Asian Disaster Reduction Center (ADRC)

Visiting Researcher Program FY2012B

Current Status of Emergency Response System (ERS) in India and Model ERS Based on International Best Practices

Final Research Report

Duni Chand Rana
Joint Secretary, Government of Himachal Pradesh,
Himachal Pradesh Secretariat, Shimla, INDIA

Disclaimer

This report was compiled by an ADRC visiting researcher (VR) from ADRC member countries. The views expressed in the report do not necessarily reflect the views of the ADRC. The boundaries and names shown and the designations used on the maps in the report also do not imply official endorsement or acceptance by the ADRC.

ACKNOWLEDGEMENT

I express my gratitude to Asian Disaster Reduction Center, Japan, Government of India and my State Government for providing me this opportunity to participate in the Visiting Researcher Program. This program provided me an excellent opportunity not only to study Japanese Disaster Management System but also to study some aspects of disaster management in other countries. I always admired Japanese disaster management system and was too keen to study it. Special thanks are therefore due to the Government of Japan and many Japanese institutions which provided me this opportunity to visit their facilities and offices and learn from their practices.

I am overwhelmed by the ADRC staff who tirelessly arranged numerous visits and facilitated my learning. Special thanks are due to Natori san, Executive Director, Shiomi san, Researcher and In-charge of the VR Program and Nakamura san, Senior Researcher and my Mentor. Without their efforts it won't have been possible for me to complete the program and compile this report. I am also very thankful to Sh. Sanjaya Bhatia, Knowledge Management Officer, IRP, Japan for providing his valuable opinion and feedback in compiling this report.

I hope this report will be useful to Government of India and ADRC and I will be able to contribute in the field of DM both in my home state and the country in future.

Table of Contents

1.0 Objectives of the Report

Due to its physiographic and climatic as well as socio-economic conditions, India is one of the world's most disaster-prone areas. Steps have recently been taken to institutionalize holistic disaster management in India. For emergency response, India has a system of multiple toll-free numbers. However, having multiple toll-free numbers tends to cause confusion. Also, in most emergencies, response efforts must be taken by more than one agency and the present system lacks a means of achieving the effective coordination and integration of services. This can lead to response deficiencies and delays. Multiple toll-free numbers and response systems also lead to waste in terms of resources and manpower. The existing system does not use the many ICT tools available for handling calls, creating databases and a decision support system, managing emergency dispatch, and optimizing the utilization of existing resources. The existing system also has no effective and efficient means of communicating early warning signals to vulnerable communities and response agencies. The end result is avoidable loss of life. The aim of this study is to critically review the current system of ERS in India, study international best practices and suggest a model ERS for India.

2.0 Introduction

The word 'emergency' originated from Latin word '*emergere'* which means 'arise, bring to light'. Oxford dictionary defines emergency as "serious, unexpected, and often dangerous situation requiring immediate action." Wikipedia defines an **emergency** as "a situation that poses an *immediate risk* to health, life, property or environment. Most emergencies require urgent intervention to prevent a worsening of the situation, although in some situations, mitigation may not be possible and agencies may only be able to offer palliative care for the aftermath. A crisis or emergency is a threatening condition that requires urgent action. Effective emergency action can avoid the escalation of an event into a disaster.

According to United Nations International Strategy for Disaster Reduction (UNISDR) **emergency management** means "the organization and management of resources and responsibilities for addressing all aspects of emergencies, in particular preparedness, response and initial recovery steps." The UNISDR commentary further say that emergency management involves plans and institutional arrangements to engage and guide the efforts of government, non-government, voluntary and private agencies in comprehensive and

coordinated ways to respond to the entire spectrum of emergency needs. The expression “disaster management” is sometimes used instead of emergency management.

Mitigation, preparedness, response and recovery are the four phases of emergency management. Federal Emergency Management Agency (FEMA) of the United States has given eight principles/doctrines of emergency management. The summary provided below lists these eight principles and provides a brief description of each:

1. Comprehensive – emergency managers consider and take into account all hazards, all phases, all stakeholders and all impacts relevant to disasters.
2. Progressive – emergency managers anticipate future disasters and take preventive and preparatory measures to build disaster-resistant and disaster-resilient communities.
3. Risk-driven – emergency managers use sound risk management principles (hazard identification, risk analysis, and impact analysis) in assigning priorities and resources.
4. Integrated – emergency managers ensure unity of effort among all levels of government and all elements of a community.
5. Collaborative – emergency managers create and sustain broad and sincere relationships among individuals and organizations to encourage trust, advocate a team atmosphere, build consensus, and facilitate communication.
6. Coordinated – emergency managers synchronize the activities of all relevant stakeholders to achieve a common purpose.
7. Flexible – emergency managers use creative and innovative approaches in solving disaster challenges.
8. Professional – emergency managers value a science and knowledge-based approach; based on education, training, experience, ethical practice, public stewardship and continuous improvement.

The succeeding paragraphs of this paper will focus on emergency response and key elements/principles thereof.

Response as per UNISDR terminology consists of “the provision of emergency services and public assistance during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected. Disaster response is predominantly focused on immediate and short-term needs and is sometimes called “disaster relief”. The division between this response stage and the

subsequent recovery stage is not clear-cut. Some response actions, such as the supply of temporary housing and water supplies, may extend well into the recovery stage." Response begins when an emergency/disaster is imminent or immediately after an event occurs. Response encompasses all activities taken to save lives and reduce damage from the event and includes assimilation and dissemination of information, emergency communication, coordination, providing emergency assistance to victims, completing emergency repairs critical to infrastructure, and ensuring the continuity of critical services. Rapid damage assessment of the situation is immediately required enabling Government to prioritize response activities, allocate scarce resources and request and mobilize additional assistance from the state, national governments and international community.

Immediate response phase of an emergency may commence with early warning, evacuation and search and rescue (SAR) activities. Effective and efficient early warning may prove life-saving to the community. In large scale disasters local capabilities are oftenly insufficient to deal with the scale of SAR activities and SAR teams and volunteers will pour in from national and international community. Soon in all cases the focus will quickly turn to fulfilling the basic humanitarian needs of the affected population. This assistance may be provided by local, state, national or international agencies and organizations. The local communication network also gets affected if it is not hazard resistant and further overburdened due to demand for increased communication in disaster. Effective coordination of disaster assistance is often crucial, particularly when many organizations respond and local emergency management agency/government's capacity has been exceeded by the demand or diminished by the disaster itself. Disaster communication and the way the emergency services are summoned is also important as it will affect the effectiveness and efficiency of the response. Michael J Phagel in his book *"Principles of Emergency Management and Emergency Operations Centers (EOC)"* lays stress on the importance of vulnerability assessment, emergency planning and role of EOCs in emergency management.

Typical requirements and attributive characteristics of emergency response make it rather different from other phases. Whereas, implementation of other phases depends on proper planning and elaboration, emergency response phase is characterized by such features as high uncertainty, limited timeframe, site accessibility problems, and necessity for decision-making, mobilization of forces and resources and quick response. The phase deals with direct or indirect, natural or technical hazard to human life, infrastructure, industry and environment. Countries all over the world exposed to all kinds of hazards and depending on

their national hazard profile, geographical conditions and administrative organization have established some sort of emergency management system.

3.0 Components of Emergency Response System

Despite the uniqueness and region specific characteristics of ERS in different countries all over the world some common principals/elements of efficient ERS can be categorized. UNISDR definitions talk about organization and management of resources and responsibilities, plans and institutional arrangement for ensuring coordination of all stakeholders and emergency services. Besides, information management and emergency communication and effective early warning system, summoning of ES are some of the other components which have emerged during discussion. Therefore, principles of ERS as drawn from the UNISDR definitions and discussion held above can be grouped as: Legal and institutional framework, emergency services and mode of summoning thereof, contingency planning, early warning system (EWS), communication, coordination mechanism, etc. The next paragraphs will try to elaborate these principles in some detail.

3.1 Legal and Institutional Framework

Disaster management has become as a full-fledged and whole time activity in the governance system all over the world. Most of the countries have by now some sort of legal and institutional set-up at various levels of the governance. Most of the countries have enacted one of few legislations whereas in many countries such as Japan have host of legislations covering various aspect of DM. Many countries such as US has dedicated and specialized agency, FEMA, which are the apex bodies for disaster management (DM). The Hyogo Framework of Action (HFA) 2005-15 has spurred the world into action and such organizations with distinctive characteristics have come up even in developing countries after enactment of legislation. Such agencies are needed at various levels such as national, regional and local for policy and planning, framing codes and regulations, coordination of response, deployment of resources, channelizing the flow of information and relief material, maintaining emergency communication, etc. Without this core, the activities of disaster management cannot run smoothly.

3.2 Emergency Services

Besides the apex DM institutional and legal framework, emergency services constitute very important element of ERS which is in fact the face of ERS. UNISDR defines emergency

services as “the set of specialized agencies that have specific responsibilities and objectives in serving and protecting people and property in emergency situations.” Emergency services include agencies such as civil protection authorities, police, fire, ambulance, paramedic and emergency medicine services, Red Cross and Red Crescent societies, and specialized emergency units of electricity, transportation, communications and other related services organizations.

Most of the countries have a number of emergency services operating within them, whose purpose is to provide assistance in dealing with any emergency. They are often government operated but in some cases they may be private companies, responding to emergencies in return for payment, or they may be voluntary organizations, providing the assistance from funds raised from donations. Most of the countries operate, police, fire services and emergency medical services (ambulance and paramedical services). In some countries two or more services may be provided by the same agency, such as Fire Services in Japan also provide ambulance and paramedical services. Similarly, Civil Defence in Singapore also runs ambulance services. The Military and other armed forces help in large emergencies such as a earthquake disaster or major civil unrest. Well organized and equipped emergency services enhance emergency response of the country. It is also important that critical facilities in which these services operate are also hazard resistant. Critical facilities such as transport systems, air and sea ports, electricity, water and communications systems, hospitals and health clinics, and centers for fire, police and public administration, elements of infrastructure that supports emergency and essential services enhances the emergency response.

3.3 Contingency Planning

ERS would not be effective and efficient until or unless all actors know actions to be taken and procedures to be followed in a given case of emergency. This calls for contingency planning. UNISDR defines contingency planning as “a management process that analyses specific potential events or emerging situations that might threaten society or the environment and establishes arrangements in advance to enable timely, effective and appropriate responses to such events and situations.” Contingency planning has to be a part of overall DRR process. It aims to focus at hazard, risk and vulnerability analysis, simulation exercise, response planning, defining or roles and responsibilities of various stakeholders, emergency support functions (ESFs), standard operating procedures (SOPs), resource mobilization, SAR activities. The contingency planning needs to be tested regularly through mock drills and

improved and updated at regular intervals. Good contingency planning will result in coordinated and effective response.

3.4 Early Warning System (EWS)

EWS is “the set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss”. This definition given by the UNISDR encompasses the range of factors necessary to achieve effective responses to warnings. A people-centered EWS necessarily comprises of four key elements: knowledge of the risks; monitoring, analysis and forecasting of the hazards; communication or dissemination of alerts and warnings; and local capabilities to respond to the warnings received. The expression “end-to-end warning system” is also used to emphasize that warning systems need to span all steps from hazard detection through to community response. Timely and effective hazard forecasting, early warning to the vulnerable community can save lives and prevent a hazard from turning into a disaster. There are numerous examples when early information of impending disaster has saved valuable lives. For EWS to be effective and efficient, it needs to monitor and analyze hazards in real time and also communicate and disseminate early warning to the vulnerable communities and response agencies in a most efficient and timely manner. Advancement in Information and Communication Technology (ICT) has made not only forecast of the hazards possible but also made it easy to mobilize response and communicate early warning to the vulnerable communities thereby minimizing deadly impact of worst disasters. “For instance compared to more than 10,000 deaths during the cyclone that hit Andhra Pradesh, India in 1979, improved communication techniques limited the loss to less than 1000 during the May 1990 cyclone of similar intensity in the same state. In Bangladesh in the early 1970s, a cyclone killed more than 300,000 people. However, after the country put in an extensive early warning system, a recent cyclone of similar intensity resulted in loss of 3,000 lives”.

3.5 Communication and Information Management

Since its earliest days, communication has played an important role in Disaster DM in providing information to all the stakeholders in Disaster Management, particularly in emergency rescue and relief operations for the disaster affected people. Perhaps, no more graphic example can be found than in the events surrounding the sinking of the “Titanic” on April 14th , 1912, when radio communication technology was instrumental in soliciting aid from

the nearby vessels “California” and “Carpathia” which were able to proceed to the rescue of the people.

In the context of communication system needed for DM work, at the Intergovernmental Conference on Emergency Telecommunications (ICET- 98) at Tampere, Finland, held on 18 June, 1998, a legally binding international treaty on employment of Telecommunication Resources was unanimously adopted by 75 countries and it was recognized, that the timely deployment of effective telecommunication resources for rapid, efficient, accurate and truthful information flows are essential for reducing loss of life, human suffering and damage to property and to the environment caused by natural disasters. As the risk continues to grow, it is imperative that the technological advances be harnessed to aid the disaster managers in reducing loss of life and property. Just as the Internet, social media such as Facebook, Tweeter, etc. have provided a new paradigm for communications, the explosive growth of new technologies provides unprecedented new opportunities and capabilities for the disaster managers. The use of new tools of ICT for emergency response coordination has been established in 2010 Haiti earthquake and 2011 GEJE. Emergency communication, EOCs, information and communication system, decision support system (DSS) on the geographical information system (GIS) based on GPS and use of latest ICT facilitates effective emergency response.

3.6 Summoning Emergency Services (ES)

In case of a disaster which has occurred or emergency situation has arisen without any early warning, citizen need to seek help of emergency services. These emergency services can be reached through either a single or multiple toll free numbers. Most countries have one emergency telephone number, also known as the universal emergency number that allows a caller to contact local emergency services for assistance. It is typically a three-digit number so that it can be easily remembered and dialed quickly. This number varies from country to country (and in some cases by region within a country). In the European Union, Russia, Ukraine and Switzerland and others "112" was introduced as a common emergency call number during the 1990s, and as the GSM standard it is now a well-known emergency number across the globe alongside the North American "911".

In most emergencies, response efforts must be taken by more than one agency and system of universal number improves efficacy of response and leads to efficient utilization and deployment of available resources. An emergency telephone number call may be answered

by either a telephone operator or an emergency service dispatcher. Emergency dispatchers may be trained to control the call in order to provide help in an appropriate manner; they can be assisted by computer aided call handling systems (CACH). In many parts of the world, an emergency service can identify the telephone number that a call has been placed from. Enhanced 911, E-911 or E911 is a system used in North America that links emergency callers with the appropriate public resources. This location may be a physical address or other geographic reference information such as X/Y map coordinates. The caller's telephone number is used in various ways to derive a location that can be used to dispatch police, fire, emergency medical and other response resources. Automatic location of the emergency makes it quicker to locate the required resources during fires, break-ins, and other events where communicating one's location is difficult or impossible.

Computer aided call handling is a methodology for managing calls to service providers, such as emergency services, through the use of computer based algorithms in order to make consistent and objective decisions on action to be taken. The computer software can provide scripting, prompts or interactive questioning to assist the call handler in gathering information. *Computer-assisted dispatch*, also called Computer Aided Dispatch (CAD), is now being increasingly being used even in developing countries for dispatching emergency resources assisted by computer. It not only facilitates dispatch of emergency services but also ensures optimum utilization of resources.

Therefore, having single universal emergency number coupled with use of ICT in handling calls and managing resources improves emergency response.

3.7 Coordination Mechanism

Large scale disasters result in chaos and confusion. This situation is further compounded with multiple response agencies consisting of various government organs, local and international organization and volunteers. Therefore, coordination becomes one of the most important element of response so that maximum results can be obtained by unified response management. Emergency managers positioned at various level in the government need to synchronize the activities of all relevant stakeholders to achieve a common purpose so that lives can be saved and appropriate humanitarian help can be provided to the most deserving disaster victims in timely manner. Donations are often sought during this period, especially for large disasters that overwhelm local capacity. Donors often prefer to send gifts in kind, which can be helpful if well matched to real needs. However, due to poor communication some

donations are poorly matched to needs, are sent to the wrong places, or are simply more appropriate for a thrift store than disaster relief. These items can end up imposing more of a burden while real needs go unmet, and can also flood local markets and economically hurt local producers. Coordination at various levels can reduce or minimize such cases.

In recent years the continuity feature of emergency management has resulted in a new concept, Emergency Management Information Systems (EMIS). For continuity and interoperability between emergency management stakeholders, EMIS supports the emergency management process by providing an infrastructure that integrates emergency plans at all levels of government and non-government involvement and by utilizing the management of all related resources (including human and other resources) for all four phases of emergencies. Therefore, coordination mechanism and information management system has to be in place, institutionalized and strengthened for effective ERS.

4.0 Current Status of ERS in India

As stated earlier, due to its physiographic and climatic as well as socio-economic conditions, India is one of the world's most disaster-prone areas. It is vulnerable to windstorm both from the Arabian Sea and the Bay of Bengal. There are active crustal movements in the Himalayas, leading to earthquakes, and about 58.7% of the total land mass is prone to earthquakes of moderate to very high intensity. The Himalayas being fairly young mountain ranges are undergoing constant geological changes that result in landslides. Floods are caused by heavy rains and droughts occur in the arid and semi-arid regions. About 12% of the total land mass is prone to flooding and 68% of the arable land is vulnerable to drought. Western India, typified by the Thar Desert, and central India, where the Deccan Plateau is located, face recurring droughts due to acute shortages of rainfall. India has also increasingly become vulnerable to tsunamis. It has a coastline that stretches along 7,600 km, and is repeatedly threatened by cyclones. In addition to the lives that are lost, India loses 2% to 3% of GDP annually due to disasters. Many pockets of the country are hotspots for disasters and India's vulnerability index is one of the highest in the world.

4.1 Legal and Institutional Set-up

Disaster management in India till recently has mainly been mainly relief centric. It has evolved from an activity-based reactive setup to a proactive institutionalized structure; from single faculty domain to a multi-stakeholder setup; and from a relief-based approach to a 'multi-dimensional

pro-active holistic approach for reducing risk'. During the British administration, relief departments were set up for emergencies during disasters. Such an activity-based setup with a reactive approach was functional only in the post disaster scenarios. The policy was relief-oriented and activities included designing the relief codes and initializing relief works. Post-Independence, the task for managing disasters continued to rest with the Relief Commissioners in each state, who functioned under the Central Relief Commissioner, with their role limited to delegation of relief material and money in the affected areas. A permanent and institutionalized setup began in the decade of 1990s with set up of a disaster management cell under the Ministry of Agriculture, following the declaration of the decade of 1990 as the 'International Decade for Natural Disaster Reduction' (IDNDR) by the UN General Assembly. Consequently, the disaster management division was shifted under the Ministry of Home Affairs in 2002 and a hierarchical structure for disaster management started evolving in India. Shifting from relief and response mode, disaster management in India started to address the issues of early warning systems, forecasting and monitoring setup for various weather related hazards. A structure for flow of information, in the form of warnings, alerts and updates about the oncoming hazard, also emerged within this framework.

The institutional structure for disaster management in India is in a state of transition. The new setup, following the enactment and implementation of the Disaster Management Act, 2005 (hereinafter referred to the Act) is evolving; while the previous structure also continues. Thus, the two structures co-exist at present. Within this transitional and evolving setup, two distinct features of the institutional structure for disaster management may be noticed. Firstly, the structure is hierarchical and functions at four levels – centre, state, district and local. In both the setups – one that existed prior to the implementation of the Act, and other that is being formalized post-implementation of the Act, there have existed institutionalized structures at the centre, state, district and local levels. Each preceding level guides the activities and decision making at the next level in hierarchy. Secondly, it is a multi-stakeholder setup, i.e., the structure draws involvement of various relevant ministries, government departments and administrative bodies.

The Act provides a legal and institutional framework for "the effective management of disasters and for matters connected therewith or incidental thereto." Under the Act, National Disaster Management Authority (NDMA) at the national level headed by the Prime Minister, State Disaster Management Authority (SDMA) headed by Chief Minister of respective states and District Disaster Management Authorities (DDMA) headed by the District Collector at the district level have been set up with financial and administrative powers. A National Institute of Disaster Management

(NIDM) with the responsibility of training and capacity building of human resource and documentation of disasters has been set up at the national level. National Executive Committee (NEC) and State Executive Committees (SEC) have been notified at the national and state level respectively to ensure the implementation of the decisions of the authorities concerned and to ensure coordination during disasters. Disaster response funds have been set up at the national and state level and funds provide for the same. The Act though talks about mitigation funds too but governments are yet to set up this fund. The act also provides for establishment of National Disaster Response Force (NDRF). The Act provides for preparation of DM plans (DMPs) at all levels comprising all phases of disaster management.

Prior to the enactment of the Act crisis management groups (CMGs) at the national, state and district level were entrusted with the disaster response. The national CMG is headed the Cabinet Secretary the National Crisis Management Committee (NCMC) has been constituted in the Cabinet Secretariat. The other members of this Committee include the Secretary to the Prime Minister, Secretaries of the Ministries of Home Affairs, Defence, Information & Broadcasting, NDMA, and Director of Intelligence Bureau, etc. Secretary (Security) Cabinet Secretariat is the convener of the NCMC. The NCMC gives direction to the Crisis Management Group as deemed necessary.

