conclusions and best practices from the panel session would be valuable for the work of Question 5/2.

A4.1.2.2 PANEL DISCUSSION

The panel session, led by **Joseph Burton, Co-Rapporteur for ITU-D SG-2 Question 5/2 from United States Department of State,** discussed both current and emerging technologies for early warning systems, as well as the experiences of government, industry and research institute stakeholders in sharing how their planning and preparation for detecting disasters and alerting must continuously evolve based on lessons learned from previous disasters.

Dr. Xu TANG, Weather and Disaster Risk Reduction Service Department, World Meteorological Organization (WMO), briefly explained WMO activities that can benefit national early warning and alerting activities, including the Multi-Hazard Early Warning Systems (MHEWS) Checklist and the Climate Risk and Early Warning Systems (CREWS) Initiative. Dr. Tang

44 https://www.itu.int/en/ITU-D/Study-Groups/2018-2021/Pages/meetings/panel-EWS.aspx

discussed how countries can use the MHEWS checklist, which is available on the WMO web site. WMO also adopted the common alerting protocol (ITU-T X.1303) and the alerting platform called Alert Hub. The Global Multi-hazard Alert System (GMAS) objective is to provide authoritative information and advice to UN agencies and the humanitarian community, in both their operational and long term decision making processes.

Imani ELLIS-CHEEK SY, Federal Communications Commission (FCC), United States, provided an overview of the Modernization of U.S. Alerting Systems; including the Emergency Alert System (EAS) and Wireless Emergency Alerts (WEA). EAS enables the delivery of alert messages by broadcast radio and television, cable television, and direct broadcast satellite. WEA can send alert messages to mobile phones in targeted areas. WEA can also provide Child Abduction Alerts.

Azar ZARREBINI, Iridium, United States, shared information about the importance of EWS by using satellite technologies. She pointed out that satellites can quickly provide emergency communications in the event of disaster, but that emergency deployments of satellite equipment are often hindered by licensing or (regulatory) issues. In the future, communications policy makers will need to consider policies that will enable, and not delay the use of M2M based disaster detection applications, which have implications for early warning.

Yulia KOULIKOVA, EMEA Satellite Operators Association (ESOA), Belgium, introduced the activities of Multi hazard Early Warning System in ESOA. ESOA had a program, called SATLAS, which is a co-funded project under European Space Agency Advanced Research in Telecommunications Systems (ARTES). SATLAS is an incubator for developing SATCOM applications. Its target market is Europe, the Middle East and Africa (EMEA), with a focus on Middle East and Africa. As with the EWS on flood, ESOA provided standalone flood monitoring solution by using BGAN-M2M. In addition, using BGAN-M2M tsunami EWS can be established which through sensors, monitor in real time changes in the sea level and other parameters then, using specific platforms, information will be disseminated to the relevant systems that can trigger sirens to alert citizens to an emergency situation. This system was tested in Thailand.

Yoshiaki NAGAYA, Ministry of Internal Affairs and Communications (MIC), Japan, briefly introduced latest research activities on Early Warning in Japan. Real-time big data analysis could be used for detecting localized torrential rain. 3-D images captured by newly developed radars are analyzed in very short time to send alert messages 20 minutes before potential torrential rains. Analyzing SNS messages could be helpful for disaster detection. DISAANA (DISaster information ANAlyzer) developed by NICT, Japan, could analyze SNS (eg. Twitter) messages which were extremely large number and non-structured data. The outputs of DISAANA could be used for collecting victim’s needs and sensing disaster affected areas.

A4.1.2.3 CONCLUSIONS AND BEST PRACTICES:

In the panel discussion, participants including Sudan, Niger, Benin, ATDI, Cote d’Ivoire, Tanzania, South Africa and Ghana, engaged in an active discussion with panellists and the BDT. The following items were recognized as best practices through panel discussion. Contributions to Question 5/2 in 2018 that take early warning systems experiences and needs into account will be quite valuable for further consideration.

