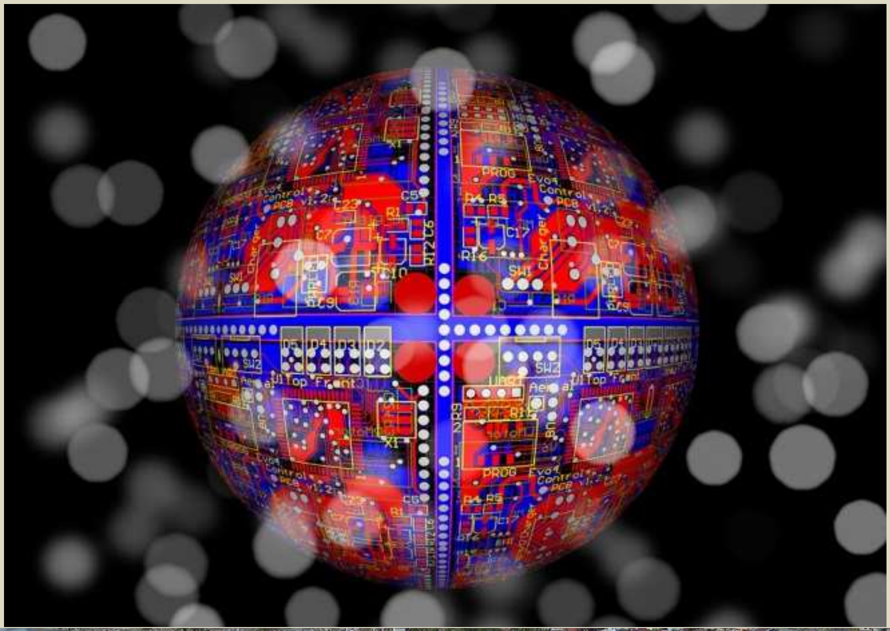
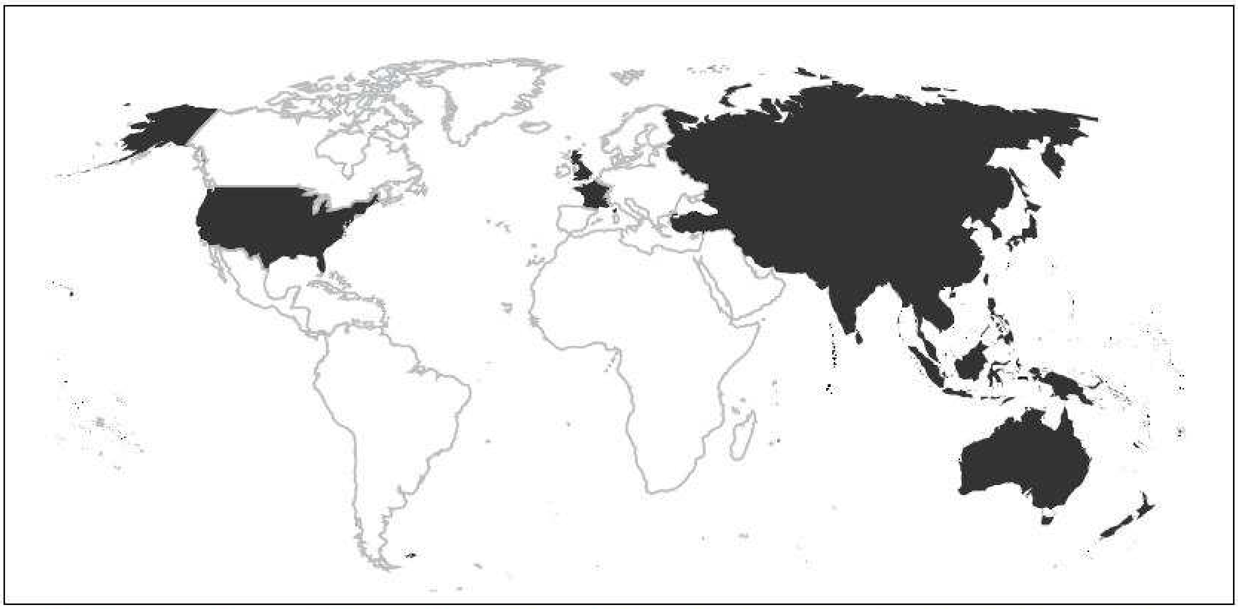
Enhancing E-resilience of ICT Infrastructure: Gaps and Opportunities in Disaster Management



Technical Brief by the Information and Communications Technology and Disaster Risk Reduction Division

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

The secretariat of the Economic and Social Commission for Asia and the Pacific (ESCAP) is the regional development arm of the United Nations and serves as the main economic and social development centre for the United Nations in Asia and the Pacific. Its mandate is to foster cooperation among its 53 members and 9 associate members. It provides the strategic link between global and country-level programmes and issues. It supports Governments of countries in the region in consolidating regional positions and advocates regional approaches to meeting the region's unique socioeconomic challenges in a globalizing world. The ESCAP secretariat is in Bangkok. Please visit the ESCAP website at www.unescap.org for further information.