At the State level state CMG is chaired by Chief Secretary of the state and attended by other secretaries who are responsible for disaster response. Relief Commissioner of the state is the convener of this group. District administration is the focal point of disaster response. A district is sub-divided into sub-divisions and tehsils or talukas. The head of a sub-division is called the Sub-Divisional Officer (SDO) while the head of a tehsil is generally known as the Tehsildar (Talukdar or Mamlatdar in some States). Below the tehsil level the urban local bodies (ULB) and panchayati raj institutions (PRIs) assist the government functionaries in responding to disasters but system has yet to be institutionalized in terms of clear defining of roles and responsibility and institutional capacity building. EOCs/Control rooms are established at the national, state and district level. This system still exist and present institutional set-up for DM comprising of pre-Act and post-Act can be seen in the figure 1.

Ministry of Home Affairs (MHA), is the nodal Ministry for management of natural disasters (other than drought, hailstorm and pest attack, which are handled by Ministry of Agriculture) on behalf of the Government of India. Disaster Management Division (DM Division) performs the function in the Ministry of Home Affairs. Cabinet Committee on DM headed by the Prime Minister gives general

direction and guidance for holistic management of disasters. The national and state governments are jointly responsible for undertaking response, relief, rehabilitation, preparedness, mitigation and response measures.

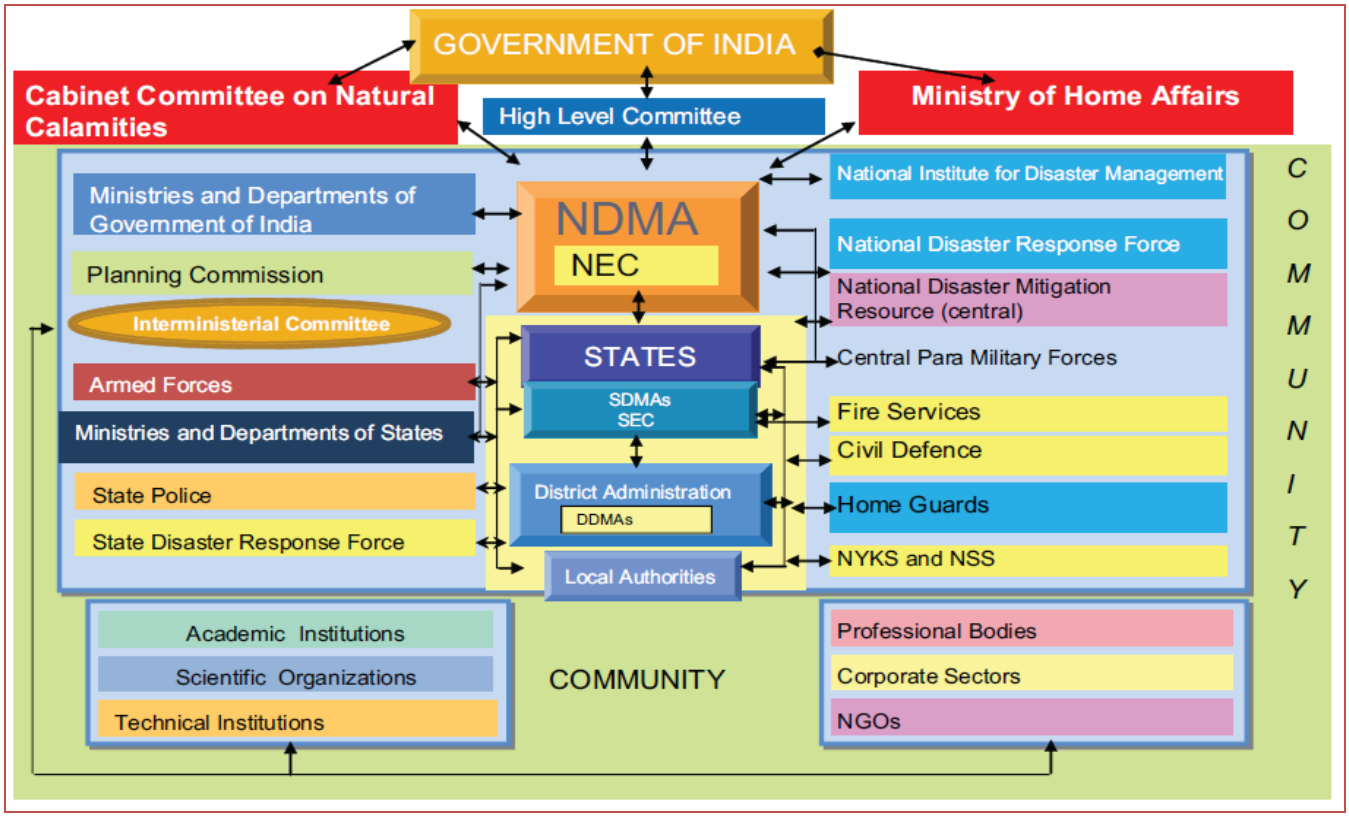

Figure 1: Disaster Management in India, MHA, GOI (Source: MHA, GOI)

The basic responsibility for undertaking these measures in the event of a disaster rests with the concerned state government. The Central Government supplements the efforts of the State Governments by providing logistic and financial support in case of natural calamities of severe nature. The logistic support includes deployment of aircrafts and boats, specialist teams of Armed Forces, Central Paramilitary Forces (CPMFs) and personnel of National Disaster Response Force (NDRF), arrangements for relief materials & essential commodities including medical stores, restoration of critical infrastructure facilities including communication network and such other assistance as may be required by the affected States to meet the situation effectively. The dimensions of the response of national government are determined in accordance with the existing policy of financing the relief expenditure and keeping in view the factors like:

(i) gravity of a natural calamity,

(ii) scale of the relief operation necessary, and

(iii) Requirement of central assistance for augmenting the financial resources at the disposal of the state government.

At the national level NDMA has been set-up but its role under the Act has been restricted to laying guidelines. It has no role vis a vis response which still rests with DM division of MHA. The NEC which is entrusted with the responsibility of implementation of NDMA guidelines is yet to hold its first meeting. SDMAs and DDMAs in most of the states and districts are just a committee structure without any dedicated team of professionals, hence non-functional. They are similar like the pre-Act CMGs which were also committee structures.

4.2 Emergency Services – Ambulance, Fire, Civil Defence and National Disaster Response Force

Like other countries India also maintains many emergency services namely fire, police, and ambulance. Except for the police there is no uniform system of management of these services. The Police works under the state governments but fire and ambulance services are differently managed and run. In some states fire services are run by the ULBs whereas in some states it is run and managed by the state governments. Many public and private sector organizations also maintain their own fire services. Ambulance services are run by multiple agencies such as Red Cross, health department, private health care organizations, charitable organizations, civil defence, etc. In the recent past many states have started integrated ambulance services mainly under the National Rural Health Mission and are being run and managed by outsourcing. At the state level it is health department which is providing funds for these services. Therefore there are hardly any integrated and centrally managed ambulance services in the country.

Fire Services: Generally it's the fire services which respond not only to fire but other emergencies too. In view of the shortcomings in the fire services in different states of the country and the need to upgrade it, the GoI in 1956 formed a Standing Fire Advisory Committee (SFAC) under the MHA. The SFAC has given various recommendations to the government for improvement of fire services. The SFAC had recommended re-organization of fire services in India way back in 1956 and also recommended a uniform fire service legislation in all states. The SFAC had also prepared a Model Fire Service Bill and the same was circulated to all the state governments in 1958. Some states have still not enacted any Fire Act of their own. The SFAC has laid down norms for setting up of fire stations based on the following parameters:-

i) Response time (3 to 5 minutes in urban areas and 20 minutes in rural areas);
ii) The scale of population to be served; and
iii) The number of minimum standard equipment that are needed and manpower required for its operation.

On the basis of above norms laid down by SFAC, the existing deficiencies as regards fire stations, fire fighting vehicles and personnel in India are as follows:

a) Fire stations – 97.54%;
b) Fire fighting and rescue vehicles – 80.04%; and
c) Fire personnel – 96.28%.

(*Source: NDMA Guidelines.)*

During their regular deliberations, the SFAC have noticed the following shortcomings in the fire services in India. Lack of:

i) Unified fire services in some of the states;
ii) Proper organizational structure, training and career progression of its personnel;
iii) Adequate modern equipment and their scaling, authorization & standardization;
iv) Appropriate and adequate funding;
v) Training institutions;
vi) Infrastructural facilities – fire stations and accommodation of personnel etc.;
vii) Vulnerability analysis;
viii) Public awareness (DOs & DON'Ts), conduct of regular mock exercises and evacuation drills; and
ix) Uniform fire safety legislation in some of the states.

(Source: NDMA Guidelines, 2012)

Civil Defence: The role of Civil Defence (CD), in terms of the Civil Defence Act, is to provide protection to individuals, properties and establishments against any hostile act. However, vide order dated 5 September, 2003 the MHA conveyed its approval to the state governments to utilize the services of Civil Defence volunteers for mitigation, prevention and preparedness for disaster as also for response and relief after a disaster has struck. In pursuance of this order, CD is already being utilized by some of the states not only in response activities during disaster, but also in pre-disaster activities, particularly in the field of community capacity building and generating public

awareness. Further the Civil Defence Act 1968 has been amended in 2009 and disaster management has been added as one of the activities of CD organization. This amendment has been notified on 21st January, 2011. However, the CD set-up is also not in good shape in the country. As per the High Powered Committee Report on Revamping of CD, only 121 towns have CD set up in the country and against the target of 1.29 million volunteers, only about 0.66 million have been enrolled so far. Only 17 states are having Central Training Institutes (CTIs) to train CD volunteers and most of them are combined training institutes for Civil Defence and Home Guards and many of these training institutions are virtually non-functional because of lack of funds and infrastructure.

NDRF: After the enactment of the Act, 10 Battalions of NDRF drawn from the CPMFs have been trained in advanced search and rescue (SAR) and stationed in different parts of the country for responding to large scale emergencies. Their services are regularly being used for disaster response of large scale or where specialized response is needed. But keeping in view the size of the country there is huge response time lag in the response of NDRF and need is being felt to raise such forces at the state levels so that maximum lives can be saved in golden hour.

4.3 Contingency Planning – Crisis Management and Disaster Management Plans

In accordance with national Crisis Management Plan (CMP) 2003 of the Cabinet Secretariat, MHA has formulated its CMP 2004 and circulated it to all States and Union Territories (UTs). The CMP of MHA is reviewed periodically. It was last reviewed in 2009 and was circulated to all Ministries and Departments of Central Government as well as States and UTs. An SOP for Responding to Natural Disasters, 2010 has also been issued. The state governments have been advised to formulate the similar kind of the CMP and SOPs. As per the provision of Act, DMPs have been formulated by some states and districts. In some cases plans have also been prepared at the local and institutional level such as schools, hospitals, industries and offices. But the national DMP is yet to be finalized. The national response plan has been drafted but yet to be finalized. In order to make DMPs functional and useful their thorough testing and regular updation and improvement is needed. Besides, formulating separate plans for DM and crisis management is against the principles of holistic management of disasters.

4.4 Early Warning and Forecasting Agencies and Dissemination System

The DM Act, 2005 binds the state governments and DDMAs to set up mechanism of early warning and dissemination thereof to the public. Steps have been taken to institutionalize EW system in the country but the system of EWS is at nascent stages in India. The SOPs, 2010 under para 4.1.1 lists the following agencies (Table 1) for forecasting and issuing EW:-

Name of the Disaster	Agency
Cyclone	Indian Meteorological Department (IMD)
Tsunami	Indian National Centre for Oceanic Information Services (INCOIS)
Floods	Central Water Commission (CWC)
Landslide	Geological Survey of India (GSI)
Avalanches	Snow and Avalanche Study Establishment (SASE)
Heat and Cold Wave	Indian Meteorological Department

Table1: Nodal Early Warning Agencies in India

The SOPs further say that early warning or prediction of earthquake is not possible. However it is possible to detect and monitor the earthquakes and the after-shocks. IMD is the nodal agency of Government of India (GOI) responsible for monitoring seismic activity in and around the country. IMD operates an Earthquake Operational Centre on a 24X7 basis with the operational responsibility of keeping a round-the-clock watch of seismic activity in and around the country. The SOPs say that the Operation Centre shall retrieve waveform data from remote field stations either in real time or through VSAT/dial up communication facilities, data analyses and quickly disseminate earthquake information to various user agencies including state and national government departments dealing with relief and rehabilitation measures.

Para 4.8.1 of SOPs say that national EOC, MHA shall be responsible for collection, assimilation and dissemination of information in terms of issuing alerts when a disaster is likely to occur or is imminent, or when it has actually taken place. The SOPs further say that dissemination of warning and other messages/information will be made through different mediums of communications. Both the latest technology and conventional methods will be used for dissemination of information upto the user levels. The SDMAs and states are to ensure that EW networks such as radio network is in working order. Presently Area Cyclone Warning Centers (ACWC) of the IMD generate special warning bulletins and transmit them every hour in the local languages through the network of 252

analogue and 101 digital ACWC receivers installed in the field. IMD also uses other convention communication like telephone, fax, radio and television for communicating warning.

CWC covers 9 major river systems in the country, including 65 river sub-basins pertaining to 15 hazard prone states. Though very few river basins have been covered with automatic sensors for observation and telemetry system for communication data. After 2004 Indian Ocean tsunami, the Regional Tsunami Warning Centre (RTWC) has been set-up at Indian National Ocean Information Service (INCOIS) Hyderabad which has become operational since December, 2007 and has been issuing tsunami warning system. Tsunami early warning is sent within 5-10 minutes based solely on earthquake information. For generating and dissemination the tsunami warning the SOPs give the figure 2.

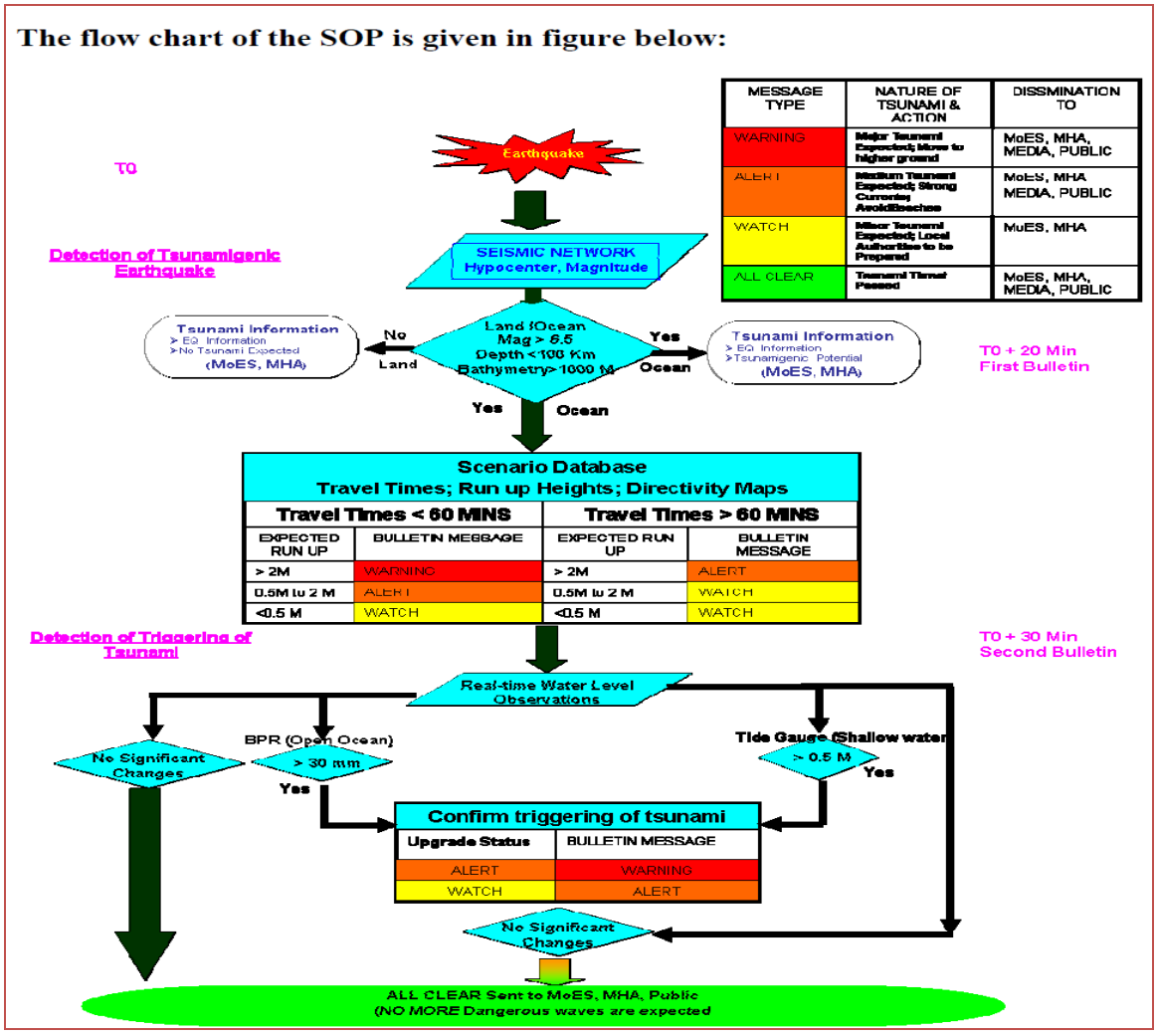

Figure 2: Flow chart of Decision Support System and Standard Operating Procedure

Some sample weather forecast and earthquake reports issued by IMD are shown in the figure 3 below:-

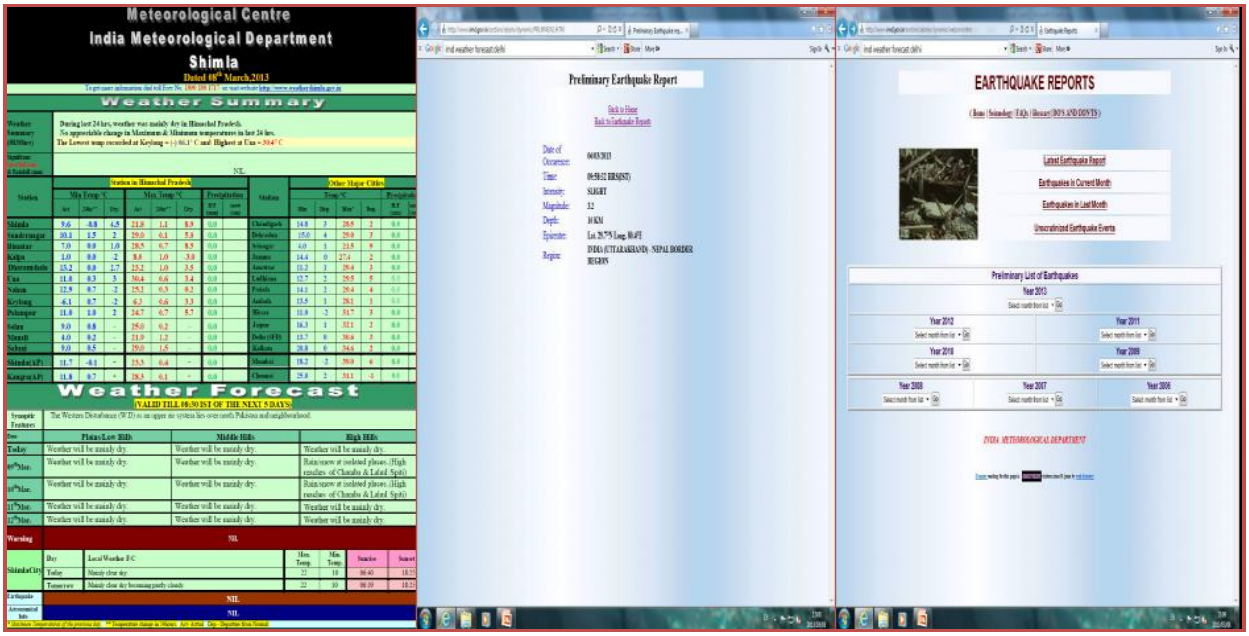

Figure 3: Sample Weather Forecast and Earthquake Reports of IMD (Source: IMD Websites)

All the EW agencies work under the national government. Many of them have not been involved in the EW beforehand and have not prepared themselves for this job properly as yet. Some agencies like SASE has still been routing its EW through MHA. But by the time it reaches the district it is outdated. Inadequate networks coupled with lack of last mile connectivity results in a poor EWS. Presently, the last mile connectivity exists for approximately 60% of villages through public/private network coverage. Moreover the warning is generated and disseminated late and most of the time it is not use-friendly.

Moreover, despite having host of laws on communication issues in the country, there is no legal framework in place to bind the private electronic operators (audio and audio visual) to broadcast early warning signals on priority. Section 67 of the DM Act, 2005 only says that NDMA, NEC, SEC and DDMA may recommend to the government to give direction to “any authority or person in control of audio or audiovisual media to carry out the necessary warning.” Early warning has to be transmitted in the quickest possible way and there is hardly any time for making recommendations and time to take action on recommendations so made.