- **Keeping developing country needs in mind:** Alerting systems must meet developing countries needs and take into account the level of technologies in use.
- **Ensuring flexibility**: Flexibility in designing, tailoring and testing alerts for multiple hazards that developing countries experience is crucial. Countries are seeking examples of enabling policies that allow flexibility for the type of alerts used, such as child abduction or terrorism, and trafficking, in addition to the wide range of potential natural disasters such as earthquakes, floods, tsunamis, or fires. Developing countries are also seeking examples of enabling policies that allow flexibility for the type of alerts used.
- **Regulatory flexibility:** Developing policies that enable regulatory flexibility, before a disaster, is critical. Communications regulators have granted “Special Temporary Authorities” (STAs) which can provide flexibility to shorten the approval period for emergency communications deployments.
- **Evolving technologies:** Evolving technologies are playing an important role in more effective and efficient dissemination of Multi-Hazard Early Warnings. For example, in addition to detecting natural disasters such as tsunamis and floods, IoT based technologies can help in collection of data which can be processed using big-data analysis technologies to detect probable diseases in livestock. Procedures and technology must be continually evaluated and updated to ensure alerts and warnings are timely, relevant, and followed by the communities that receive them.
- **Evolving emergency alert system**: Countries must consider the means of alerting emergency information to citizens, recognizing the ongoing and critical importance of broadcast media (radio, television, etc.) for distributing information to citizens in the case of disaster, while simultaneously recognizing that people are increasingly relying on mobile devices to get information.
- **The need for enabling policies:** The Tampere Convention on the Provision of Telecommunications Resources is a valuable tool for countries to increase disaster preparedness and response capabilities but often countries that have signed the Convention have not put the necessary enabling policies and procedures in place. Member States are encouraged to request implementation capacity building assistance from the BDT.
- **Ensuring connectivity:** A lack of connectivity is not just a development issue, it’s a safety issue as lifesaving alerts and warnings may not be received when disasters strike, in addition to delaying or hindering disaster response and recovery. It is important that communications development policies consider potential emergency communications needs and the resiliency of networks.
- **Capacity Building:** There are potential opportunities for the BDT to enhance the capacity of Least Developed Countries (LDCs) and Small Island Developing States (SIDS) to generate and communicate effective, impact-based, multi-hazard, gender-informed early warnings and risk information. Capacity building to improve alerting, detection and response is critical.
- **Continual Improvement in emergency procedures:** Pilot projects, disaster management drills and exercises are important to test procedures

and make adjustments as needed to better prepare for specific types of emergencies.

- **Other areas for consideration:**
  - Advance training on satellite systems
  - Warnings in the last mile for sending warning messages from local government to citizens, and the capacity of satellite systems
  - The ongoing pursuit of disaster risk knowledge, which can be expanded based on the systematic collection of data and disaster risk assessments; Detection, monitoring, analysis and forecasting of the hazards and possible consequences. This enables the communication of timely, accurate relevant, and actionable warnings with information on likelihood, impact and actions that citizens should take.
  - The need for ongoing Stakeholder coordination

A4.1.3 CLOSING

Sanjeev BANZAL, Co-Rapporteur of Question 5/2 from Telecom Regulatory Authority of India (TRAI), India, summarized the outcomes of panel discussion. He pointed out that issues on EWS covered from regulatory to emerging technologies such as M2M and SNS, and importance of hazard early warning checklist was recognized. He concluded the topic is of great interest to participants and encouraged further information exchange on EWS, in particular through the submission of contributions to the October 2918 meeting of Question 5/2 which provide specific examples of the application of technologies to specific areas of EWS, and examples of enabling policies.

Dr. Ahmad R. SHARAFAT, ITU-D SG2 Chairman, Iran, made closing remarks. He expressed thanks to management team of Q5/2, BDT, panellists and participants for having fruitful panel discussions.

A4.2. Workshop session on disaster drills and emerging technologies on disaster management

Report of the session on disaster drills and emerging technologies on disaster management, held on 3 October 2018 in conjunction with the Question 5/2 rapporteur group meeting

(Geneva, October, 3 October 2018, 09:30 – 15:45 hours)

A4.2.1 Introduction

As part of the work of **ITU-D Study Group 2 Question 5/2**, Q5/2 organized a **workshop session on disaster drills and emerging technologies on disaster management** on Wednesday 3 October 2018 from 09:30 to 15:45 hours. This workshop consisted of three detailed sessions, and was aimed to present and exchange information on disaster drills, exercises and emerging technologies. The discussion focused on identifying lessons learned based on the experiences of a diverse group of stakeholders. The discussion results will be considered for further study as the Question focuses on disaster drills in 2019, with key findings incorporated into the annual report of Question 5/2 for 2019 on disaster drills using ICTs.