The shaded areas of the map indicate ESCAP members and associate members.

The cover:

Acknowledgments

The technical brief has been prepared under the general direction of Shamika Sirimanne, Director of the ICT and Disaster Risk Reduction Division (IDD), ESCAP, with substantive contributions from Atsuko Okuda, Chief, Matthew Perkins and Seung Yeon Kwak of the ICT and Development Section, IDD. Tarnkamon Chantarawat and Waraporn Pichetshote undertook the related administrative processing and provided other necessary assistance for issuance of the brief.

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Acronym

3G	3rd generation mobile telecommunication
APEC	ASIA-PACIFIC Economic Cooperation
AP-IS	Asian and Pacific Information Superhighway
APDR	Asia-Pacific Disaster
BTS	Base station
CDR	Call detail records
COW	Cells on wheels
CSO	civil society organization
ESCAP	Economic and Social Commission for Asia and the Pacific
GIS	Geographic Information System
ICT	information and communications technology
IP	Internet Protocol
MNBD	mobile network big data
NGO	Non Govermental Organizations
SCADA	supervisory control and data acquisition systems
SDGs	Sustainable Development Goals
SUAVs	Small Unmanned Aerial Vehicles
TCP	Transmission Control Protocol
UAV	unmanned aerial vehicles

Introduction:

The smooth functioning of the domestic and international telecommunications infrastructure, which serves as the major supply line for the Internet, has never been so critical as it is now. Government and business operations have increasingly come to depend on the reliable telecommunication infrastructure across the globe. According to the 2012 APEC report[1], the U.S. Federal Reserve estimated that submarine cables, for instance, had carried over USD 10 trillion in global financial transactions on a daily basis, while the CSL Bank, which operates the largest multi-currency cash settlement globally, had been training more than 1 million transactions in the amount of USD 4.7 trillion a day over the cables. ESCAP member countries have been progressively integrated into the global financial systems and government, businesses and citizens alike have been connected to the Internet for daily communication and complex transactions. As a pillar of regional connectivity, the telecommunication infrastructure is now seen as the enabler to facilitate the movements of goods, people, money, services and knowledge within and across national borders. Thus, reliability, diversity, speed and resilience of regional (and national) ICT infrastructure, in particular broadband networks, is a critical development priority of the region.

In recognition of the prominence of this infrastructure, new emphasis has been placed on the concept of e-resilience. Given the above mentioned dependency on ICT for vital transactions, the resilience of ICT backbones, networks and systems should be considered as the priority in network and infrastructure development. At the same time, ICT plays a pivotal role in enabling timely disaster response, management and reconstruction after disasters and in promoting disaster risk reduction and preparedness. In addition, the technologies concerned have become heavily embedded in a variety of other infrastructural components, such as management of the electrical grid and control systems and transport systems. With the increasing interconnectedness of these infrastructure components, the risk of failure in one sector creating knock-on effects which have an impact on other systems is increased. Therefore, for disaster risk reduction, consideration must be given to bringing these infrastructure components together and planning for risk holistically.

In the past, disaster management planning had been focused on such areas as power, water and sanitation, among others. Unfortunately, there are many instances in which telecommunication services are not considered a priority when there is lack of access to these basic services. However, it is often access to accurate information that facilitates the restoration of the services and speed up the recovery processes, and that enhances better coordination among different government and humanitarian organizations. In order for information to be communicated, the underlying network must be functional and resilient. Similarly, in order to communicate accurate information to the right people at the right time, the supporting processes, such as institutions and policies, must exist. ICT allows for documentation of needs and resources, spatial coordination, communication and facilitation of payments in the aftermath of disasters and plays different roles in different phases of the cycle.

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[1] APEC (2012).Economic impacts of Submarine Cable Disruptions Available from http://www.detecon.com/ap/files/2013_psu_%20Submarine-Cables.pdf.

ESCAP's ICT for DRR Agenda

Given the importance of these issues, ESCAP has pursued an active research agenda to identify ways in which the region's telecommunications networks can be strengthened and the use of ICT for disaster management be expanded. This has included a series of country-level case studies, a cohesive regional review, and a data gathering exercise within ICT for DRM initiatives, including examples at the national, sub-regional and regional levels. The country studies were conducted on the Philippines, Sri Lanka, Mongolia and China. These analytical exercises provided evidence of the importance of ICT for promoting inclusive and disaster resilient development in Asia and the Pacific, whilst allowing for comparison and analysis with other countries.