4.5 Communication Network and EOCs

According to Telecom Regulatory Authority of India (TRAI) telecommunication segment as on 31.01.2011 (source: TRAI's Press release No. 13/2011) was as under:-

- Total Subscribers : 806.13 millions
- Wireless : 771.18 millions
- Wireline : 34.94 millions
- Teledensity : 67.67
- Broadband subscribers : 11.21 millions

The coverage exists for approximately to 60% of villages through public/private network coverage which is inadequate. The MHA evolved National Emergency Communication Plan (NECP), in 2004, for management of law and order and crisis and disaster situations. The plan is primarily a satellite based network resting on POLNET, with NICNET and VPN (DMS) as standby supports. The voice centric and limited data handling capability system is aimed to provide communication links between national, state and district EOCs as well as mobile and transportable EOCs for deployment at emergency / disaster sites. The plan was to be implemented in two phases, viz: phase 1 by Aug 2004 and phase 2 by March 2006. However, it is only the phase 1 of the plan, comprising of one VSAT terminal for national EOC at MHA, one mobile EOC for a disaster site, and six transportable communication sets for search and rescue teams of one NDRF Battalion that could be implemented by Aug 2006. Phase 2 of the plan is yet to be implemented. EOCs meant for emergency response and coordination equipped with fail safe communication in most of the states and districts are just simple control rooms without any communication redundancy, decision support system, information management and professional handling. There is no integration of the host of existing networks such as Disaster Management Support (DMS) Network of Indian Space Research Organization (ISRO), Police Telecommunication Network (POLNET), National Informatics Centre (NICNET) Infrastructure, State Wide Area Network (SWAN), etc. for emergency communication.

4.6 Summoning of Services – Multiple Toll Free Numbers and Control Rooms

For emergency response, India has a system of multiple toll-free numbers (Table 2). However, having multiple toll-free numbers tends to cause confusion. Also, in most emergencies, response efforts must be taken by more than one agency and the present system lacks a means of

achieving the effective coordination and integration of services. This can lead to response deficiencies and delays. Multiple toll-free numbers and response systems also lead to waste in terms of resources and manpower. The existing system does not use the many ICT tools available for handling calls, creating databases and a decision support system, managing emergency dispatch, and optimizing the utilization of existing resources. The existing system also has no effective and efficient means of communicating early warning signals to vulnerable communities and response agencies. The end result is avoidable loss of life.

Besides, having multiple toll free numbers, there are control rooms at local, district and state level for each services separately. There is no centralised call centers which can handle the calls at one place and utilize the available resources effectively within a state or a district. Response by the concerned agency such as fire, ambulance, etc. is generally restricted to the jurisdiction limit.

Table 2: Some Emergency Response Toll Free Numbers in India

Police	Ambulance	Fire	EOC	Other Important Control Rooms
100	102, 1298, 108, 112	101	District – 1077 State & National - 1070	Chennai Traffic Police - 103. Delhi Traffic Police - 1095. Kolkata Traffic Police - 1073. Bangalore Traffic Police - 108 and 100. Women crisis response – 1091 Child Distress Service – 1098

4.7 Coordination Mechanism

Coordination at the national and the state level is espoused to be achieved by way of various committees and authorities created under the Act involving all departments that are working in Disaster management. A response set-up across the country may be viewed in Figure 4. This mechanism may be good enough for small scale emergencies but for a large scale disaster a mechanism not only to coordinate the actions of state but non-state actors such as Non-Governmental Organizations (NGOs), International NGOs (INGOs), United Nations (UN) Agencies is required to be in place both at national and state level. Such mechanisms are also

needed at district and local level involving local actors. The Act provides for coordinating the actions of various NGOs during response phase of disaster. The NDMA has issued guidelines for establishing coordination mechanism and establishment of Inter-Agency Group (IAG) at national, state and district level but these guidelines are yet to be fully implemented.

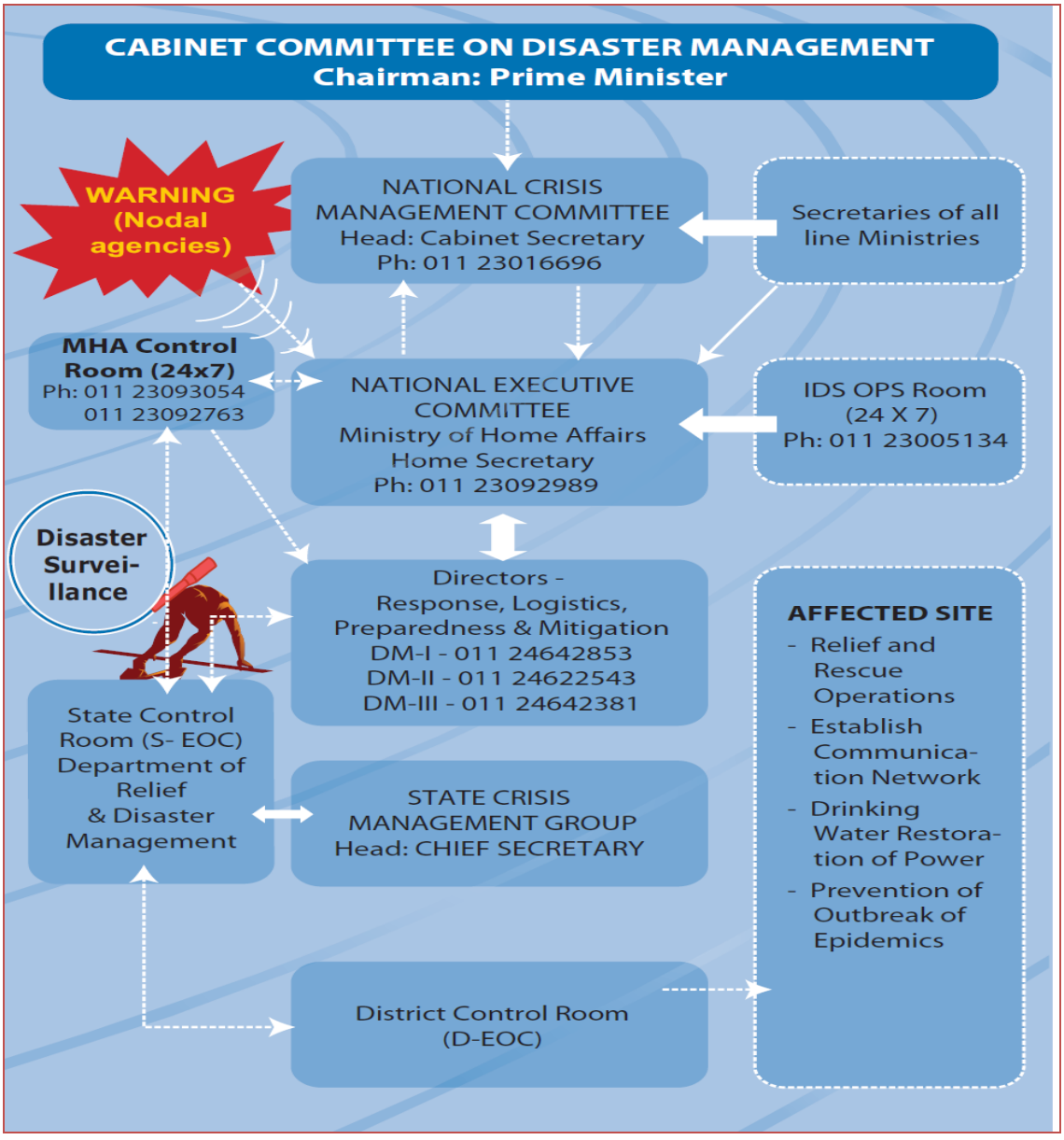

Figure 4: National Coordination Mechanism in Disaster Response

Sphere India has initiated two project of coordinated response. One is formation of IAG and second Unified Response Strategy (URS). The process of setting up of IAG is in progress in six

states in India namely, Assam, Bihar, Orissa, West Bengal, Tamil Nadu and Andhra Pradesh. The URS as “an action-based project was launched with this rational to build common understanding among different stakeholders for an organized and coordinated response. The vision is to bring stakeholders at state level (implementation level) on a common platform, map the resources, capacities and vulnerabilities to identify gaps and overlaps and gradually build a common understanding for common assessments, common response planning and common monitoring & evaluation processes.”

5.0 Case Study of Recent Major Disasters

In order to see the effectiveness of current ERS of the country to recent major disaster that struck India starting from 1999 Orissa Super Cyclone to 2010 Leh flash floods a review of some case studies and literature on emergency responses was done and the following key points emerged:-

5.1 Orissa Super Cyclone, 1999

IMD issued cyclone warnings three days before the cyclone struck Orissa in October 1999. Residents within ten km of the sea were asked to evacuate their homes. What caught everyone off-guard was the sheer ferocity of the storm which swept the entire Orissa coast, across 12 districts and parts of neighbouring West Bengal, at wind speeds of 300 km per hour. The administration learned that it was a super cyclone at 5:30am on 29 October. At around 7:30am the state’s communication networks collapsed and the situation could no longer be monitored. With the state administration paralyzed, immediate rescue and relief measures had to be organized from outside the state. United Nations Disaster Management Team (UNDMT) interacting with the government at the national and the state, as well as collaborating with international and national NGOs, various UN Agencies prepared daily situation reports that were shared with the donor community. UNDP coordinated the efforts of all UN agencies working in Orissa. Government of Orissa constituted Orissa State Disaster Mitigation Authority (OSDMA) after the October 1999 super cyclone, to have a systematic and planned approach to disaster mitigation management in the State.

5.2 Bhuj Earthquake, Gujarat, 2001

Communication system in the earthquake affected area was badly affected. Communication and family tracing was a challenge but addressed, to an extent, with the use of newly installed mobile

phones from private companies and satellite phones set up with support from donors including Department for International Development (DFID) of United Kingdom and UNDP. Emergency communication was also provided by the Army and the Air Force. Although systems were in place to manage cyclone, drought and flood relief through the relief commissioner's office, Gujarat was ill -prepared for earthquakes. No authority had official responsibility for earthquake preparedness, and there were no contingency plans or policies for dealing with such a catastrophe. As per one estimate 185 NGOs, 240 INGOs worked in response phase and around 50 countries sent relief material involving around 250 flights. Army, Air Force and Navy was pressed into relief efforts. Opening of UN's coordination centre, OSOCC within the District Collector's office compound and formation of NGOs coordination mechanism with local NGO federation *Abhiyan* later converted to 'SETU' facilitated by the UNDP ensured two way communication between the response agencies and the community and facilitated inter-agency coordination. The Gujarat SDMA was created on 9th February, 2001 within 14 days of the earthquake as an apex body for DM in the state.

5.3 Indian Ocean Tsunami, 2004

On 26th December, 2004 Indian Ocean Tsunami affected Indian coastal areas including many other countries and resulted into the deaths of more than 9000 people. According to ADRC reconnaissance report there was no early warning system developed before the tsunami disaster. There was also no communication mechanism to disseminate information to residents. Governments tried to warn people using telephones, mobile phones and loudspeakers. Due to the lack of knowledge about tsunami disaster, response and evacuation activities were difficult. Local governments, residents, private companies were all ignorant about tsunami risk and disaster response. In addition, no concrete evacuation or response plan was in place prior to the tsunami disaster due to the complacency and ignorance of the people to the impending danger. More people would have been saved if prior cautions had been taken. Large number of NGOs responded. As per one estimate more than 500 NGOs were working in Nagapattinam district alone. Initial response was full of confusion and chaos because of lack of coordination. In order to ensure coordination amongst various responders, relief organizations and victims the Nagapattinam district in Tamil Nadu set an example for other districts through the formation of the NGO Coordination and Resource Centre (NCRC) on 1 January 2005 through a coming together of the South Indian Federation of Fishermen Societies (SIFFS) and the Social Need Education and Human Awareness (SNEHA) —two NGOs that had closely worked with the affected fishing community — as they strongly felt that no single body could assume leadership in this process. The NCRC office was set up in the District Collector's office and the meetings were chaired by the

District Collector. Further, this body set up a Village Facilitation Unit that created links to village clusters by placing volunteers in Village Information Centres (VICs) in these clusters. These VICs became the information and distribution links to the villages through its liaison with the elected Panchayat leaders. In order to be linked to the state level administration, NCRC along with partner organizations set up The Resource and Information Network (TRINet) which was an avenue for the NCRC and other district level bodies to take up issues at the state level.

5.4 Bihar Floods, 2008

Although floods have been a recurring feature in parts of the state, the 2008 floods were not usual. On 18 August 2008, a breach in a barrage of the Kosi River in Nepal's Kusaha district resulted in the Kosi changing its course 120 kilometers eastwards, to a course it had abandoned over 200 years ago, making it a worst flood of half a century. Since most affected households had not experienced floods for several decades, they were not prepared to respond quickly, which resulted in more loss of life and property. The State also was not prepared to deal with a catastrophe of this magnitude. While the Bihar IAG was an existing network of NGOs for flood response, the lack of sustained funding stymied capacity for effective response and coordination. On 26 August, the Chief Secretary called a meeting of the NGOs working in the region to institutionalize a government-NGO coordinator. There was hardly any EW for the flood which could have resulted into timely evacuation and planned response.

5.5 Leh Flash Floods, 2010

As per the report compiled by the Sphere India communications infrastructure was severely affected by the flash floods, and the inability to gain access to some affected communities meant that there were significant delays before clarity on the scale and extent of damages and needs emerged. The sheer volume of aid in relation to the number of people affected, particularly of non-food items such as blankets made it extremely difficult to avoid duplication. The presence of a large number of unorganized responses by several private individuals, groups and agencies considerably compounded the task of coordination and avoiding duplication.

5.6 Summary of Lessons Learnt from the Recent Major Disasters – The above case studies lead to the following lessons learnt:-

i) Timely and effective early warning could have saved many precious lives and given lead time for the emergency services and government machinery to respond.

ii) Emergency communication network which failed after disaster hampered disaster response.

iii) Absence of legal and institutional institutions such as SDMA was felt and immediately after Orissa Super Cyclone and Gujarat Earthquake such institutions were immediately set-up.

iv) Coordination during relief phase can help ensure an adequate and appropriate response. It can help find solutions to problem, manage resources effectively, save lives and facilitate large coverage of assistance through stakeholder interaction and knowledge sharing. Inter-agency coordination mechanisms are required at all levels to ensure that humanitarian agency act in a coordinated way.

v) Information management is very important in the aftermath of a disaster. Systems need to be in place which collate exchange and disseminate information to all stakeholders in a real time basis.

vi) Planning for disasters is very important. Multi-hazard DMPs would have improved emergency response.

6.0 Summary of Gaps identified in current system of ERS in India

The existing system of ERS in India has many gaps many of which have already been discussed in the proceeding paragraphs. However, a summary of the same is given as below:-

a) There is parallel system of DM set-up, pre-Act and post-Act institutions both at national and state. The new set-up created under the Act is not fully operational and functional.

b) There is acute shortage of spread, strength, equipment and training of fire services in the country. There is no uniformity in the fire services and in times of disasters there may be serious issue related to compatibility of equipment, etc. The ambulance services are being managed by different agencies.

c) Having two sets of plans, CMP and DMPs will lead to confusion. Absence of national and state DM plans will hinder DRR and ERS in the country.

d) EWS is in its nascent stage and many steps are required to be taken to make it adequate and effective.

e) Information management and disaster communication is yet to take shape. The existing communication networks available have not been integrated. Even the nodal centers for emergency communication in the country, the EOCs are yet to be set-up.

f) Multiple toll free numbers system is outdated and old and not in conformity with the international best practices.

g) Effective steps are yet to be taken to ensure inter-agency coordination despite having legal obligation to do it.

7.0 Selected International Best Practices in ERS

Keeping in view the gaps identified in India's current ERS and lessons learnt from recent major disasters, this section documents selected case studies relevant to the identified gaps so that a model ERS for the country can be proposed. The best practices detailed below focuses on legal and institutional framework, early warning system and dissemination mechanism, disaster planning, disaster communication and information management system of Japan. Besides, early warning dissemination mechanism of the US, single universal number system of EU, and case studies of Romania and Philippines, case studies of use of ICT in 2010 Haiti earthquake and 2011GEJE have been included. Taking the case of private company a case study of Osaka Gas Co. Ltd has been captured to show how emergency response system has been designed and planned at this level. Also a case study of prefectural level taking Hyogo as an example has been included to show how fail safe emergency communication and response system can be been established.

7.1 Legal and Institutional Framework of Japan

In Japan, the DM system has been developed and strengthened following the bitter experience of large-scale natural disasters and accidents over the years. The country has 7 basic acts, 18 disaster prevention and preparedness legislations, 3 legislations governing disaster emergency response and 23 disaster recovery and reconstruction and financial measures acts. The first act i.e. Disaster Relief Act dates back to 1947 passed after the 1946 Nankai earthquake. Thereafter every disaster led to learning and experience and it led to passing of new legislation. There is almost a separate legislation for each disaster and separate legislation for every aspect of disasters such as prevention, preparedness, response, rehabilitation and recovery, building standard, financial measures, earthquake insurance, etc. The turning point for strengthening the

disaster management system came after the immense damage caused by the Ise-wan Typhoon in 1959, and led to the enactment of the Disaster Countermeasures Basic Act in 1961, which formulates a comprehensive and strategic disaster management system in Japan. The DM system has further been strengthened following the lessons learnt from large-scale disasters such as the Great Hanshin-Awaji Earthquake, 1995. The learning of the 2011 Great East Japan Earthquake and Tsunami (GEJET) and nuclear disaster has been incorporated in the Disaster Countermeasures Basic Act by amending it in June, 2012 and by making changes in Basic Disaster Management Plan in December, 2011. The most notable piece of legislation is the Act passed in 2002 namely 'Act on Special Measures for Promotion of Tonankai and Nankai Earthquake Disaster Management'. The country is expecting big earthquake which may arise out of Tonankai and Nankai troughs and this legislation aims at reducing possible impact from these earthquakes and preparing the country to face them.

At the national level Central Disaster Management Council, the apex body for DM in Japan is housed within the Cabinet Office headed by the Prime Minister. Along with a series of reforms of the central government system in 2001, the post of Minister of State for DM was newly established to integrate and coordinate disaster reduction policies and measures of ministries and agencies. In the Cabinet Office, which is responsible for securing cooperation and collaboration among related government organizations in the wide-razing issues, the Director-General of Disaster Management is mandated to undertake the planning of basic disaster management policies and response to large-scale disasters, as well as conduct overall coordination.

Additionally, taking into account the lessons learned from the Great Hanshin-Awaji Earthquake, 1995, the Cabinet Secretariat system was also strengthened, including the appointment of the Deputy Chief Cabinet Secretary for Crisis Management and the establishment of the Cabinet Information Collection Center, to strengthen risk management functions to address emergencies such as large-scale disasters and serious accidents.

7.2 Disaster Management Planning System in Japan

In Japan Disaster Management Planning is done at three levels namely:-

i) National Level: Basic Disaster Management Plan - This plan is a basis for disaster reduction activities and is prepared by the Central Disaster Management Council based on the Disaster Countermeasures Basic Act, 1961. The Basic Disaster Management

Plan states comprehensive and long-term disaster reduction issues such as disaster management related systems, disaster reduction projects, early and appropriate disaster recovery and rehabilitation, as well as scientific and technical research. The first Basic DMP was prepared in 1963 and subsequently revised several times. The plan was revised entirely in 1995 based on the experiences of the Great Hanshin-Awaji Earthquake. It now consists of various plans for each type of disaster, where tangible countermeasures to be taken by each stakeholder such as the national and local governments, public corporations and other entities are described for easy reference according to the disaster phases of prevention and preparedness, emergency response, as well as recovery and rehabilitation. Changes were effected in the plan in December, 2011 based on the recommendations from the Central Disaster Management Council's technical committee for reviewing earthquake and tsunami measures based on the lessons from the GEJET. The plan, it has been decided, shall be continuously revised in future in order to reflect further policy development based on the GEJET and other disasters.

ii) Department/Organizational Level: Disaster Management Operation Plan - Disaster Management Operation Plan: This is a plan made by each designated government organization and designated public corporation based on the Basic Disaster Management Plan.

iii) Prefectural/Local Level: Local Disaster Management Plan: This is a plan made by each prefectural and municipal disaster management council, subject to local circumstances and based on the Basic Disaster Management Plan.

The plans at all levels have been prepared and regularly revised and updated incorporating the lessons learnt and changes made in the Basic DMP prepared at the national level. DMP is the main document which is referred to for disaster management and emergency response.