All presentations for this session are available on the event website at: https://www.itu.int/en/ITU-D/Study-Groups/2018-2021/Pages/meetings/session-Q5-2-oct18.aspx.

A4.2.2 Session details

A4.2.2.1 Opening

The workshop was opened by **Mr Sanjeev Banzal (India), Co-Rapporteur for Question 5/2**, who welcomed participants, then briefly explained the background and objectives of this workshop.

A4.2.2.2 Session 1: Experiences of disaster drills by using emergency telecommunication systems

Session 1 was moderated by **Mr Hideo Imanaka (National Institute of Information and Communications Technology – NICT, Japan), Vice-Rapporteur for Question 5/2.** The objectives for this session were:

- Explore experiments on actual disaster drills using ICTs
- Consider lessons learned from experiences of disaster drills, and effectiveness of the drills in emergency situations
- Discuss the key objectives of drills, and how stakeholders are involved.

Mr Lars Bromley (United Nations Institute for Training and Research – UNITAR), presented "UNITAR's role in disaster preparedness and drills", which briefly explained UNITAR and UNOSAT activities for disaster drills and assessment of disaster affected areas using satellite imagery analysis technologies. The triplex exercise, which is a large scale field simulation exercise focusing on strengthening preparedness and response in regard to coordination and effective emergency response held in Norway in 2016, simulated hurricanes and floods, with over 100 participants from several organizations including UNOSAT. The Virtual on-Site Operations Coordination Center (VOSOCC) was established within UNOSAT. Lessons learned from this exercise were that frequent exercises are important for ensuring that emergency systems are available and operational when needed.

Mr Jeffrey Llanto (Central Visayas Information Sharing Network Foundation – CVISNet, Philippines), presented remotely on the "Use of emergency telecommunication systems in disaster management drills: the case of the Philippines", which provided an overview of CVISNet's emergency telecommunication drills, exercises and trainings in the Philippines. Mr Llanto discussed the Movable and Deployable ICT Resource Unit (MDRU) which was utilized in ITU projects in the Philippines, held in 2014. Because of the dual benefits of regularly utilizing this technology and bringing connectivity, CVISNet is considering using MDRU to provide connectivity between disasters.

India asked how MDRU connects with communications networks. Mr Llanto responded that MDRU has interfaces with ordinary telephone networks and the Internet.

Mr Hiroshi Kumagai (National Institute of Information and Communications Technology – NICT, Japan), presented on "Emergency communication drills in metropolitan areas" which introduced MDRU and the "NerveNet" (ad-hoc network system), and also introduced actual disaster drills using ICTs held in Japan. Lessons learned from these drills were that the battery capacity of ICT equipment was a significant factor, and ensuring power should be important in disasters, and NerveNet with MDRU could be utilized in the case of disaster.

India asked how big MDRU is. Dr. Kumagai responded that MDRU had several types from container type to attaché case type. The moderator showed an actual attaché case type system. India also asked whether special equipment was required to use MDRU. Mr Kumagai explained that no additional equipment is needed, when MDRU software is installed on smartphones. **The United States** asked whether MDRU can be pre-positioned before a disaster or if it is only deployed post-disaster. Mr Kumagai replied that MDRU could be installed in both cases.

Mr Akihiro Nakatani (Astem, Japan), presented on "Disaster relief applications for broadcasting services", which introduced an IPTV-based translation system for persons with hearing impairment, called "Eye Dragon", that combined sign language and captions with live terrestrial TV programs to assist Persons with Disabilities (PwDs). This system could provide significant information to PwDs in the case of disaster. Utilization of this system and experience of disaster drills saved the lives of PwDs at the Great East Japan earthquake and Tsunami in March 2011.

Nigeria asked whether IPTV broadband networks are needed to receive sign language translation for live television, or if this could be provided on over-the-air television (terrestrial TV). Mr Nakatani responded that for IPTV, broadband networks are needed to receive such transmissions.

A4.2.2.3 Session 2: Emerging technologies on disaster management

Session 2 was moderated by **Mr Abdulkarim Ayopo Oloyede (Nigeria), Vice-Rapporteur for Question 5/2**. The discussion points of this session were introduced as follows:

- Understand how technologies are being applied
- Policies that enable the advancement and deployment of evolving technologies
- Explore examples and types of new emerging disaster management technologies, including recent and expected technological evolutions.

Ms Emily Yousling (Google, United States) presented on "The role of the Loon project in disaster risk reduction". She detailed how Google Loon was used in following Hurricane Maria in Puerto Rico and following floods in Peru, and how it can be used around the world for providing access to telecommunication services before, during and after a disaster. She emphasized the need for prepositioning of communications capacity, and not to wait until a disaster before taking actions to ensure the redundancy of communications as it takes some time to restore network infrastructure.

India asked whether Loon's height (20km above ground) will pose flight path issues, how licensed spectrum for LTE services will be obtained for deployments, and how power is supplied to Loon (which is considered a "base station-in-the-sky") in the rainy season and at night, given Loon is solar powered. Ms Yousling responded that due care is taken so that Loon network does not interfere with flight paths and that the spectrum utilized is that of existing telecom operators for whom Loon deploys. Regarding power supply, she responded that multiple Loons are deployed enabling consistent service.

Ms Salma Farouque (Global Emergency Telecommunications Cluster – ETC, United Nations World Food Programme – UN WFP) presented on

"Practical use of drones in disaster response and recovery". She explained that ETC is the part of the United Nations Cluster System responsible for telecommunications. In certain disasters, the ETC can provide security communications through VHF, Internet connectivity through quick deployment of satellite terminals and Wi-Fi, and provides user assistance, as well as helping support communications coordination and information management. Other potential services include liaison with government authorities, preparedness assistance and services for communities, including drone coordination. She noted that drones can be used for multiple humanitarian purposes, including mapping, monitoring, search and rescue, delivery, and providing communication during the response and recovery phases.

Mr Yuichi Ono (Tohoku University, Japan), presented on "Global centre for disaster statistics". He described the use of big data in emergency situations, noting the need for statistics/record keeping the impacts of disasters in different countries of the world. He explained how the data collected can be used by a country during the recovery process, and gave examples how the centre has helped different countries to prepare and plan in order to reduce the recovery process and mitigate future disasters.

Ms Vanessa Gray (ITU/BDT) presented on "Disruptive technologies and disaster management". She explained how ITU supports Member States with capacity building assistance to assist preparedness, as well as in the case of disaster. She emphasized the use of technology to assist in all phases of disaster management. She also explained how ITU is putting in place a disaster management toolkit and drafting Guidelines for Emergency Communications Planning that can be adapted by Member States.

A4.2.2.4 Session 3: Disaster Management and Drills by using ICTs

Session 3 was moderated by **Mr Joseph Burton (United States), Co-Rapporteur of Question 5/2**. The objectives for this session were:

- Examples of the range, scope and frequency of emergency communications exercises and drills
- Understand how exercises and drills can increase preparedness, and ways to increase the effectiveness of drills
- Tailoring of drills and exercises to national conditions and complex emergencies
- Types of potential participants, and enabling robust stakeholder engagement
- Use of innovative technologies in preparedness exercises as well as use of old technologies in innovative ways to support preparedness and response.

Ms Salma Farouque (Global Emergency Telecommunications Cluster – ETC, United Nations World Food Programme – UN WFP) presented on "Coordinating communications drills and exercises – setting the stage". Ms Farouque discussed the range of communication exercises that might consider from a table-top exercise to a functional exercise, to perform a full scale drill like WFP's "opEx Bravo". She further noted that the purpose of an exercise was to test procedures and increase preparedness, by documenting and verifying procedures in place and identifying and addressing gaps. Ms Farouque also noted factors to consider in planning an exercise, and the steps involved in an exercise, including the importance of setting objectives for the exercise in advance, and not only performing a debrief or after action, but drafting an action plan to address and fix issues identified during the after-action. Exercise participants might include the communications regulator, the Ministry of communications, the national disaster management agency, meteorological and geophysics departments (or other hazard warning entities), communication service providers, power utilities, humanitarian organizations, and community stakeholders.