7.3 Early Warning System in Japan

EWS Agency - Japan Meteorological Agency - Japan Meteorological Agency (JMA) is the sole national authority responsible for issuing weather/tsunami warnings and advisories, earthquake early warning/alerts, and other disaster warning and is required to provide reliable and timely information to governmental agencies and residents for the purposes of natural disaster prevention and mitigation. Within the structural framework of Japan's central government, the JMA is placed as an extra-ministerial bureau of the Ministry of Land, Infrastructure, Transport and

Tourism (MLIT). When a Heavy Rain Warning is issued, Sediment Disaster Alerts are issued jointly by MLIT and prefectural government civil engineering bureaus when sediment-related damage caused by heavy rain is considered likely within the next few hours. JMA is also responsible for providing flood forecasting services in collaboration with central and local river management authorities. These services include flood warnings and advisories covering 407 rivers (as of March 2011) throughout the country that have been designated by these authorities as sites of potential flood disasters. Flood forecasting systems for 289 of the 407 rivers are managed jointly by JMA and the MLIT, and the other 118 are managed jointly by JMA and prefectural governments. JMA operationally monitors seismic and volcanic activity throughout the country and issues relevant warnings and information to mitigate damage caused by disasters related to earthquakes, tsunamis and volcanic eruptions. JMA began issuing volcanic warnings and volcanic forecasts for each active volcano in Japan on Dec 1, 2007 to mitigate damage from volcanic activity. Volcanic warnings are issued in relation to expected volcanic disasters, and specify the municipalities where people need to take action. Volcanic forecasts are issued for less active volcanoes or those that become so.

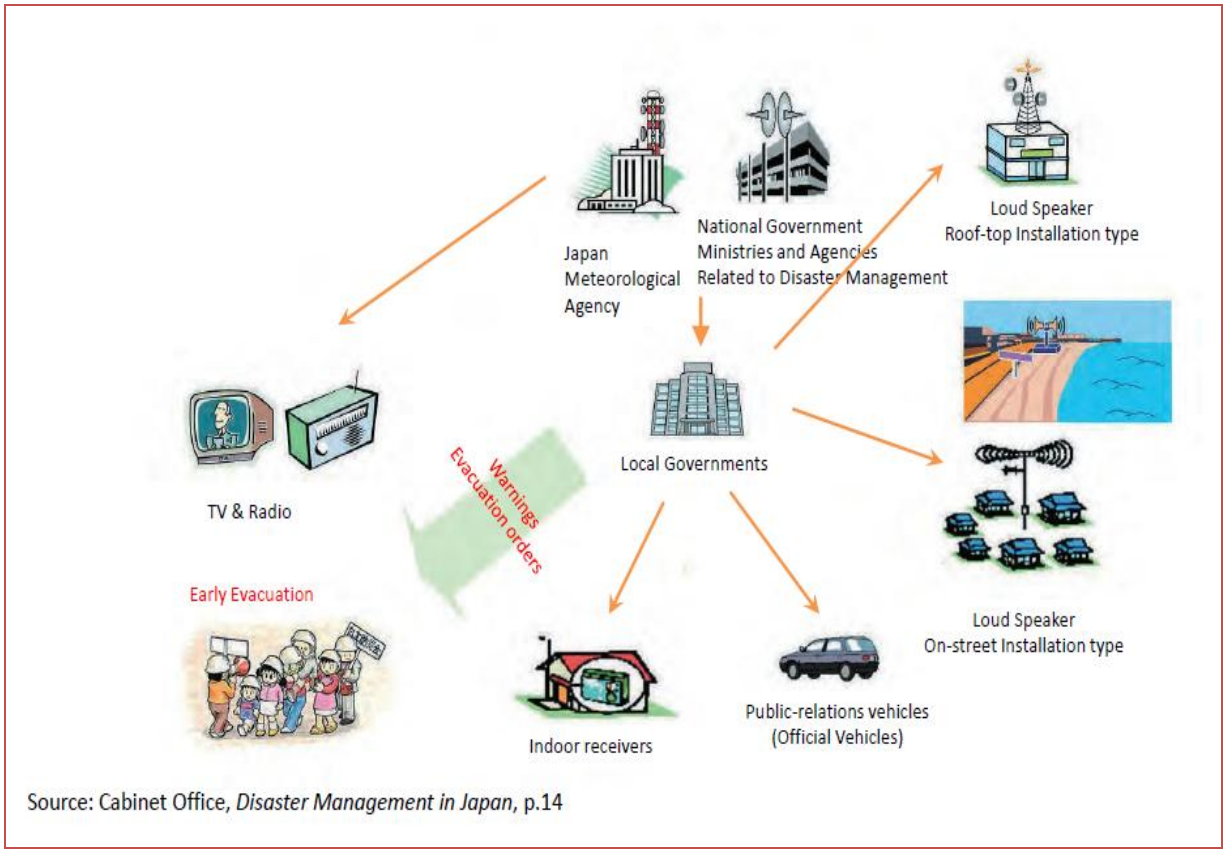

Figure 5: An Outline of EWS in Japan. (Source: Cabinet Office, Japan.)

Observation System for Earthquakes - In order to constantly monitor seismic activity, the JMA and other relevant organizations install and maintain seismometers that are used for estimating the location of the epicenter and magnitude of an earthquake as well as for tsunami forecasts, and seismic intensity meters that measure the intensity of ground motion, in numerous places nationwide. As soon as an earthquake occurs in or around Japan, the JMA analyzes the data from various seismometers and seismic intensity meters. Within about two minutes, it issues a seismic intensity information report for earthquakes of intensity 3 or greater, and within about five minutes issues an earthquake information report indicating the epicenter and magnitude of the earthquake and the seismic intensity in the municipalities where strong shaking was observed.

Dissemination of Forecast and EW - In order to prevent and mitigate damage caused by natural disasters and support prompt disaster prevention activities, JMA disseminates weather information and warnings via various channels to government disaster prevention agencies, local governments, the mass media and the public. An outline of EWS in Japan is given in figure 5. For this purpose, the Agency maintains direct communication links with meteorological offices and central/local governments. Strong communication with municipal governments that play direct roles in disaster management and mitigation in affected areas is essential. Such communication is ensured via various channels for information dissemination, such as prefectural governments, NTT (Nippon Telegraph and Telephone Corporation), J-ALERT (an instant information broadcasting system introduced by the Fire and Disaster Management Agency (FDMA) and the Internet. To support prompt disaster mitigation activities by local governments, the Agency has introduced a new information provision system called the Information Network for Disaster Prevention (INDiP), which enables effective and rapid dissemination of data in both text and graphic form. INDiP (Figure 6) connects disaster prevention agencies and local governments with JMA headquarters via the Internet and provides detailed weather information and warnings tailored to individual municipalities. Information for maritime users is transmitted via the JMH radio facsimile broadcast service operated by JMA and fishery radio communications services. Such information is also disseminated within the framework of the Global Maritime Distress and Safety System (GMDSS), i.e. via the NAVTEX broadcast service of the Japan Coast Guard for seas in the vicinity of Japan, and via the Safety-Net broadcast service for ships in the high seas via the maritime satellite INMARSAT. Nowadays, the Internet plays a vital role for JMA in the public dissemination of a wide range of meteorological information not only on forecasts but also on historical and current observation data.

J-Alert System - J-Alert is the system to immediately transmit emergency information such as

Emergency Earthquake information, tsunami warning, information of ballistic missiles, which people have no enough time to deal with, is transmitted to the municipalities by using satellite (via the Fire and Disaster Management Agency, the Cabinet Secretariat, and JMA). It became operational on 09 February 2007 and on 01 October 2007 started sending the emergency earthquake information. As of first March 2010, 344 municipalities have introduced this system. Among them, automatic activation system of radio broadcasting and community FM have been introduced to 282 municipalities. The J-Alert framework has been given in figure 7.

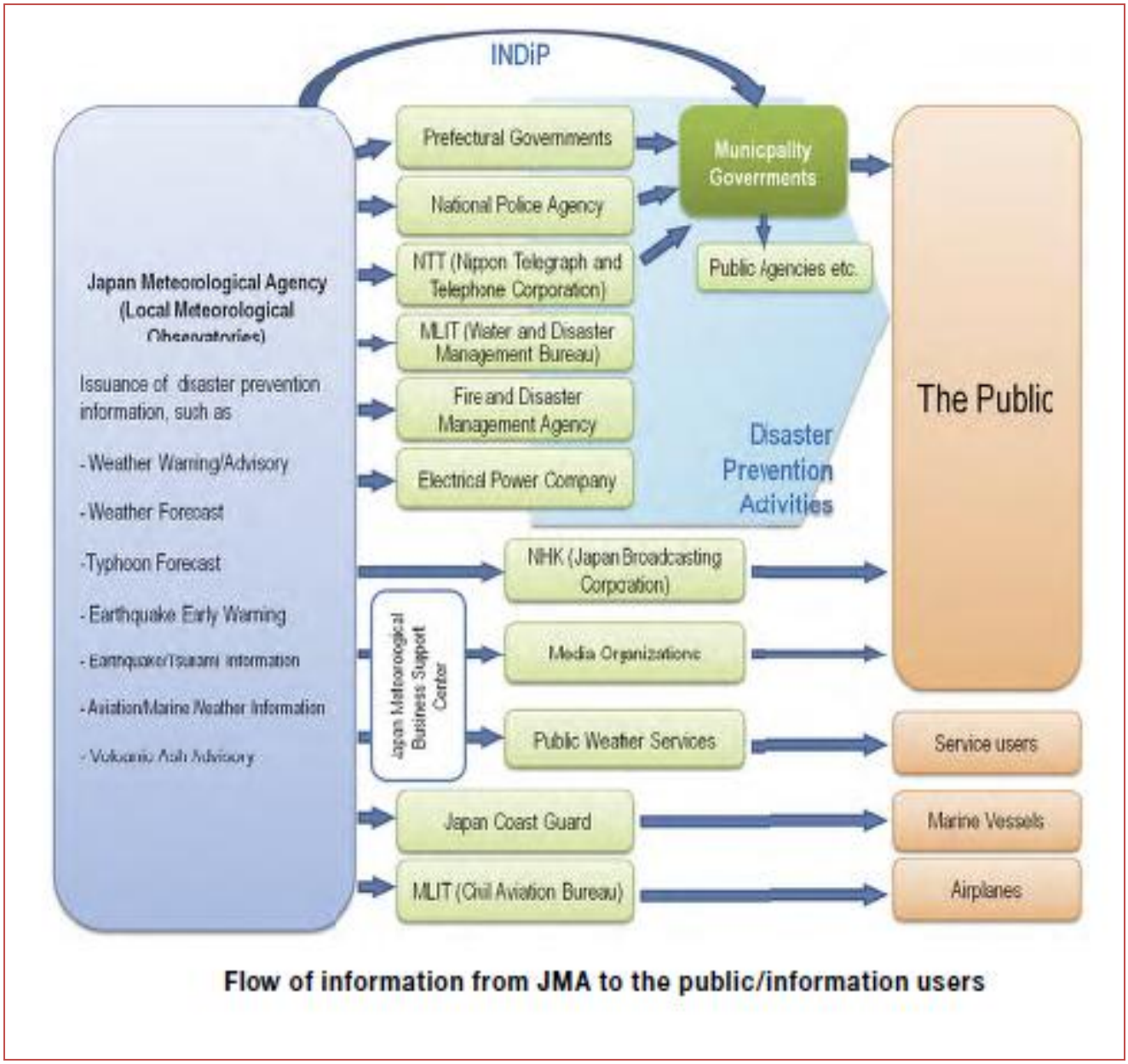

Figure 6: INDiP Network (Source: JMA)

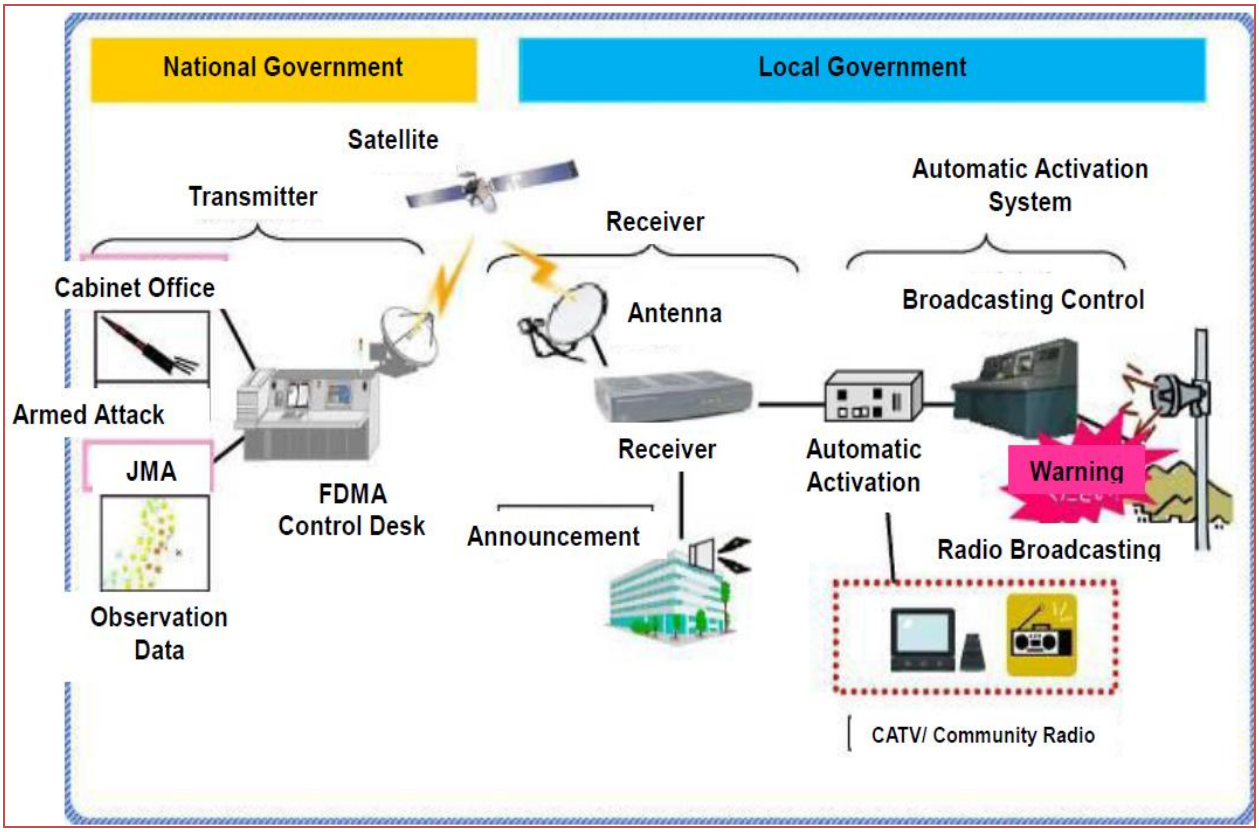

Figure 7: Framework of J-Alert System

Utilization of Earthquake Early Warning Information - Earthquake Early Warning (EEW) information announces the estimated hypocenter and magnitude of an earthquake as well as the estimated arrival time of the S-wave of the earthquake and seismic intensity in each area. This information is made possible by detecting the P-wave near the epicenter and immediately processing the data since there is a difference in the speed of the P-wave, which arrives faster, and the S-wave, which arrives later and causes more severely destructive phenomena. In the case of a large-scale ocean trench-type earthquake, there may be a time lag (several seconds to several tens of seconds) between the issuance of the EEW information and the start of severe shaking (when the S-wave arrives). This can be a critical time to be used for mitigating damage by stopping trains and elevators, extinguishing flames or crawling under tables. Research and development has been promoted by the JMA in cooperation with related organizations, and the provision of the EEW information to specific entities such as railway companies began in 2006. Earthquake or tsunami warnings are instantly delivered to central & local governments, broadcasters, telecom carriers. After receiving this warning, local government deliver alarm

through their sirens or microphones (Fig 9). The flow of information in EEWS has been given in figure 8, and use of this alert by train services in figure 10.

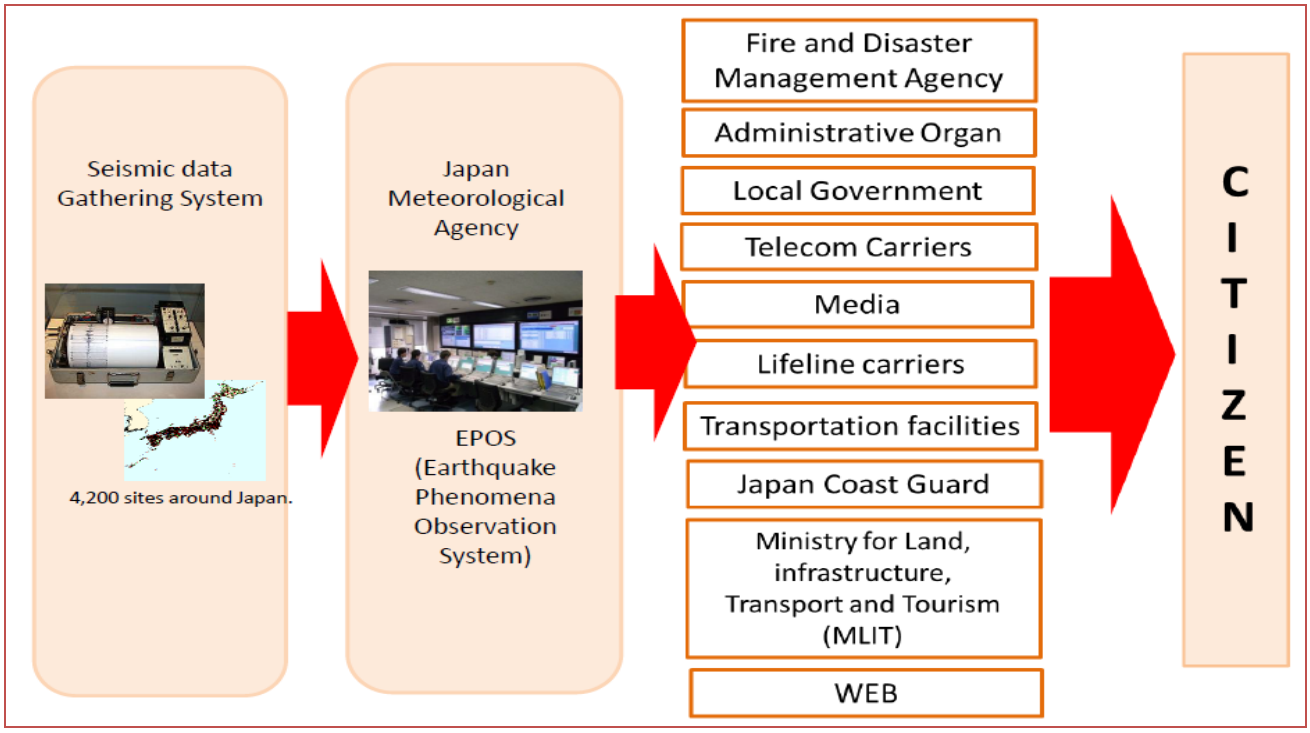

Figure 8: Outline of Earthquake Early warning Information (Source: MIC, Japan)

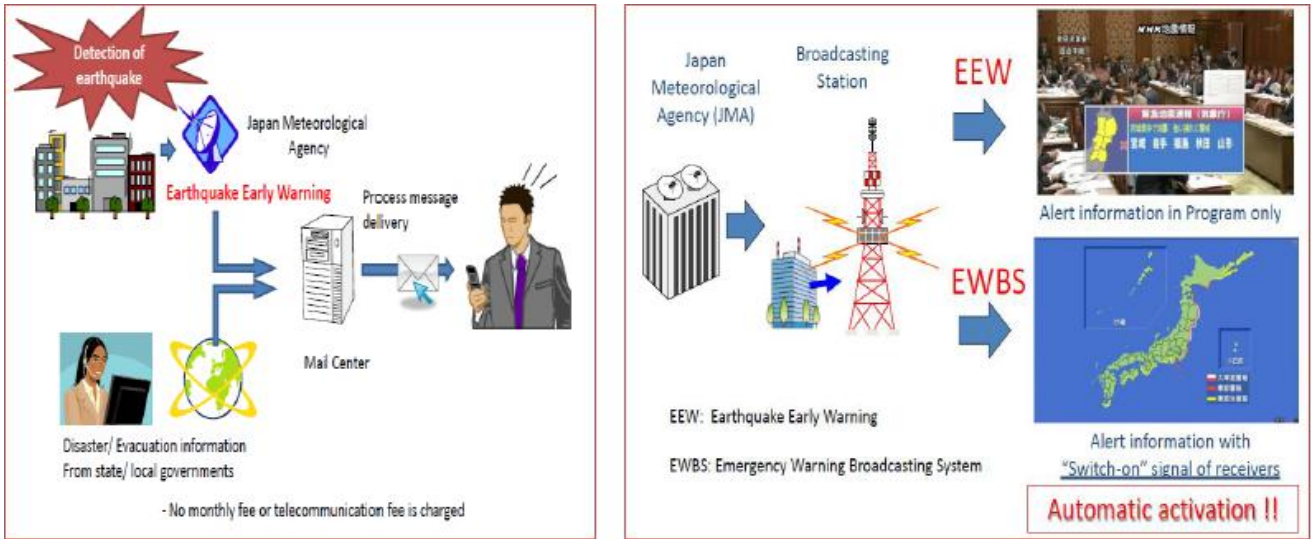

Figure 9: an outline of Earthquake Early warning Information to community (Source: MIC, Japan)

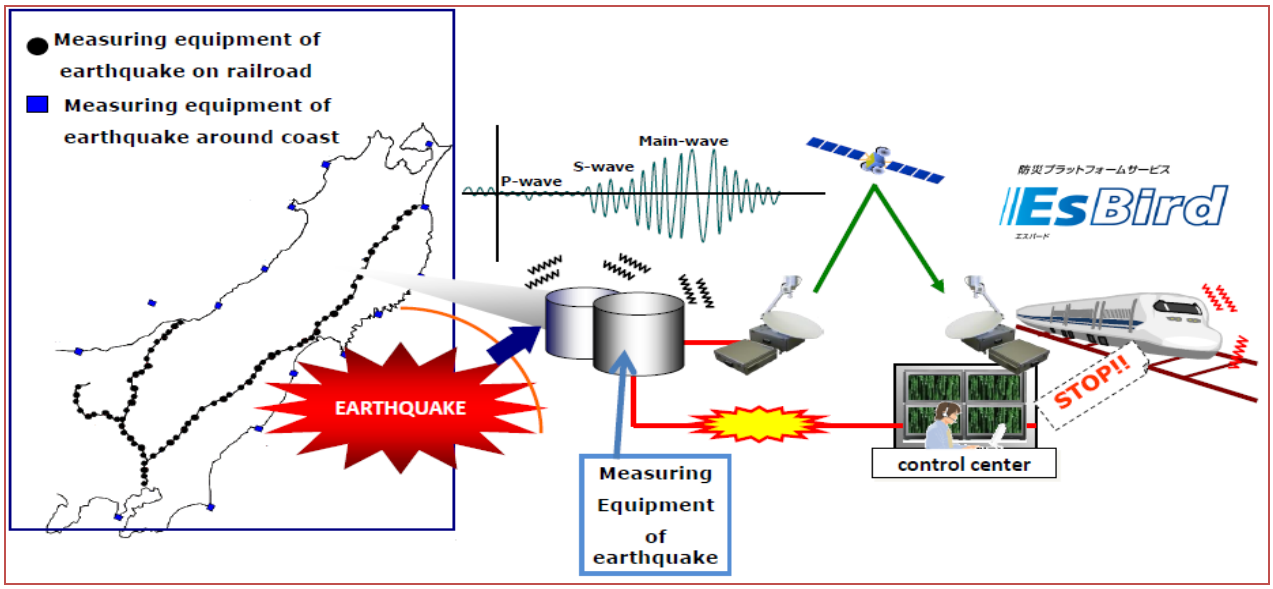

Figure 10: An outline of Earthquake Early warning Information used to stop high speed trains (Source: MIC, Japan)

Legal Framework for EW Dissemination - The Japanese legal system empowers the disaster management authorities to broadcast emergency alarm/early warning through any available network. Section 57 of the Disaster Countermeasures Basic Act, (Act No. 223, November 15, 1961) says that "In cases where notification, request, transmission or alarm …. requires urgency when there is a specific need, the governor of a prefecture, the mayor of a city or town, or the head of a village may, by ordinance unless otherwise provided by law, request broadcast thereof on a priority basis from the electrical communications businesses….".

As a result the EW is instantly communicated in all the mediums available. On 6th February, 2013, an earthquake measuring Mw = 8.0 struck near Solomon Island and tsunami alert was sounded by the JMA. The alert started appearing in the TV channels across the country depicting the tsunami likely to reach Japanese coast on the right corner. A picture shot from TV footage that day has been given in figure 11. Important feature of EWS in Japan is JMA being the sole agency for generating EW and dissemination thereof to a certain level including public through TV, internet, etc.

The EW is disseminated through multiple channels including secure channels such as INDiP and J-Alert. Another important feature is usable and use-friendly nature of EW and weather forecast. JMA issues weather forecast three times a day – 5 AM, 11 AM and 5 PM. The figure 12 shows

how JMA generate and issues use-friendly weather forecast.

Figure 11: TV Footage of Tsunami Warning

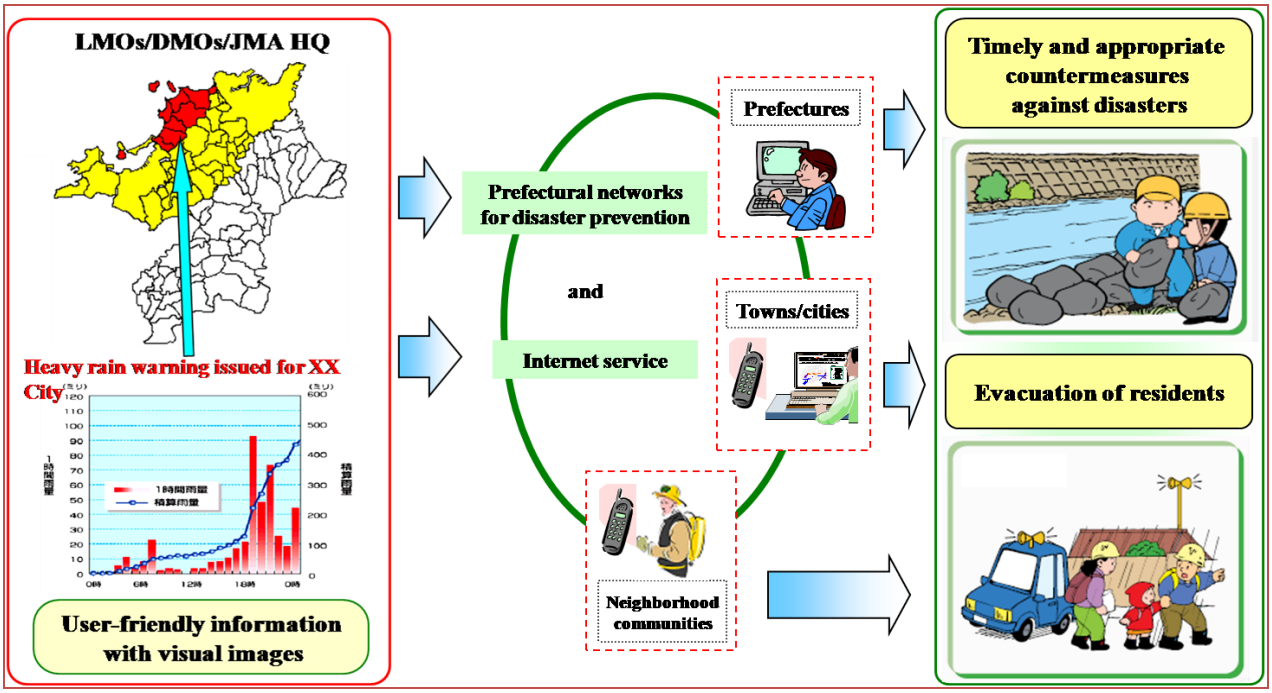

Figure 12: Weather Forecast and Warning and flow thereof (Source: JMA Broacher, 2012)

7.4 Integrated Public Alert and Warning System (IPAWS) – United States of America

Another example of effective dissemination of EW is the Integrated Public Alert and Warning System (PAWS) of the US. The IPAWS introduced in USA in 2006 established by Executive Order 13407, provides the necessary platforms for advanced warning to the American public of impending natural and man-made disasters during an emergency. IPAWS a modernization and integration of the nation's alert and warning infrastructure allows federal, state, territorial, tribal, and local officials and emergency managers to provide the public with life-saving information quickly. It integrates new and existing public alert and warning systems and technologies in order to provide authorities a broader range of message options and communications pathways, thereby increasing the capacity to save lives and property. IPAWS facilitates the delivery of alert and warning information over more media to more people before, during, and after a disaster.

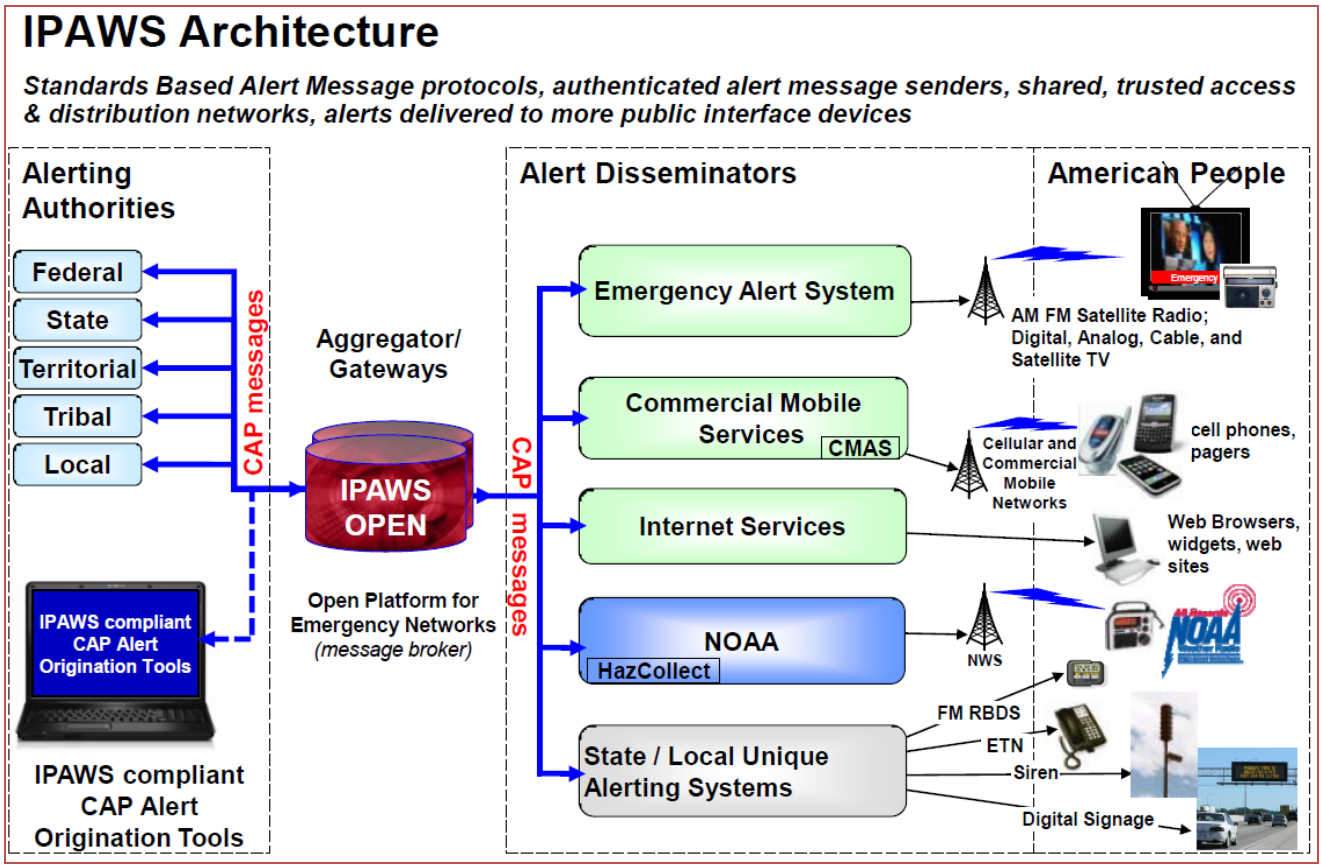

Figure 13: IPAWS Architecture (Source: FEMA, USA).

In the event of a national emergency, the President will be able to use IPAWS to send a message to the public quickly, easily, and simultaneously through multiple communications paths in order to

reduce loss of life and property damage. In addition, IPAWS provides state, territorial, tribal, and local governments with the capability to integrate their alert and warning systems with the national alert and warning infrastructure.

In this way, IPAWS will increase resilience to local systems and provide additional means by which life-saving information can be distributed to residents during a crisis. This system has been designed with the aim to “ensure that under all conditions the President of the United States can alert and warn the American people.” Communication architecture of IPAWAS has been elaborated in the figure 13.

7.5 Integrated Disaster Management Information System – Japan

The development of a quick and accurate communications system is essential for the effective use of early warning information. The Japan Meteorological Agency has therefore built an online system linking disaster management organizations of the national and local governments and media organizations. Disaster management organizations have also been developing radio communications networks exclusively for disasters: the Central Disaster Management Radio Communications System (figure 14) which connects national organizations; the Fire Disaster Management Radio Communications System which connects firefighting organizations across the country; and prefectural and municipal disaster management radio communications systems which connect local disaster management organizations and residents. The Cabinet Office has developed the Central Disaster Management Radio Communications System so that designated government organizations and designated public corporations can use telephones or facsimiles via a hotline, and has prepared an image transmission circuit so that pictures of disaster situations can be transmitted from helicopters in real-time. Furthermore, as a backup for terrestrial communications, a satellite communications system has also been constructed. Simultaneous wireless communications systems using outdoor loudspeakers and indoor radio receivers are used to disseminate disaster information to residents. Tsunami and severe weather warnings are widely provided to citizens via TV and radio broadcasts.

Based on the experiences of the Great Hanshin-Awaji Earthquake, the Cabinet Office has been developing an integrated disaster management information system that helps to grasp the situation of the disaster early on and promotes information sharing among relevant organizations, thereby enabling quick and appropriate decision-making for emergency response operations. Key components of the information management system of Japan are as under:-

i) Earthquake Disaster Information System (DIS) – DIS is automatically activated upon the receipt of earthquake (intensity level 4 or greater) information from the JMA to estimate the approximate distribution of seismic intensity and scale of dmage (human suffering and building damage) within 30 minutes.

ii) Real Damage Analysis System by Artificial Satellite (RAS) - RAS uses satellite images to assess actual disaster damage when it is otherwise difficult to determine the disaster situation due to the disruption of transportation and communications networks.

iii) Disaster Information Sharing Platform (PF) - PF is a common information sharing system with a standardized information format, where various disaster information provided by ministries and agencies, local governments, relevant organizations and residents, can be posted and freely accessed by all.

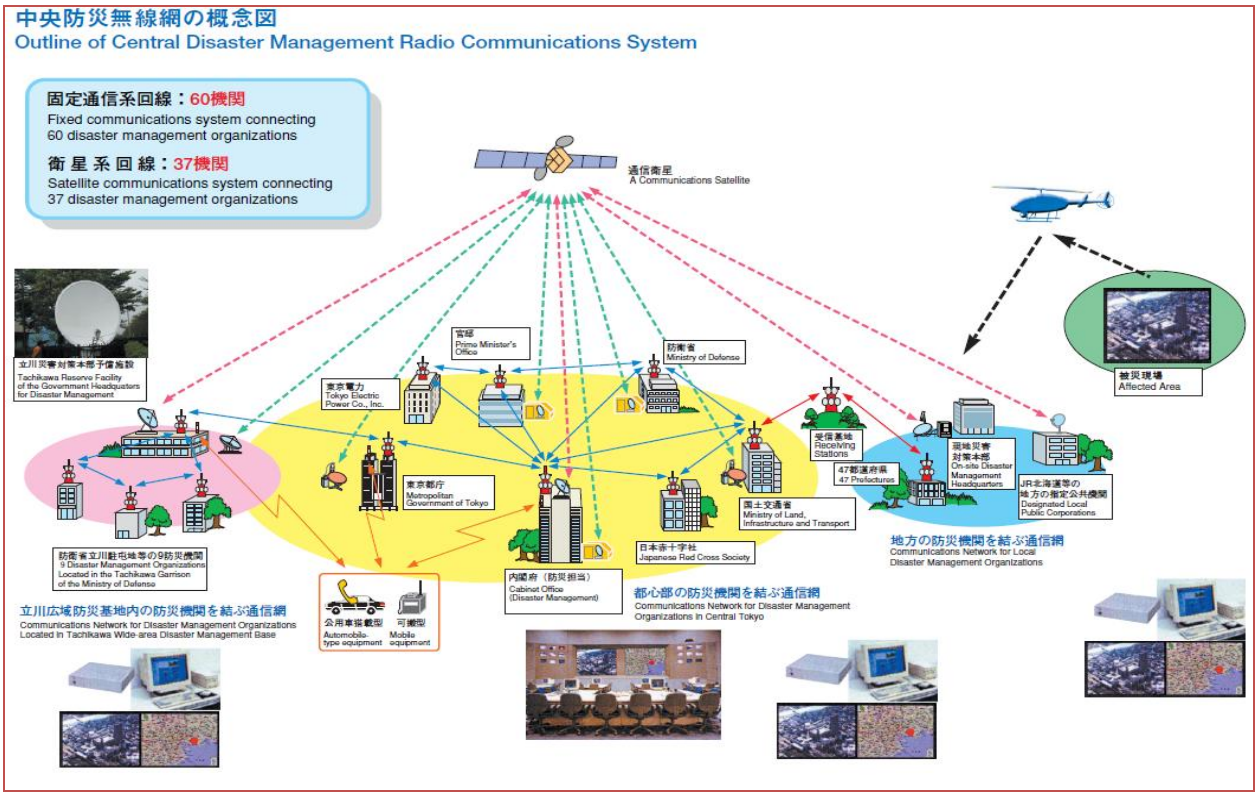

Figure 14: Outline of Central Disaster Management Radio Communication system in Japan (Source: Cabinet Office, Japan)

7.6 Emergency Response and Communication System of Osaka Gas Engineering Co. Ltd., Japan

This case study focuses on ERS at the company level. Osaka Gas Engineering Co. Ltd. supplies gas in Kansai region of Japan which comprises of six prefectures namely Hyogo, Osaka, Kyoto, Nara, Wakayama and Shiga consisting of 6.3 million households/customers. The company ensures safety in areas heavily damaged by earthquakes by stopping city gas supply. The intelligent gas meters installed at each customer's location automatically shut off at 200 (gal). Furthermore, low pressure gas supply is automatically shut off in earthquakes capable of damaging pipelines and structures by an automatic shut-off system installed at medium pressure governor B. Moreover, in extreme cases (widespread damage), city gas supply can be shut off remotely from the Central Control Center and Back-Up Center. A diagrammatic presentation of the emergency shut off system is given in the figure 15.

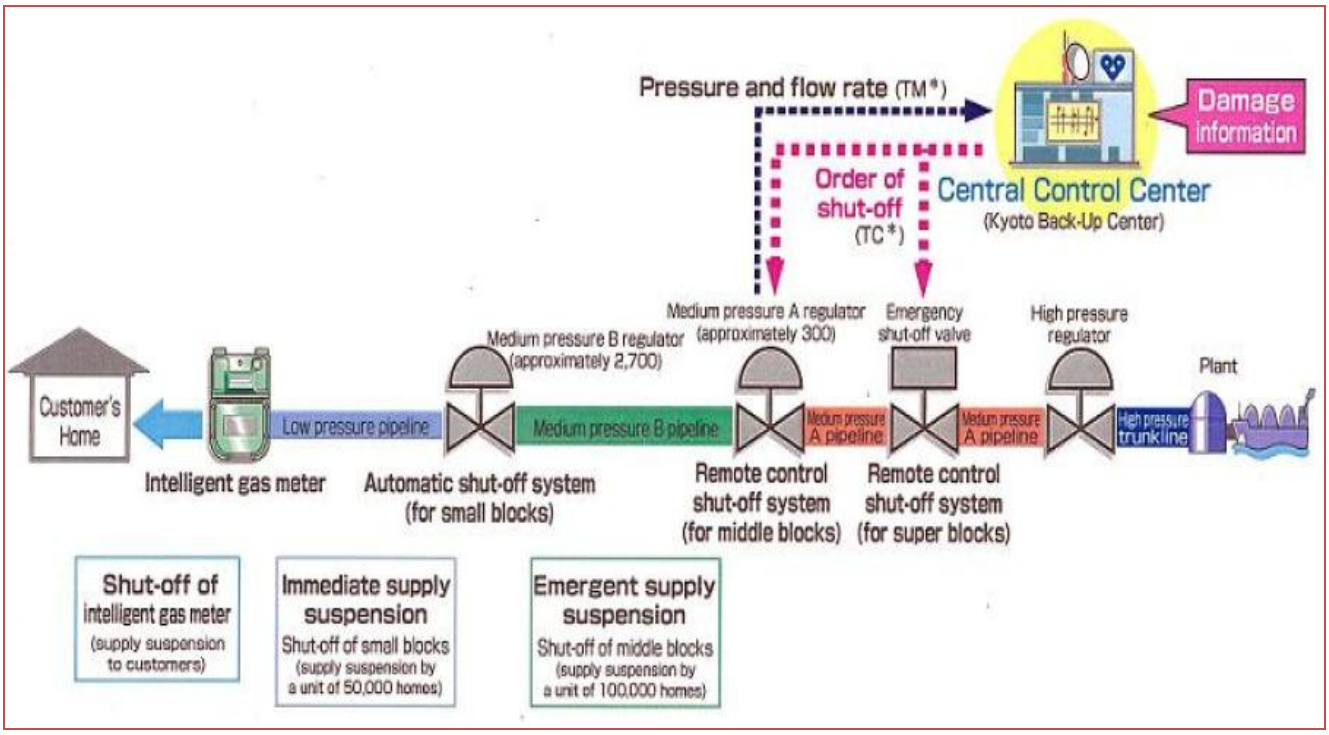

Figure 15: System of Emergency shutting off gas supply by Osaka Gas (Source: Osaka Gas Co. Ltd.)