Mr Rod Stafford (International Amateur Radio Union – IARU) presented on “Communications drills and exercises, the amateur radio perspective”, which described the use and application of amateur radio in a range of communications drills. Mr Stafford specified that when communications infrastructure is down, amateur radio may be the only way to communicate in certain areas, so incorporating amateur radio as a part of planning drills and exercises is important, and might provide redundancy of communications. He further discussed (and was asked about) the features of amateur radio technology, which were of great interest to participants. Communication technologies used by amateur radio include HF, VHF, microwave frequencies and amateur radio satellites.

Japan then noted the importance of amateur radio to enable Small Island Developing States (SIDS) to communicate across many islands and great distances. It was also noted by multiple participants that young people often might not be aware of amateur radio itself, and that there was a need to overcome this generation gap. **Mr Ahmad Sharafat (Iran), Chairman of ITU-D Study Group 2**, suggested that IARU submits a white paper on amateur radio benefits and operational modes.

Ms Preeti Banzal (India) presented on “India’s experience executing a mega drill in the Western Himalaya region” to provide the perspective of communication officials coordinating as a part of a national disaster (earthquake) exercise. The scenario enabled a detailed review of preparedness, training and coordination between national and state level officials. The exercise did not only test the response capabilities of various agencies across all levels of government, but also identified gaps policies, procedures and training for further action, and helped facilitate preparation of response plans at all levels of government.

Intel stressed the importance of educating citizens on back-up/redundant means of communications.

A4.2.2.5 Conclusions and best practices

Mr Sanjeev Banzal (India), Co-Rapporteur for Question 5/2, summarized the outcomes of workshop discussions, in terms of the following lessons learned and best practices related to disaster drills and exercises, and on the use of emerging technologies for disaster management:

- Importance of satellite imagery in assessing the extent of disaster affected areas and damages occurred during disasters.
- Importance of using exercise such as Triplex, effective coordination at local site with the control center.
- The use of Virtual Reality (VR) designed by using actual data from prior disasters could help build a more realistic simulated disaster scenario to make training more “life-like”.

- Importance of having MDRU for quick restoration of ICT networks during disaster. Extension of the restoration area could be achieved by the NerveNet.
- Necessity of planning for resilient network capacity, because in emergency situations, even if networks are not damaged, they tend to congested during disasters. It was also observed that network batteries could get depleted during disasters, transmission lines could get disconnected and there might be direct damaged to physical infrastructure.
- “ Technology does not stand alone”. Attention to planning, coordination, exercises and drills, then revising policies and procedures on an ongoing basis, is key. Testing equipment on a regular basis is likewise critical.
- Low technology solutions might be essential in disaster response. Responders should be prepared for technologies not to work, and have redundant means of communications when there was a lack of connectivity and electricity.
- Planning was critical. It was important prior to exercises to outline the goals of the exercise and socialize them with participants and stakeholders.
- The exercise scenario was important and should be appropriate to local hazards and conditions. However, surprises always happen, so the need to adapt and adjust, and encourage flexibility is key. To better prepare participants for complex and shifting scenarios, it should be ensured to include a number of “injects” that escalate a scenario and test the ability of participants to react to increasingly complex situations.
- Practice! Practice! Practice! Frequent training, re-training and disaster response simulations were key to identify gaps and refine policies and procedures.
- Immediately after a disaster happens, the demand for communications would be very high, given the need for the public to contact loved ones for safety confirmations and for responders to coordinate responses on congested and damaged networks. This demand would go down over time and through the recovery period.
- Drills should be specialized by priority need and application such as for medical Information sharing.
- Drills and planning should include persons with disabilities (PwDs), and ensure that PwDs could access information and enable communications. Their communication needs should be fulfilled using all available means, including sign language and captions.
- Enabling early evacuation is key to survival for Persons with Disabilities.
- Countries should encourage citizens to learn to use amateur radio as a means of redundant communications when all other network infrastructures fail.
- The exercise debrief (or after action) where facilitators and participants share experiences and challenges, and provide feedback, was the most important part of an exercise. The debrief should set an action plan for areas that need improvement or adjustment, in addition to confirming areas of strength in the preparedness program. This action plan should prioritize actions for follow-up, starting with “quick wins” identified in the exercise.
- A table-top drill can be a very effective first effort, which can identify gaps and allow for refinements to plans and procedures. It should be followed by mock drills, functional drills and then full scale exercises. Team building during drills helps in coordinating the activities during real situations.