In-house radio network - In order to smoothly produce and supply city gas, Osaka Gas remotely monitors and controls city gas supply 24-hours a day. Because around-the-clock operation is

necessary as much in an earthquake as on a regular basis, Osaka Gas introduced a radio network that works by radio waves and satellite. System of radio network operated by the company is given in the figure 16.

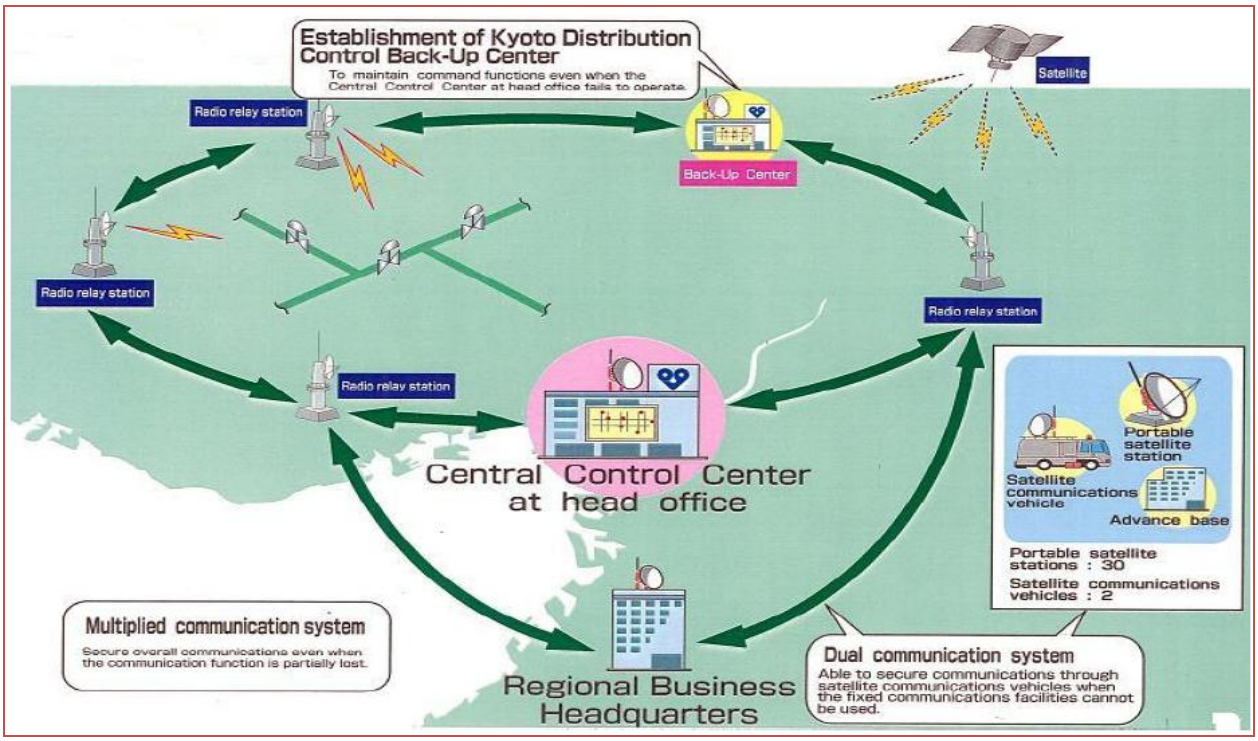

Figure 16: Radio Communication System of Osaka Gas (Source: Osaka Gas)

8.0 Use of ICT during Large-scale Disaster for Humanitarian Response and Coordination

In the recent times, use of modern ICT tools such as social media has tremendously enhanced communication between individuals and community. These ICT tools are now being widely used in humanitarian response too. In this regards, two case studies have been picked up – one from 2010 Haiti earthquake (a developing country) and second from 2011 GEJE (a developed country) to show as how these tool are important and how the use of these tools can facilitate emergency response and coordination.

8.1 Case Study 1: 2010 Haiti Earthquake

On January 12, 2010, a 7.0 magnitude earthquake rocked Haiti killing an estimated 2,30,000 people, injuring another 3,00,000 and leaving around two million out of nine million people of the

country homeless. An estimated 18,000 civil servants were killed and blocks of public buildings were leveled, which further limited the ability of an already impoverished government to deliver food, water and health care. Haiti's news media was temporarily paralyzed. Haiti's newspapers have been hampered by the country's low literacy rate of 52 percent and Radio is Haiti's dominant medium. Access to radio can be shared easily and relatively cheaply among many people, and serves both literate and illiterate populations. But earthquake also knocked down most Haitian radio stations off the air. Only one, Signal FM, managed to continue broadcasting to an audience of nearly three million throughout the crisis. Haiti's population of 9.6 million possessed only 108,000 landlines in 2009 (ranking it 142nd in the world per capita), compared to 3.6 million cell phones.

As with most of natural disaster international community responded to assist Haiti for humanitarian response. Haiti's already inadequate infrastructure was shattered, crippling rescue efforts and creating additional hazards. Communications systems, one of the few tools that could bring order to the chaos, were also imperiled by the quake. The emergency response required an unprecedented level of coordination among vast numbers of relief workers from all over the world.

The critical role of communication cannot be undermined for disaster response but in Haiti, the importance of the media rose to a new level. In fact, Haiti earthquake also marked the beginning of a new culture in disaster relief. Occurring several years into a revolution in communications technology, the event attracted legions of media specialists bearing new digital tools to help. The relief efforts quickly became a living laboratory for new applications such as short message service (SMS) texting, interactive online maps and radio-cell phone hybrids. These tools were applied to urgent tasks such as guiding search-and-rescue teams, locating missing persons and delivering food and water to the populations that needed them the most. Haiti constituted a learning opportunity, not a perfect model. Working partnerships had to be forged quickly between traditional actors, including governments and international institutions, and more spontaneous technological coalitions. Haiti's shaky communications infrastructure, crippled by the earthquake, often faltered under the new demands. Yet the operations also yielded a wealth of data and experience that will be of vital importance for future relief efforts.

Due to Haiti's proximity to the United States and its large diaspora community there, communications technology served as a catalyst to overcome culture and language barriers. Technology even offered new avenues for fund raising via SMS donations. Many Americans first heard of digital philanthropy through the Red Cross 90999 campaign for Haiti, which raised $5

million within 44 hours of the earthquake and $20 million within five days. Radio's importance as an information source was amplified because it complemented other critical information sources. Community networks and local churches were able to distribute messages more effectively by working with radio. Other forms of media such as text messaging and social networking combined with radio to improve delivery of key information with a consistent message to the widest possible audience. Given the scarce access and widespread disruption of internet service, much of the internal Haitian media initiative was fueled by cell phone. The SMS reporting initiative began shortly after the earthquake. A largely volunteer band of new media and information technology experts converged to apply their innovations in support of the rescue effort. They worked energetically across a range of platforms, from FM radio to Internet mapping, to test everything from SMS messaging systems to new digital people-finder programs. These services, in partnership with local media, helped people find emergency food and shelter, locate missing friends and family, direct calls for help and recruit support to rebuild the country.

Based on report by Anne Nelson, Ivan Sigal with Dean Zambrano, titled as "*Media* Information System and Communities: Lessons from Haiti", brief description of the ICT applications used in the Haiti for emergency response in the aftermath of the earthquake is given as under:-

i) SMS Broadcast – Initiated by the International Federation of the Red Cross (IFRC) in parternership with the local cellphone company Voila to issue public health messages on relief services, etc. to all the Voila subscribers. Thomson Reuters Foundation, working with the InSTEDD Emergency Information System platform, used the Mission 4636 SMS short code for a public health-focused SMS broadcast services, creating a one-way service to send out public health messages to approximately 26,000 subscribers.

ii) Short Code 4636 - Provided as free service by cell phone company Digicel to the general public to send SMS using short code 4636 to seek assistance for search and rescue, medical aid, food, etc. Two weeks after the earthquake, Crowdflower took over the management of the message workflow becoming the "switchboard" for mission 4636. Energy for Opportunity and Standford University enlisted thousand of Creolo (language spoken by Haitians) speaking volunteers to translate and categorize SMS coming though 4636 while plotting the senders' location on a map. These messages (triaged with a translation and coordinates) were then streamed back to relief groups in Haiti.

iii) Local Media – Radio broadcast through Radio aired many types of programmes to collate

and disseminate information. Interviews provided humanitarian program “News You can Use” to all radio stations. This program reported critical information about water distribution points, displaced persons camps and public health. Information from local government officials and community and religious leaders was relayed to the general public via press conferences, interviews and field visits. SMS, call-in program and open mic at radio stations were mediums for people to make announcements and look for relatives and friends.

iv) Geo-tagging – Ushahidi, a group of volunteers established a direct live feed that pluged into the information stream from the 4636 short code as well as form social media (e.g. Facebook, Twitter and blogs) from Haitian together with reports from local and international media. Volunteers at Fletcher School at Tufts University, Boston, USA, organized to provide technical support for this application. The translators and coders launched Haiti.ushaidi.com, a web based platform to parse, sort and geo-locating data on online maps. These maps were then shared with response teams on the ground and the US Marine, US Coast Guard to help coordinate their resources and response. These reports were equally accessible online to general public too.

v) Crowdsourced Maps – Lack of maps was one of the major constraints being felt by the humanitarian responders. Humanitarian Open Street Map team build functional maps to help emergency services find their way to the affected areas. The crowsoruced maps became the standard/default maps for the responders. Users of these maps included not just information technology platforms such as Ushahidi, but also large providers of humanitarian services.

The use of ICT applications has been summarized in the figure 17.

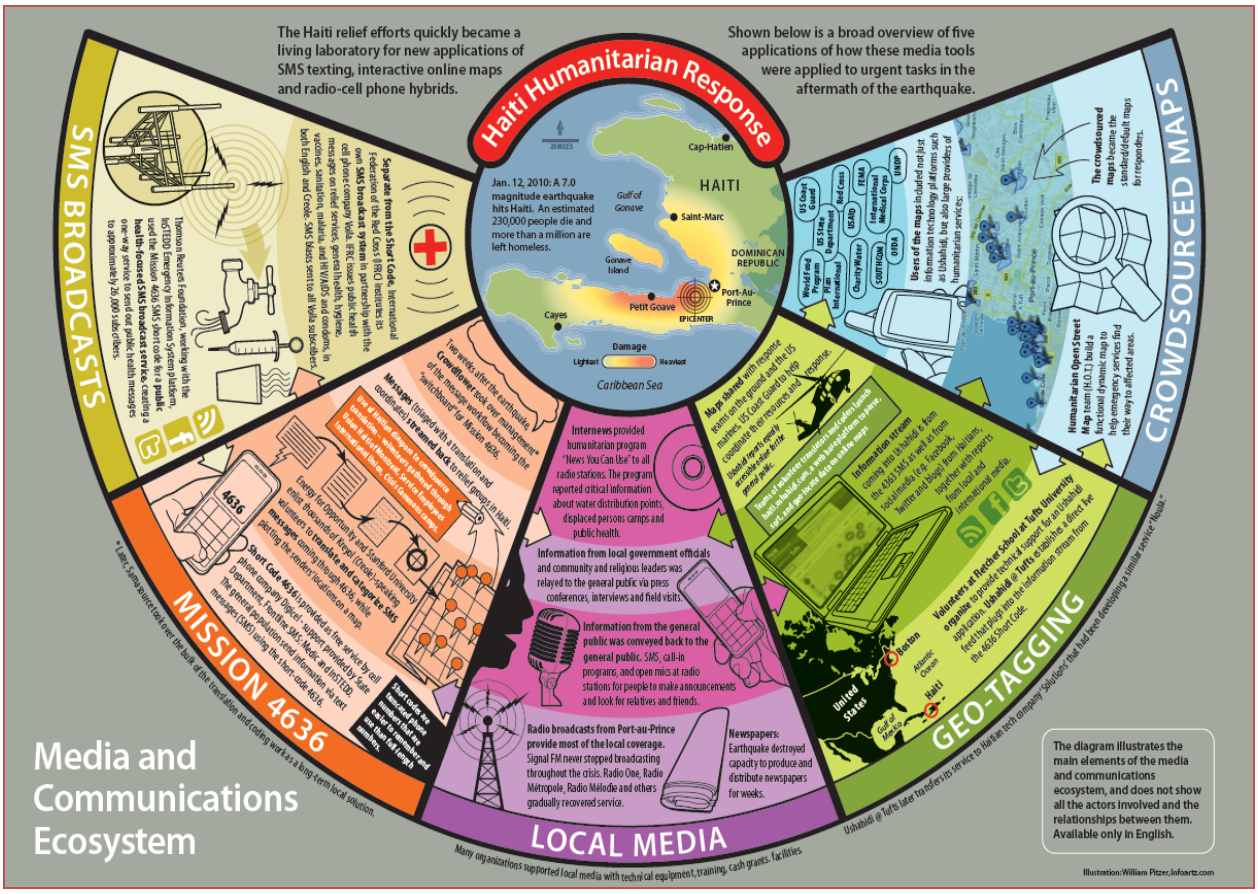

Fig. 17: Summary of ICT application used in 2010 Haiti earthquake response (Source: Anne Nelson, Ivan Sigal, et. al.).

8.2 Case Study 2: 2011 GEJET

The 11th March, 2011 Great East Japan Earthquake (GEJE) caused immense damage and congestion in telephone infrastructure, including 1.9 million fixed-line services and 29,000 mobile phone base stations. The disaster management radio communications networks of national and local governments are generally considered to be more robust and resilient than public fixed networks. But in the GEJE many towns and villages, particularly those located along the Pacific coastline, suffered various levels of damage to their radio communications systems, including both community announcement systems with loud speakers and mobile systems on emergency vehicles. Compared to terrestrial communication infrastructures, satellite phones and satellite communication systems were less vulnerable. Satellite phones, in particular, played a vital role in emergency communication among local governments and rescue organizations. Satellite mobile phones. provided voice and internet communication capabilities for disaster management

organizations, evacuation shelters, and staff working on infrastructure rehabilitation, among others. Portable and truck-mounted satellite earth stations were used by disaster relief organizations and media entities to transmit video images from disaster sites.

Some mobile phone carriers introduced an emergency messaging service whereby the terminal device converted voice recordings into voice files that could then be sent via packet transmission. Other mobile phone carriers also followed suit. These services were used some 14 million times following the GEJE. Voice messages were widely used to confirm whether family members and relatives were safe.

After the earthquake occurred, broadcasting companies including NHK (Japan's public broadcasting corporation) and local operators interrupted regular programming to provide disaster-related information. For example, NHK delivered emergency earthquake warnings, followed by news reports on a continuing basis starting 2 minutes after the earthquake occurred on the company's 8 channels. People were able to watch many of those programs on their mobile phones in areas where the electricity supply had failed. The programs were delivered by one-segment broadcasting (A mobile terrestrial digital audio video and data broadcasting service in Japan). One-seg TV on mobile phone also proved life savior for many. The EW alert and warnings received through it saved many lives.

Social media such as Twitter, Face Book, Mixi, Webpages or Blogs, etc. were used extensively during the GEJE for various purposes, such as search, rescue, and fundraising. Social media and the internet were found to be highly reliable regardless of the users' role, location, or the extent to which they were affected by the disaster. Users found social media to be extremely beneficial in general to an overwhelming degree. For directly affected individuals and people in the affected areas, the strongest reasons for using social media were convenience and their mass dissemination capacity.

Immediately after the disaster, the communication systems developed by local governments did not work because of power failures and a lack of emergency backup power supply. As many as 120 television relay stations in 11 prefectures stopped functioning because of the loss of commercial electricity during the initial period of the disaster, and as many as 4 radio relay stations shut down. Ministry of Information and Communication (MIC) distributed 10,000 portable radio receivers to evacuation shelters, and requested equipment manufacturers such as Panasonic and Sony, to distribute over 40,000 portable radio receivers. Emergency FM radio also played a crucial role in providing information to local residents. In the Tohoku area, 25 emergency broadcasting stations specializing in disaster information were set up. Many volunteers and government officials

contributed to the operation of such local radio stations. Pictures of the Studio of “Natori Saigai (disaster) FM” established at Natori City office building, Miyagi prefecture has been given in figure 19 (a) and Ringo (Apple) Radio of Yamamoto Town, Miyagi Prefecture is given in figure 19 (b)

Figure19 (a) (Courtesy: MIC)

Figure 19 (b) (Courtesy: WB Knowledge Notes)

FM Radio at first, only announced information such as bathing times and food rationing information for those living in the town. Later the content became less about daily life than about supporting and comforting the residents. FM radio provided locally customized information, such as information about aftershocks, or the availability of local services and activities related to people’s everyday needs. This kind of information was beneficial immediately after the disaster, while different information was required as reconstruction progressed. Some entertainment programs were presented 6 to 9 months after the disaster. Social media and community radio reached two distinct age groups: social media for the younger generation and community radio for the older generation.

Media Used at the time of Disaster - Digital signage network is effective tool for information provision at the time of disaster. After the earthquake, all the train services stopped and there was terrible traffic jam in Tokyo. About 5 million people were not able to go home. Digital signage system was used as media to provide information. The Google Person Finder (Figure 20) let people enter an inquiry about a missing person or provide information for interested parties. Google person finder was widely used to search for the missing person and unite families separated during disasters. In total over 600,000 person names were registered.

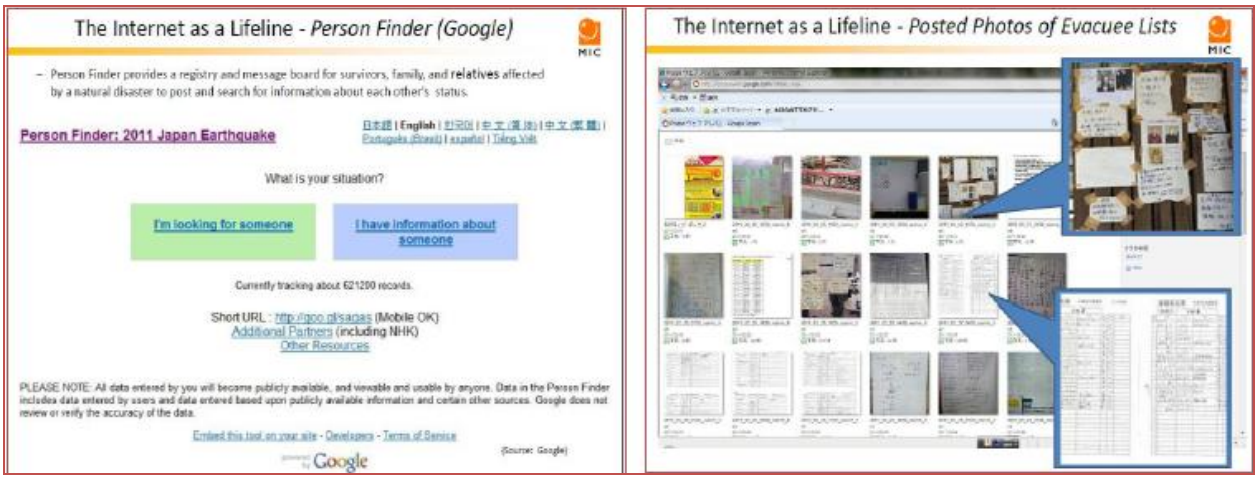

Figure 20: Picture showing images use of Google Person Finder

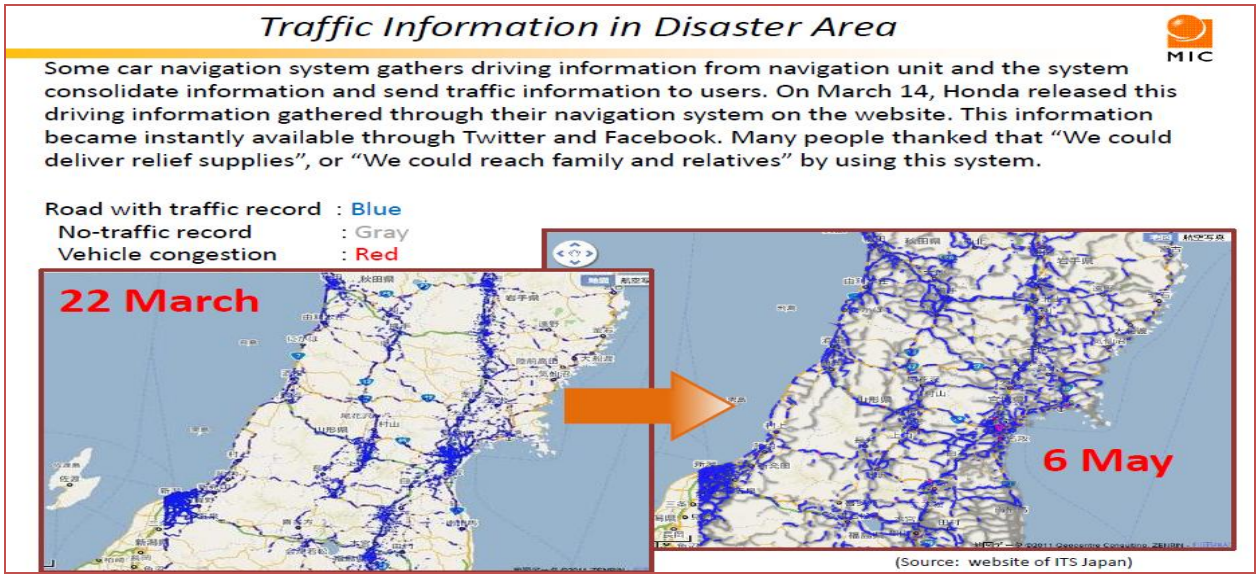

Figure 21: Traffic Information in Disaster affected area.