- Importance of including a range of different actors in communication drills, such as communication officials, responsible for emergency frequencies, public safety and regional responsibilities.
- Drills and exercises should also consider ways to increase regulatory flexibility, such as Special Temporary Authorities (STAs), to enable the quick import and deployment of ICT infrastructure.
- Countries should contact the BDT for capacity building assistance, as well as information on disaster/emergency communications preparedness.
- It was advisable to seek outside assistance where desirable.
- It was recommended to prepare Standard Operating Procedures (SOPs) at the national, state and district/community level, and consider how interoperability among these entities might be increased.

A4.2.3 Closing

Mr Sanjeev Banzal (India), Co-Rapporteur for Question 5/2, thanked all the speakers, moderators, participants, BDT Staff and interpreters for their active support and contributions for making the workshop a real success.

A4.3. Workshop session on Conducting National Level Emergency ICT Drills and Exercises: Guidelines for Small Island Developing States (SIDs) and Least Developed Countries (LDCs)

Report of the Session on Conducting National Level Emergency ICT Drills and Exercises: Guidelines for Small Island Developing States (SIDs) and Least Developed Countries (LDCs)

A4.3.1 Introduction

A workshop was held on “Conducting National Level Emergency ICT Drills and Exercises: Guidelines for Small Island Developing States (SIDs) and Least Developed Countries (LDCs)” on Monday 7 October 2019 from 09:30 to 15:45. This workshop was held in conjunction with the Q5/2 Rapporteur Group meeting dedicated to “Utilizing telecommunications/ICTs for disaster risk reduction and management”.

A.4.3.2 Opening

The workshop was opened by **Ms Doreen Bogdan, Director, Telecommunication Development Bureau (BDT), International Telecommunication Union,** who welcomed participants, noting that she had just returned from the Bahamas, where she witnessed the devastating damage in Abaco and Grand Bahamas caused by Hurricane Dorian. The ITU has identified numerous opportunities to provide disaster preparedness capacity building support to the Bahamas and other Member States, including for the advance consideration of policies/regulations to enable roaming in disasters; utilising the ITU’s recently developed Global Guidelines for Drafting National Emergency Telecommunications Plans (NETPs), as well as guidance from ITU partners on conducting ICT drills and exercises. Ms Bogdan noted that the need for ICT preparedness planning is universal, which underscores the importance of holding continued ICT preparedness-focused workshops. Ms Bogdan thanked the panellists from Vanuatu (Republic of), Haiti (Republic of), GSMA, AT&T (United States), the International Amateur Radio Union (IARU), the UN Emergency Telecommunication Cluster (ETC, World Food Programme) and the U.S. Department of State for coming to Geneva to hold these important conversations. She then highlighted the importance of drills and exercises for testing and refining policies and plans, outlining the workshop program and objectives.

A4.3.3 Workshop methodology

The workshop featured 3 sessions, each moderated by Q 5/2 Co-Rapporteur Burton. Session 1 ("Experiences of Planning Disaster Drills and Exercises for SIDS and LDCs") featured presentations by Vanuatu and Haiti on their experiences, followed by a guided Tabletop Exercise. In addition to a presentation by each panellist, an open discussion among panellists was held across Session 2 ("Conducting Drills: A Guided Discussion With Panellists And Participants") and Session 3 ("The Wrap Up: Capturing and Turning Lessons Learned into Action") which followed the phases of holding drills and exercises, including planning, conducting, after actions and translating lessons learned into updated policies.

The workshop then introduced capacity building resources and tools that the BDT has recently developed, in coordination with partners, including the Emergency Telecom Cluster (ETC), to help Member States to develop a robust emergency communications framework and preparedness program, which includes developing National Emergency Telecommunication Plans (NETPs) and conducting ICT drills and exercises.

Outcomes from these discussions will be incorporated into the Q5/2 "Guidelines for Conducting ICT Drills and Exercises" Annual Report.

A4.3.4 Workshop presentations

The following presentations were given during each workshop session:

Session 1: Experiences of Planning Disaster Drills by SIDS and LCDs

- **Mr John Jack** (Office of the Government Chief Information Officer (OGCIO), Vanuatu (Republic of)) presented on Vanuatu's experiences in exercises and drills.
- **Mr Gregory Domond** (Conseil National des Télécommunications (CONATEL), Haiti (Republic of)) presented on Earthquake and tsunami drills and exercises in Haiti.
- **Mr Joseph Burton** (Cyber and International Communications and Information Policy (CIP), United States of America) then led participants through a table-top simulation exercise, developed by the ETC and the ITU for the 2019 Global Symposium for Regulators on The role of the regulator in disaster management, table-top simulation exercise**.**

Session 2 – Conducting drills: a guided discussion with panelists and participants

- **Mr Antwane Johnson** (Federal Emergency Management Agency (FEMA), United States of America) presented on IPAWS – utilizing alert & warning in drills and exercises.
- **Mr Rod Stafford** (International Amateur Radio Union (IARU)) presented on Amateur radio - prepared for drills and exercises.
- **Mr Justin Williams** (Network Disaster Recovery, AT&T (United States of America))
  presented on Leveraging ICTs for disaster and response: what have we learned.

- **Mr Dulip Tillekeratne** (Mobile for Humanitarian Innovation, GSMA) presented on Engaging with Mobile Network Operators (MNOs) on Drills and Exercises.

Session 3 – The wrap-up: capturing and turning lessons learned into action

- **Ms Ria Sen** (Global Emergency Telecommunications Cluster (ETC), World Food Programme (WFP)) introduced the ETC-ITU table-top simulation exercise guide, which is expected to be finalized shortly.
- **Ms Maritza Delgado** (Telecommunication Development Bureau, International Telecommunication Union (ITU)) presented the range of available ITU capacity building assistance. BDT developed information resources to increase overall ICT preparedness and response coordination, including by utilizing the ITU's recently developed Guidelines for Developing National Emergency Telecom Plans (NETPs), in addition to other preparedness services developed in partnership with the ETC for Member States.

Note: All presentations for this session are available on the event website. Best practices and lessons learned from presentations (and workshop discussions) will be reflected in the Q5/2 "Guidelines for Conducting National ICT Drills and Exercises" workshop outcome document.

A4.3.5 Workshop outcomes

Preparations for the workshop resulted in a **draft outcome document by Q5/2 on Guidelines for Conducting National Level ICT Exercises and Drills** that could be tailored to meet the unique needs of Small Island Developing States (SIDS) and Least Developed Countries (LDCs). Co-Rapporteur Burton presented this draft in Document SG2RGQ/TD/12 during the Rapporteur Group meeting for Question 5/2 held on 8 October 2019. These Guidelines will be updated with key learnings, including lessons learned and best practices from workshop discussions. Input into these Guidelines from workshop participants is welcomed. The final draft of the Q5/2 Guidelines will be incorporated into the annual report of Question 5/2 on ICT Drills and Exercises.

A4.4. Workshop session on "Enabling Policy Environment for Disaster Management including for Covid-19 response"

During the study period Q5/2 conducted a public webinar on the "Enabling Policy Environment for Disaster Management including for Covid-19 response" chaired by Mr Ahmad Reza Sharafat, Chairman of ITU-D Study Group 2. The main objectives of the webinar were to:

- Discuss the elements that create an enabling policy environment for increasing emergency telecommunication preparedness, network resilience, disaster risk reduction and disaster management
- Provide examples of policies that enable flexibility when deploying emergency communications equipment and also enable successful disaster preparedness and response with respect to telecommunications and ICTs.
- Share ITU Member experiences and lessons learned in developing and implementing enabling policies and NETPs

During the session, expert panelists discussed the importance of implementing measures and polices that would ensure the continued functioning of communication networks during disasters, such as declaring telecommunication networks as essential services or performing organised drills. The Webinar also featured examples of policies for preparedness as well as different responses observed around the globe during the COVID-19 pandemic.