Car navigation system was used to gather driving information and uploaded in the social media sites which were widely used by various agencies to provide relief to the affected community. Figure 21 shows the two maps of the affected area with route maps as on 22nd March and 6th May depicting the difference of road density mapped by this tool.

9.0 Summoning of Services – Universal Emergency Telephone Number

In many countries the public telephone network has a single emergency telephone number sometimes known as the universal emergency telephone number (Figure 22) or occasionally the emergency services number that allows a caller to contact local emergency services for

assistance. The emergency number differs from country to country; it is typically a three-digit number so that it can be easily remembered and dialed quickly. In the European Union, Russia, Ukraine and Switzerland and others "112" was introduced as a common emergency call number during the 1990s, and as the GSM standard it is now a well-known emergency number across the globe alongside the North American "911". 9-1-1 is a common emergency telephone number, used in countries such as Canada, Costa Rica, El Salvador, Jordan, Liberia, Paraguay, Uruguay and the United States.

Figure 22: Universal Emergency Number of Different Countries.

9.1 Case of European Union

According to the Directive No. 98/10/EC (ONP: provisions for the open telephone networks and the universal service in telecommunications), 112 is the single emergency call number throughout all European Union (EU) countries, being answered to in several foreign languages; it is a free of charge call which can be made from all terminals connected to the fix, mobile telephones, or other systems, and it is to be first implemented alongside the already existing systems. The 112 European Emergency Number Association Foundation was created in order to promote the knowledge and appropriate use of the European Emergency Number 112. The 112 Foundation developed a common graphic line and logo for the 112 service so as to be available and used in the entire EU. 112 became the single European emergency number in 1991.

It is possible to call 112 from fixed and mobile phones to contact any emergency service: an ambulance, the fire brigade or the police. Operators in many countries can answer the calls not only in their national language, but also in English or French. If the caller does not know where he is, the

operator will identify where the person making the call is physically located and will pass it to the emergency authorities so that these can help immediately. 112 doesn't replace the existing national emergency numbers. In most countries, it operates alongside them. However, Denmark, Finland, the Netherlands, Portugal, Sweden, Malta and Romania have opted for 112 as their main national emergency number. 112 is also used in some countries outside the EU - such as Switzerland and South Africa - and is available worldwide on GSM mobile networks. Case study of the functioning of 112 emergency number in Romania has been given in the next paragraphs.

9.2 Case Study of Romania

The Single National Emergency Call System (SNECS) in Romania is a vital constituent of the universal service obligations, as laid down in one of the Directives of the EU acquis, significant for policy-making in the telecommunications field. The main objective of 112 is to safeguard lives, property and environment. The 112 system works countrywide 24 hours a day and 7 days a week and aims at ensuring citizen protection and providing the highest level of assistance, regardless of their location. The SNECS consists of emergency call answering centers known as Public Safety Answering Points (PSAP) and their associated equipment - an operative telecommunications system, designed to notify, receive, process and transfer the emergency calls to the requested services, in a centralized and unitary way. The system also applies to the communications between the Police, the Fire Brigade, and the Ambulance special response systems which have the obligation to respond in case of emergency calls. The first PSAP was made operational on 15th June, 2004. The PSAP personnel is composed of professionals who respond to the emergency calls 24/7. They are trained to assist the callers during the emergency situations and help them as soon as possible.

Special Telecommunications Services (STS), a legal government operator operates the SNECS which works through 40 PSAP i. e. county centers (one in every county capital, with back-up capacities) one centre within the STS Headquarters, (Bucharest), the back-up centre for disasters, and Local Emergency Dispatcher Centers one for each agency (Police, Fire Brigade, Ambulance).

The SNECS receives and automatically records the emergency calls received on/through telephone, radio, automatic announcement devices, signaling, and alarming by other methods, confirming and locating, as much as possible. It analyzes, organizes and promptly transfers the emergency calls as received to specialized response agencies, competent authorities (depending on the nature of the events and their consequences); transfers immediately the calls, the data and the information received in case of disaster to the Permanent Technical Secretary of the

Government Commission for Defense against Natural Disasters, receives and records the data and information on the events and response development and collects, stores and makes available for the competent authorities the data regarding the handled emergency calls. This is a multi-lingual service made available to all countrywide citizens (both Romanian and foreign) who are in an emergency situation.

Examples of emergency situations handled through 112 includes such as homicide, armed assault, attack, robbery, public disorder, desertion, break-outs, smuggling and drug consumption, thefts, traffic accidents resulting in human casualties or persons trapped in cars, explosions, electrocution, falls, landslides, serious subway/underground accidents, aircraft accident, train accident, serious medical problems, fires, flooding, etc.

How does the system work? - The PSAP have a database which helps 112 call takers to locate the call and identify the nature of incident and the adequate response resources. This is possible by using two identification indicators: Automatic Number Identification (ANI) - the caller's telephone number is automatically displayed and Automatic Location Identification (ALI) - the caller's address, the place he calls from and further information needed to find the optimal solution for the response to reach the incident site in time are displayed.

In responding to an emergency, the Automatic Vehicle Location (AVL) application is also used to identify the position of the vehicles responding to emergency situations, equipped with (conventional or digital) radio communications equipment, including a GPS subsystem. In order to route the data between the mobile terminals and AVL server, the AVL application uses digital radio and/or analogue (conventional) networks, to locate the response vehicles and identify the best routes to get to the incident site. The STS uses Phoenix, Dimetra and conventional UHF and VHF networks to achieves local cooperation for the response. The communcation archtecture of 112 is given in figure 23.

The call handling process in 112 is as under:-

- caller dials 112 to report serious accidents, resulting in human casualties;
- the system identifies the caller's phone number;
- the caller's name and address are then determined by database automatic search (the same process applies to the EU countries, USA and Canada, too, as a measure needed to confirm call authenticity);
- the call taker requests incident information from the caller;

- all the data are then transmitted to the Police, the Fire Brigade and the Ambulance dispatchers, depending on the case type (no longer than 2-3 seconds time frame);
- the dispatchers rapidly identify the means of response (response services) participating in the case resolution, using the AVL application;
- the case-response services connection is displayed on the map.

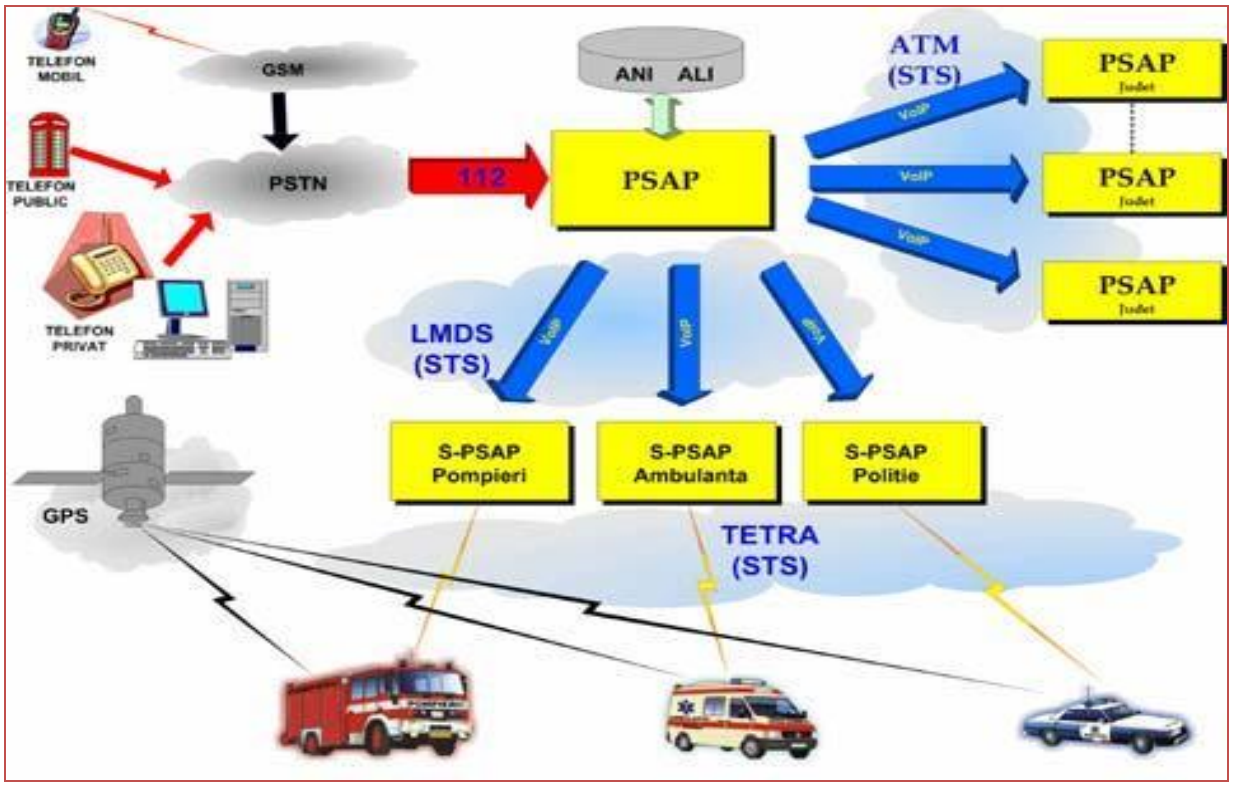

Figure 23: Communication Network of 112 in Romania

9.3 Single Universal Emergency Number Wold wide

Other than the EU and North American countries the universal emergency number has been implemented in the world throughout from the developed to developing country, from East to West and from North to South. Details of universal numbers of the countries have been given in the table 2.

Table: 3: Single Emergency Toll Free Nos. in Countries around the world

Sr. No.	Name of the Country/Region	Emergency Helpline
1.	USA	911
2.	Australia	000/112
3.	United Kingdom	999/112
4.	European Union Member Countries	112
5.	France	112
6.	New Zealand	111
7.	South Africa	10111/10177
8.	Nigeria	199
9.	Sudan	999
10.	Bahrain	999
11.	Cambodia	117
12.	East Timor	112
13.	Myanmar	191
14.	Hong Kong	999
15.	North Korea	819
16.	Kuwait	112
17.	Macau	999
18.	Maldives	112
19.	Malaysia	999
20.	Oman	999
21.	Philippines	117
22.	Qatar	999
23.	Thailand	999
24.	Solomon Island	111
25.	Canada	911
26.	Greenland	112
27.	El Salvador	911
28.	Nicaragua	118
29.	Honduras	199

30.	Haiti	118
31.	Surinam	115
32.	Uruguay	911
33.	Venezuela	171

Source: Wikipedia and SOS Number World wide

A case study of the functioning of universal number from Philippines, one of the developing countries has been given below.

9.4 People's Action Team Responding On-Line (PATROL 117) - Philippines

Patrol 117 is the national and official emergency hotline number of the Philippines. Launched in 2003 by the Department of the Interior and Local Government (DILG), Patrol 117, the local counterpart of the United States' 911, seeks to connect concerned government agencies with callers in emergency situations for immediate response. It aims to establish an easy recall number that can be accessed by anyone, anytime, anywhere in the Philippines in cases of emergencies, as well as to monitor the efficiency of its responders' network. It however, does not compete with other locally established emergency numbers or with local responders, but complements their local operations. "117″ is not a responder, but a Call Centre that processes received calls and relays emergency situations to the appropriate responders. One may call Patrol 117 during emergencies and life threatening situations that require immediate response e.g. crime incidents, fire incidents, medical assistance, rescue operations, public safety concerns, to report abusive officials and law enforcers, illegal activities, and crimes that require immediate assistance. Patrol 117 operates nationwide. Apart from easy access, it has a monitoring mechanism that assures the public that all cases relayed through "117″ are duly responded to and acted upon. With "117″, the services of the government responders are for free.

The objective of the 117 Patrol is to establish an easy recall number that can be accessed by anyone, anytime, anywhere in the Philippines in case of emergencies and to monitor and help improve the efficiency of its responders. DILG facilitates if Caller reports an emergency to "117″ through the dispatcher who processes the call and relays the incident to the appropriate responder(s) and monitors the responders' action on the calls relayed.

10.0 Emergency Management System, Hyogo Prefecture, Japan

The Disaster Management Center - Learning from 1995 Hanshin-Awaji earthquake, Hyogo Prefecture established state-of-the-art Disaster Management Centre (DMC) with Phoenix Disaster Management System in the year 2000, a government facility specializing in disaster management. The DMC serves as the central base for the preparedness and information collection, base for rescue activities and administrative office of the emergency relief headquarter. The DMC is housed in a separate building consisting of six floors and one basement opposite to the prefectural buildings. It is an earthquake resistant structure seismically isolated. An underground pathway connects the center with the prefectural buildings.

The center is equipped with independent and back-up essential services such as water, electricity, air-conditioning, etc. The Administrative Office of the Emergency Relief Headquarters (Figure 24) is used as the office of the Disaster Management Division during normal time, but used as emergency headquarter during emergencies. To ensure efficient emergency activities, such a as information collection, the room layout is functional and highly flexible with spacious desks. The Emergency Relief Headquarter Control Room (Figure 25 (a) serves as the central base for disaster management activities. This room is equipped with Phoenix System which provides the latest formations on disaster damage.

To ensure inter-agency coordination the DMC has a cooperative organization staff room which is used by staff who deals with Self-Defence Forces, the police, fire-fighting authorities, lifeline companies and other entities involved in damage prevention when a disaster occurs.

Broadcasting equipment (Figure 25 (b) is installed in the DMC to provide information directly to local residents in the prefecture when a disaster occurs. Emergency broadcast is delivered via an AM radio station. Information and communication devices have been installed in the network control room, including server, the heart of Phoenix, and radio communication devices that utilize satellite communication networks. The devices are protected from seismic vibration by a base-isolation floor.

Figure 24: Administrative Office of the Emergency Relief Headquarter

Figure 25 (a) : Network Control Room

Figure 25 (b): Broadcast Room

The Hyogo DMC offers a variety of hardware and software-related functions so that it can fully play its role as a hub for disaster prevention activities. DMC has facilities with multiple redundancies that prevent government office building from failing to function even during a disruption of lifelines.

The DMC also acts as concentration and unification point for the different disaster prevention-related offices that are scattered within the prefectural government buildings. The center has a system management room (Figure 25 (a) for switching between Heli-Tele footage, high altitude camera footage, disaster information and other data on the large screen of the emergency relief headquarter and the large text display panel which is 103-inch hi-vision plasma display panel television displaying meteorological and disaster information in real time.

All facilities necessary for the 24-hour watching and prompt response system such as night duty rooms have been provided in the DMC. Near the center, standby staff are provided with 76 accommodation units consisting of three buildings for initial response mobilization just after the occurrence of a disaster. To call up standby staff, promptly, each unit is connected with the center through broadcasting equipment. In the DMC, food and blankets for immediate use for three days are stored so that emergency relief headquarter staff can devote all their attention to emergency response without external supply.

Phoenix Disaster Management System - Phoenix Disaster Management system employed in the DMC is a web-enabled comprehensive disaster prevention information system that can quickly respond to earthquakes and other any kind of disaster, based on the lessons learnt of the Great Hanshin Awaji Earthquake. It facilitates the initial and emergency response at the time of a disaster at prefectural agencies, municipalities, fire department, police headquarters, police stations, Fire and Disaster Management Agency, Self-Defence Forces, coast guard headquarters and lifeline operators, as well as other related agencies, and strengthen cooperation and coordination with relevant organizations. Communication support features, such as e-mail and electronic bulletin boards contribute to flexible information sharing between agencies and organizations involved in disaster prevention.

This system has functions including the collection and provision of disaster and meteorological information, damage and prediction, disaster flash report, a display of disaster situation map and the estimation of supply and demand and it acts as a total system supporting decisions made by the emergency relief headquarter in rapid and accurate emergency response. Concerning the initial response by the Prefectural Emergency Relief Headquarter, the system displays the flow and procedures for each prevention measure item and also record processing status, together with the progressive management of initial response.

It is a large-scale network of a total length of approximately 1100 km that has been established as fundamental information infrastructure to promote information technology within prefecture, and connects key locations within the prefecture with optical fiber lines. High reliability has been achieved for the system through the use of a high-speed and high capacity (10Gbps), a monitoring and maintenance regime running 365 days a year. The system connects key locations such as the prefectures general building and the regional agencies of the prefectural government with a dedicated digital line in a loop, utilizing the Hyogo Information Highway and the prefectural government WAN as its main transmission channels. From each access point, the municipalities, fire department headquarters and other organizations are connected by dedicated optic fiber lines, thus covering the entire prefecture. Also, in order to ensure security, transmission use a dedicated disaster prevention, VPN has been created within the network. The system connects the prefectural government office with all municipalities, fire department headquarter, etc. using a satellite communication line. Also the prefectural government office is connected with the bureau for prefectural residents and civil engineering offices, etc. by a terrestrial radio line. This system is not only utilized in times of non-emergency for uses including the disaster prevention wireless phone, for the sending bulk faxes function and image transmission, but is also used for reception and transmission of Heli-Tele images and other information at times of disaster. During normal time this system is used to share information on disaster prevention to citizens and other stakeholders. The information flow of the Phoenix Disaster Management System used by the DMC in case of disasters such as earthquake, etc. and at normal times is given in figure 26.

Hyogo Prefectural Emergency Management and Training Center - The prefecture has set-up Hyogo Wide-Area Emergency Management Network at four different locations of the prefecture to stock-pile essential relief material and Hyogo Prefectural Emergency Management and Training Centre located at Miki General Disaster Prevention Park, few kilometres away from DMC, an area which was not affected during the 1995 earthquake. It acts as a back-up center for DMC too. This facility, in normal times, is a center of training for staff on emergency management, a sports complex and storage facility for relief material. The center has the same communication and network facility as the DMC. Interestingly, the ground floors below the sitting areas of sports stadium are being used as storage spaces for relief goods. During emergencies, the entire sports stadium is converted into a central place for dispatch of relief material to the affected area of the prefecture.