Juan Roldan of Luxon Consulting Group initiated the presentations by discussing the challenges that come with developing a national emergency telecommunication plan (NETP). An effective NETP accounts for multiple hazards, uses multiple technologies, contains multiple phases and is supported by multiple stakeholders. Mr. Roldan also emphasized the need for political will and support for an NETP, highlighting that governments must clearly identify which specific department or agency is responsible for emergency telecommunications.

Continuing on the theme of cross-sectoral collaboration, Chris Anderson of CenturyLink Global Network advocated for public-private partnerships, declaring them as “necessary for effective disaster management.” Such a partnership should always be assembled during the “blue sky scenario,” meaning before disaster has actually struck, since it is much harder to bring the necessary people together during a crisis, he cautioned.

Concluding the session of the webinar, Paul Margie of Télécoms Sans Frontières (TSF) explained that while disaster management is never one-size-fits-all, commonalities can be observed in the countries where TSF works. These include training beforehand, formally recognizing ICTs as critical infrastructure, publicly identifying points of contact for ICT response, developing procedures so experts can enter quickly, and adopting mechanisms within the telecom regulator to speed decision-making, he said, highlighting how a “Special Temporary Authority” can enable rapid changes to be made when they are most needed.

COVID-19 responses from around the globe

The second segment of the webinar focused on COVID-19 responses that have been observed in different countries worldwide. ITU Programme Officer Maritza Delgado explained how tracking and analyzing these responses is one of the main objectives of REG4COVID, an ITU initiative designed to help communities stay connected during crises and to prepare medium- and long-term recovery measures. “The Global Network Resiliency Platform is just one example of it.

Kathryn O’Brien, Chief of Staff, International Bureau of the US Federal Communication Commission (FCC) shared some guiding principles that has been focusing on in the United States, the first being to set clear priorities. Then there is importance of collaborating with the private sector. Technology must go hand-in-hand with policy when it comes to effective disaster responses. Professor Ryosuke Shibasaki of the University of Tokyo focussed on Information on people flow and density statistics, better-informed decision-making. He discussed about open source analysis software which uses big data from mobile serial data to support COVID-19 responses by measuring movement. The development of this software was originally triggered by ITU in 2015,” and it is now in operation in several African countrie

MainOne CEO Funke Opeke, Nigeria, shared the challenges faced by developing countries in coping with COVID-19.

Mr Rahul Vatts, Chief Regulatory Officer, Bharti Airtel Limited from India explained about traffic surges during covid times have increased up to 50 per cent and therefore it has created infrastructure challenges in India. Due to lockdown there were channleges in movement of maintainance staff. However Telecom Service Providers (TSPs) overcame this challenge with the special permissions from the government and the regulator for movement of telecom staff to enable their movement across critical sites. To address maintenance areas TSPs worked with OTT providers, as network optimization was a continuous necessity. The Government directed the TSPs to change the ringback tone and ringtone of all landlines – nearly 987 million working phones – to a special COVID-19 message asking subscribers to stay home, and practice social distancing.

Lessons learned: Enabling policy today saves lives tomorrow

Access to a robust, resilient and secure ICT infrastructure worldwide is critical in a pandemic, and in any kind of disaster. ICT is essential to to have power, security, health and sanitation – essential services in a global emergency. However the ability of ICTs to perform the necessary function relies on an enabling policy environment, from granting temporary authority for additional spectrum use, to giving complimentary recharge margins for emergency calls.

Among the many other lessons learned from the COVID-19 pandemic is the fact that the world's telecommunication networks and digital infrastructure must be better prepared for disasters of all kinds. Collectively, it should be ensured that drills are carried out and rapid response measures are ready, since future disasters – including pandemics – can occur anytime, anywhere, and with little to no warning.

Any negative consequences of disasters can be diminished if robust resilience networks and disaster management tools are in place well ahead of time. Note: All presentations for this session are available on the event website at https://www.itu.int/en/ITU-D/Study-Groups/2018-2021/Pages/meetings/Webinars/2020/Q5-2-july14.aspx

____