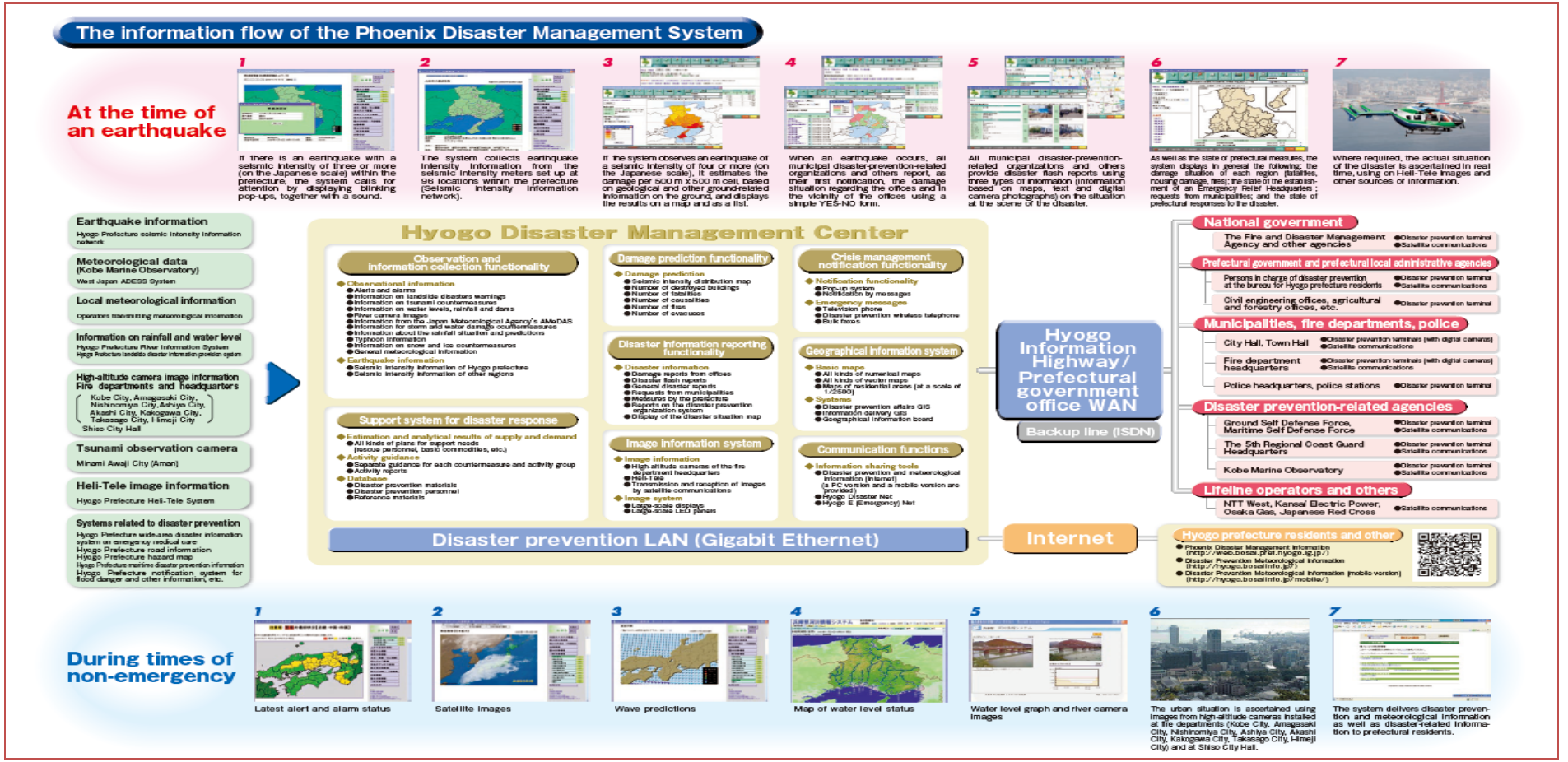

Figure 26: Flow Chart giving flow of information of the Phoenix Disaster Management System

11.0 Model Emergency Response System for India

Keeping in view the gaps identified in current ERS of India and the selected case studies of international best practices a model ERS for the country under different headlines is proposed as under:-

11.1 Universal Emergency Number and Integration of services

i) World over countries have moved from a system of multiple toll free numbers to single/universal emergency number for the entire country. The classic example is of the EU where the entire EU countries have opted for one number throughout the union. Many developing countries have also realized the wisdom of opting for single universal number (Table 3) keeping in view the convenience and safety of general public. And there is similar need for India too. In India also states like Assam have also integrated all toll free numbers and opted for 108 as the universal number for any emergency.

ii) There is need not only to integrate all the toll free numbers but also to integrate numerous control rooms each emergency service such as fire, police and ambulance have been maintaining. One control room at the state level with back-up center is good enough and resources of these services should be centrally managed at the state level only. Utilizing the modern ICT tools the calls in these centers should be assisted by CACH and CAD should be used for dispatching emergency resources.

iii) 108- Emergency Services introduced by many states in the country are already using this system. What they lack is ALI which the government needs to push for. Enhanced 911 and 112 services have already been using this world over. Most of these systems (108 type emergency services) are running without any back-up center and in case of large scale disaster these services can fail. Secondly many ambulance services are being run in public and private sector. There is also need to integrate all these services under one roof for providing better services to the citizens. Integration of all toll free number and their call centers/control room would not only make the system efficient but also reduce the deployment of manpower in numerous control rooms being managed across the state.

iv) The case study of Romania (For details please follow: http://www.112.ro/index.php?pag=1) offers a good model for country to follow. In case these call centers are outsourced on the 108-emergency service pattern, necessary protocols and procedures need to be drafted carefully.

11.2 Comprehensive and Integrated Legal and Institutional Framework

i) The current system of co-existence of old and new institutions is not good for DM in the country. There is need to either merge these institutions or abolish which are redundant now. Since most of the old structures are only committee structures they can simply be de-notified.

ii) All phases of DM should be assigned to one authority, keeping response and policy making separately as it exist today is an anomaly.

iii) The new systems created under the Act should be staffed and made functional.

iv) The NDMA has issued excellent guidelines and if implemented they will change the face of DM in the country. These guidelines should become part of the current training and capacity building activities being undertaken by the NIDM or any other institutions in the country so that the new system is institutionalized.

v) There is also need to learn from Japan and fill up gaps in legal and policy framework which is more glaring in case of post-disaster scenario. (For details please follow the link: http://www.bousai.go.jp/1info/pdf/saigaipanf_e.pdf)

vi) Many parts of county can be hit by large earthquake in future. Learning from Japanese wisdom and realizing the value of human lives there is need to proactively take concrete actions with tangible and measurable outputs to reduce the damages from such earthquakes.

11.3 Strengthening of Fire Services

i) As described in the foregoing paragraphs the fire services in the country is in very bad shape. World over the fire services act as multi-hazard response force and naming it as "Fire and Emergency Services" should be done. There is also urgent need to convert and equip the fire services all over the country as multi-hazard response force by strengthening, revamping, training and equipping it in a uniform way by legislation as recommended by the SFAC and as laid in the NDMA Guidelines.

ii) Roping in civil defence system for disaster management may be good in its own way but effort should be made to avoid creating multiple agencies. It may be ideal if civil defence is also merged with fire services so that the latter can be strengthened within minimum possible effort.

iii) On the pattern of Japan a cadre of Fire Services Volunteers should be created to supplement the effort of fire services in large scale disasters.

iv) The Home Guards should also be trained in fire-fighting besides training them in other aspects of emergency response such as search and rescue, medical first aid, management of relief, etc. Disaster Management, SAR and medical first aid should also be made part of NCC, NSS, and NYKS curriculum so that they can learn life saving skills and share this knowledge with other students.

11.4 Communication and Information Management System

i) The Act provides for establishment of emergency communication in vulnerable areas and establishment of communication links. The Government of India is also signatory to the 1998 Tampere Convention on the deployment of Telecommunication Resources for disaster management. India has a host of networks such as Disaster Management Support (DMS) network of Indian Space Research Organization (ISRO), Police Telecommunication Network (POLNET), National Informatics Centre Network (NICNET), State Wide Area Network (SWAN), Railway Communication Network, BSNL communication network such as Digital Satellite Phone Terminal (DSPT), and Broadband VSAT, Power Grid Corporation of India (PGCIL) network, network of Department of Atomic Energy (DAE), Common Services Center (CSC) Scheme, the National Knowledge Network and Emergency Planning and Response System of Ministry of Environment & Forest (MoE&F). In the first place there

is need to integrate these network for using them in disaster management. And in the long run a plan of action for fail-safe communication network for the entire country needs to be planned and implemented in a time bound manner. The NDMA has already issued guidelines for this purpose in 2012 and there is need to get the same implemented.

ii) The information and communication system used in countries like Japan using multiple networks and phoenix system (http://www.drlc.jp/english/wp-content/uploads/e38395e382a7e3838be38383e382afe382b9e998b2e781bde382b7e382b9e38386e383a0e38391e383b3e38395e383ace38383e38388.pdf) should be considered for adoption in the country. The DMC of Hyogo Prefecture (http://www.drlc.jp/english/wp-content/uploads/hyogo-disaster-management-center1.pdf) is an ideal model for implementation at the state level in India.

iii) Protocols for sharing of information and databases on real time basis by all the ministries, department and agencies on common platforms should be finalized and security concerns should not be allowed to cloud the safety issues of the citizens and SOPs in this regard should be finalized after holding due consultation with all the stakeholders.

iv) Use of ICT, Social Media and Community Radio is inevitable in large scale disasters. The Haitian and Japanese experiences strongly suggest that digital media and information technology can significantly improve humanitarian response with the right applications, coordination and program management. Large number of mobile subscribers in the country can allow for the effective use of social media during disasters, provided they are also used during normal times. Social media can also provide information to communities outside the disaster-stricken area, and facilitate the acquisition and appropriate allocation of aid and assistance.

v) Starting with the Haiti Earthquake of 2010, the use of social media during disasters has significantly increased in other countries. There is a strong potential for cultivating the use of social media among different stakeholder groups and for developing a social media-based platform designed for emergency situations.

vi) Community radios can provide information such as times and locations for provision of emergency water and food supplies or distribution of relief goods in the immediate aftermath of a disaster, and then gradually shift to providing different information for daily living or to help lift the spirits of people in the local communities. Radio is also appreciated by the elderly who may not have access to internet-based information. Establishment of community radios should be promoted in large scale. Countries like Indonesia and Philippines have already a large network of community radios.

11.5 Integrated Contingency Planning

i) The current system of preparing both DMPs and CMPs should be immediately discontinued for disaster management.

ii) Only DMPs at all level should be prepared as provided in the Act. The NDMA and SDMA should provide necessary assistance in the preparation of these plans. There is urgent need of country wide multi-hazard vulnerability and risk analysis. Besides, making these studies available in the public domain is equally important so that all the stakeholders are aware of the risk and integrate risk concerns in their day to day life, development and business Plans. In countries like Japan, risk maps are available on website in an interactive mode and they

are distributed to the citizens by the ward offices. Without this all planning, mitigation and preparedness activities will be directionless.

iii) These plans should be tested through regular mock drills to improve them.

11.6 Effective and User-friendly Early Warning System

i) The EWS in the country needs to be strengthened. There is also need to consolidate and orient EW agencies too making them efficient and citizen friendly. If JMA (http://www.jma.go.jp/jma/indexe.html) can be a single EW agencies in Japan why we need so may EW agencies, more particularly when many agencies so identified will be dependent upon each other for data for generating EW. For example, INCOIS will depend upon IMD for earthquake occurrence data before tsunami warning can be generated. Similarly, CWC will require data from IMD about rainfall before flood warning can be issued.

ii) There is need to authorize the EW agencies to disseminate the early warning signals and alerts directly to the government structure up to district level, user agencies and general public through all available means on the pattern of Japan.

iii) Mexico and Japan (http://www.jma.go.jp/jma/en/Activities/eew.html) have used their earthquake early warning system (EEWS) for several years. Institute of Care-life, China which is supported by the Chinese Ministry of Science and Technology, China Earthquake Administration and Sichuan Bureau of Science and Technology has recently built experimental EEWS covering 400,000 square kilometers in China. Since June 7, 2011, over 1000 earthquakes, with some of them to be destructive quakes, have triggered the EEWS. And China is planning to build its own EEW across the whole country in the next few years. Several other countries, including USA, Indonesia, Mongolia, Turkey, etc. are planning to build their own EEWS. It is therefore imperative for India too to focus its strategic thinking in this direction as more than 58% of her territory is prone to damaging earthquakes of varying intensity. The EEWS can be used in the country to stop trains, stop gas supply (case study of Osaka Gas), stop electricity supply, etc. to save lives and property.

iv) Secondly, the time taken to even report the occurrence of an earthquake event is unacceptable with the current advancement in science and technology. The EW agencies should seriously think and plan dissemination of early warnings and forecast not only the designated national, state, district and public sector utilities such as power corporations, railways, armed forces, gas and petroleum companies but to general public too in real time basis.

v) There is also need that relevant telecom and telegraph Acts including Disaster Management Act, 2005 are suitably amended to give powers to EW agencies and national and state governments to disseminate the EW in all available public and private media on priority in real time basis on the patter of Japan and IPAWS of the US.

vi) One of the most important components of EW is last mile connectivity. There is need not only to improve last mile connectivity but also need to make use of SMS broadcast, FM radios, social media and internet besides the electronic and telecommunication media available in the country. As on today the dissemination of EW/forecast below the district level is very difficult as no system and mechanism exist.

11.7 Inter Agency Coordination and Unified Response Mechanism

i) IAG involving UN organizations, INGO, NGOs, faith based organization and various government agencies as a platform for coordination should be set-up and strengthened. It would strengthen the existing systems, institutionalize unified response strategy in humanitarian crisis, and bring in the culture of "working together" in emergencies and normalcy. It is required for effective planning, coordination and execution over the issues pertaining to DRR, disaster preparedness and response. IAG would also promote sharing of best practices, tools & techniques and different types of resources among the stakeholder organizations for enhance solution exchange among stakeholders.

ii) Emergency response in large scale disasters should work with unified response strategy (URS) bringing all the stakeholders on a common platform so that relief reaches the right place in an equitable and timely manner.

iii) The EOCs/Control Rooms at various level should also act as Resource and Facilitation centers for all the stakeholders and information should be shared and disseminated with all concerned on a single platform through various media available. A model of effective coordination mechanism has been given in figure 27.

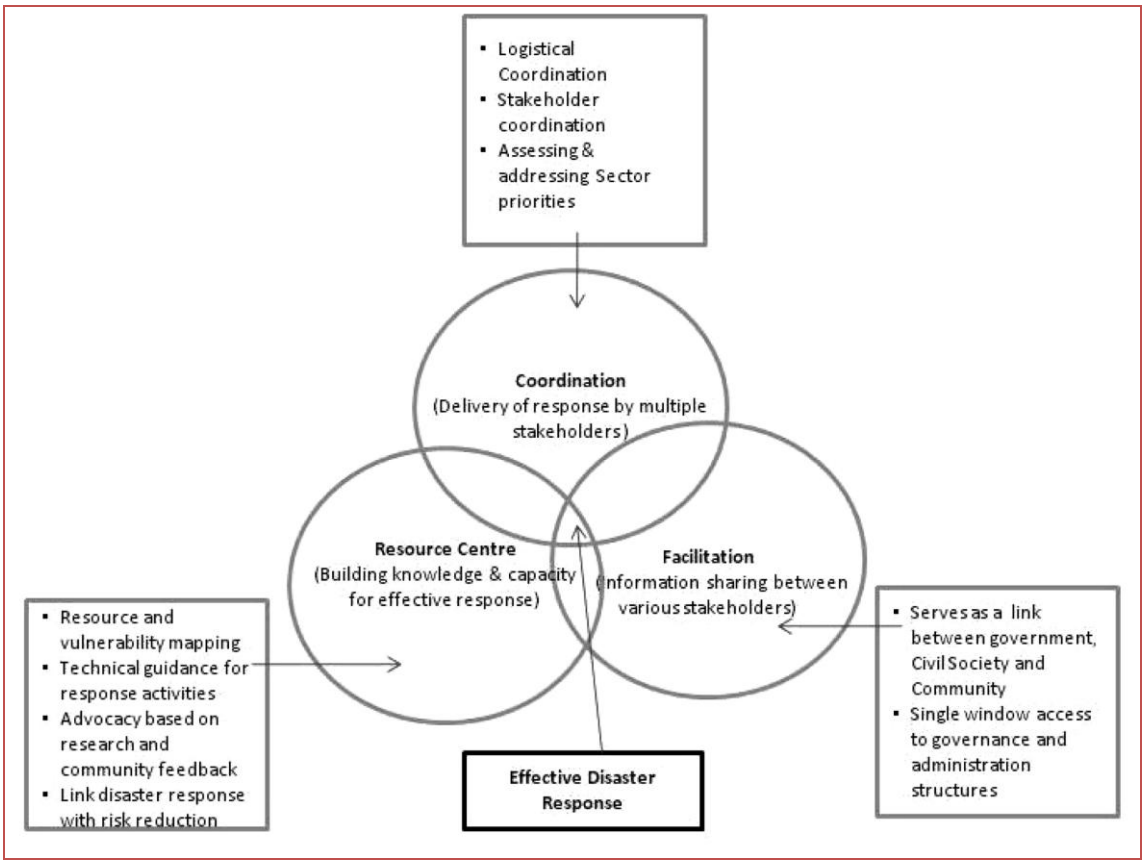

Figure 27: Model of Effective Disaster Response (Source: Arunima Chatterjee and other et. al.)

12.0 Conclusion

Keeping in view the foregoing discussion, the current system of ERS in India is far from satisfactory and needs both change and improvement. Strategic thinking is required from the national authority to spur the system into an action. The system needs ‘public-centric’ and ‘citizen-friendly’ orientation. There is also need that we should stop the system of creating new toll free numbers every now and then. Instead of strengthening the existing institutions and system, we are in the habit of creating new systems and institutions which only add to and compound the existing problem and confusion. We have numerous models and system world over which can help us choose the best system for India to follow. Let us learn from others mistakes and suffering to create a system which saves lives and reduces losses at the minimum possible cost.

13.0 REFERENCES

1. United Nations, I*nternational Strategy of Disaster Reduction, UN ISDR Dictionary of Disaster Risk Reduction*, 2009, English.
2. FEMA:Source:http://training.fema.gov/EMIWeb/edu/docs/emprinciples/0907_176%20EM%20Principles12x18v2f%20Johnson%20(w-o%20draft).pdf).
3. Michael J Fagel, *Principals of Emergency Management and Emergency Operation Centers (EOCs)*, CRC Press, USA.
4. NDMA, *National Disaster Management Guidelines: National Disaster Management Information and Communication System, 2012*, New Delhi.
5. NENA: National Emergency Number Association (http://www.nena.org/ - accessed on 2013.03.08).
6. EENA: European Emergency Number Association (http://www.eena.org/view/en/index.html - accessed on 2013.03.08).
7. NG 9-1-1 Institute (http://www.ng911institute.org/Home.html - accessed on 2013-03-08).
8. NAED: National Academy of Emergency Dispatch (http://www.emergencydispatch.org/ - accessed on 2013.03.06).
9. SOS Service Numbers Worldwide (http://sos1.tel/ - accessed on 2013-03-05).
10. European Union, Digital Agenda for Europe (http://ec.europa.eu/digital-agenda/en/112 - accessed on 2013-03-04).
11. Wikipedia (http://en.wikipedia.org/wiki/Emergency_telephone_number - accessed on 2013-03-01).
12. MHA, *Disaster Management in India*, Ministry of Home Affairs, Govt. of India, 2011.
13. MHA, *Standard Operating Procedures for Responding to Natural Disaster, 2010*, Ministry of Home Affairs, Govt. of India.
14. NDMA, *National Disaster Management Guidelines: Scaling, type of Equipment, and Training of Fire Services, 2012*, Govt. of India.
15. NDMA, *Revamping of Civil Defence in the Country*: *National Policy Approach Paper—High Power Committee Report*, Government of India.
16. NDMA, *National Disaster Management Guidelines- National Disaster Management Information and Communication System (NDMICS) 2011*, GOI.
17. GOI, Disaster Management, Act, 2005.
18. NDMA, *National Disaster Management Guidelines: Role of NGOs in Disaster Management.* A publication of the National Disaster Management Authority, Government of India, ISBN: 978-93-80440-10-1, September 2010, New Delhi.
19. Sphere India, *Unified Response Strategy* (www.sphereindia.org.in).
20. Arunima Chatterjee, Deepali Gupta, and Neela Jain, *Coordination of Disaster Response: Potential Challenges from Indian Experiences*, KCCI/2010-06, . UNICEF, UNDP or RedR India Publication.
21. Sinha, A. *Report on Recovery and Reconstruction Following the Orissa Super Cyclone in October 1999,* Asian Disaster Reduction Centre.
22. UNDP, *From Relief to Recovery: The Gujarat Experience,* UNDP, New Delhi, 2001, p. 6.
23. Pramod K Mishra, *The Kutch Earthquake 2001: Recollections, Lessons and Insights by NIDM Publication*. Repri*nt – 2012.*
24. Price, G. and Mihir. B., *The Role of the Affected State in Humanitarian Action: A Case Study on India,* Overseas Development Institute, London, 2009.
25. ADRC, Final Report Multi-national Mission to the Tsunami Affected Areas in India 8-13 April 2005.
26. Sphere India, Leh Flash Floods 2010: Common Forward Looking Learning Mission - *Lessons for Leh and the future from the response to the flash floods of August 2010 (Draft).*

27. Cabinet Office, Japan: *Disaster Management in Japan, 2011,* Director General for Disaster Management, Cabinet Office, Japan.
28. Japan Meteorological Agency, J*apan Meteorological Agency, 2012*, Japan.
29. Japan Meteorological Agency, Earthquake and Tsunami Disaster Prevention, 2009, Japan.
30. Osaka Gas, *Earthquake-Triggered Disaster Prevention Measures at Osaka Gas*, January 2009, Osaka Gas Engineering Co., Ltd.
31. FEMA, *Strategic Plan for the Integrated Public Alert and Warning System (IPAWAS) Program June, 2010*, Federal Emergency Management Agency, USA.
32. FEMA, *Integrated Public Alert and Warning System (IPAWAS), Get Alerts, Stay Alive, December, 2010 power point presentation,* Federal Emergency Management Agency, USA.
33. Anne Nelson, Ivan Sigal with Dean Zambrano, *Media* Information System and Communities: Lessons from Haiti, John S and James L Foundation for Communication with Disaster Affected Communities (http://www.knightfoundation.org/media/uploads/publication_pdfs/KF_Haiti_Report_English.pdf)
34. WB, KNOWLEDGE NOTE 3-2 , CLUSTER 3: Emergency Response , Emergency Communication.
35. Michiko Fukahori , *Disaster and ICT Systems in Japan, December 2012*, Ministry of Internal Affairs and Communications Japan, (Source: http://www.dilg.gov.ph).
36. European Commission: https://ec.europa.eu/digital-agenda/en/about-112
37. The 112 Foundation: http://www.112foundation.eu/.
38. Single National Emergency Call System, Romania: http://www.112.ro/index.php?pag=11.
39. FEMA:http://www.fema.gov/pdf/about/programs/disastermanagement/dmistools/program_updates_121510.pdf
40. FEMA: http://www.fema.gov/integrated-public-alert-warning-system.
41. *Hyogo Disaster Management Center*, Disaster Response Bureau, Disaster Management and Planning Bureau, Civil Policy Planning and Administration Department, Hyogo Prefectural Government, Japan.
42. *Phoenix Disaster Management System*, Disaster Management communication Office, Disaster Response Bureau, Disaster Management and Planning Bureau, Civil Policy Planning and Administration Department Hyogo Prefectural Government, Japan.