The country studies researched the ICT factors in national DRR and sustainable infrastructure development plans, focusing on aspects of e-resilience across all components of disaster response planning. Further, the studies synthesized findings from policy and implementation perspectives into a cohesive summary of ICT for DRR in the relevant countries, within the context of the Sustainable Development Goals (SDGs). The analysis specifically considered the steps necessary for the development of quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

The regional review included a brief introductory overview of the use of ICTs for effective information management in DRR generally. Particular focus was given to the issue of ICTs as a cross-cutting and enabling tool for information management. Further, it identified a few specific, tangible examples of ways in which ICTs have been used in DRR at the national and regional levels, the development of sustainable and resilient infrastructure and the role played by ICT in last mile information dissemination and community empowerment particularly for marginalized communities. As applicable, big data solutions were also included where relevant. Finally, the review provided highlights of the strengths and weaknesses in effective information management through ICTs demonstrated by ESCAP member countries. Special attention was given to fibre-optic connectivity networks and broadband as critical infrastructure in DRM and DRR in the ESCAP region and the role of ICTs in strengthening end-to-end communication chains. The role of government, the contributions of crowd sourcing and the effective management of these information flows at all stages of the disaster management cycle were also covered. As part of this research effort, ICT for DRM initiatives were identified throughout the region and updated in ESCAP's portal the Disaster Information Gateway (http://www.drrgateway.net/).

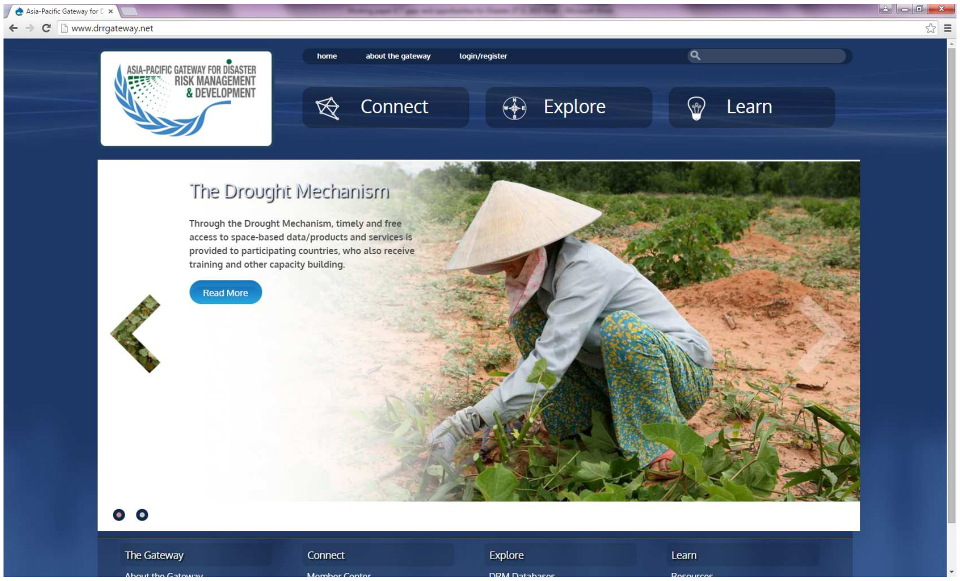

Figure 1- ESCAP's portal the D the Disaster Information Gateway (http://www.drrgateway.net/).

Source: Asia-Pacific Gateway for Disaster Risk Reduction and Development. Available at http://www.drrgateway.net/

Taken together, these research activities provided much needed insight into the use of ICTs in these countries and the broader ESCAP region. The lessons learned from this exercise have been highly valuable and integrated into ESCAP's capacity building and broader research agenda. An ESCAP report[2], for example, identified four ICT functions which were considered critical during the disaster response phase based on its analysis of how ICT systems had been effectively used in disaster responses in the 2004 Tsunami in the Maldives and Sri Lanka and 2011 earthquake in Japan. These four functions centered on documentation of needs of resources, spatial coordination, publication and facilitation of payments.

As to the need for resilient broadband networks[3], a series of studies mapped out existing backbone networks (the ITU-ESCAP map) and planned broadband infrastructure expansion, while identifying missing links in the region. The reports also pointed out inefficiencies and gaps in managing Internet traffic and networks which contributed to higher fees and constraints on access expansion. The studies and analysis paved a way to identify vulnerabilities in backbones and broadband networks and to enhance e-resilience.

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[2] ESCAP (2013). The Resilience of ICT Infrastructure and its Role during Disaster.
[3] ESCAP (2014). In-depth study on the broadband infrastructure in South and South-West Asia. Available from http://www.unescap.org/sites/default/files/Broadband_Infrastructure_South%26West_Asia.pdf.
ESCAP (2015). In-depth study on the broadband infrastructure inn Afghanistan and Mongolia Available from http://www.unescap.org/sites/default/files/Broadband%20Infrastructure%20in%20Afghanistan%20and%20Mongolia%20v3.pdf.
ESCAP (2014). Discussion Paper Series on Problems and Challenges in Transit Connectivity Routes and International Gateways in Asia Available from http://www.unescap.org/sites/default/files/Discussion%20Paper-Transit-Connectivity_0.pdf.
ESCAP (2014). In-depth study on the broadband infrastructure in North and Central Asia Available from http://www.unescap.org/sites/default/files/Discussion%20Paper-Transit-Connectivity_0.pdf.

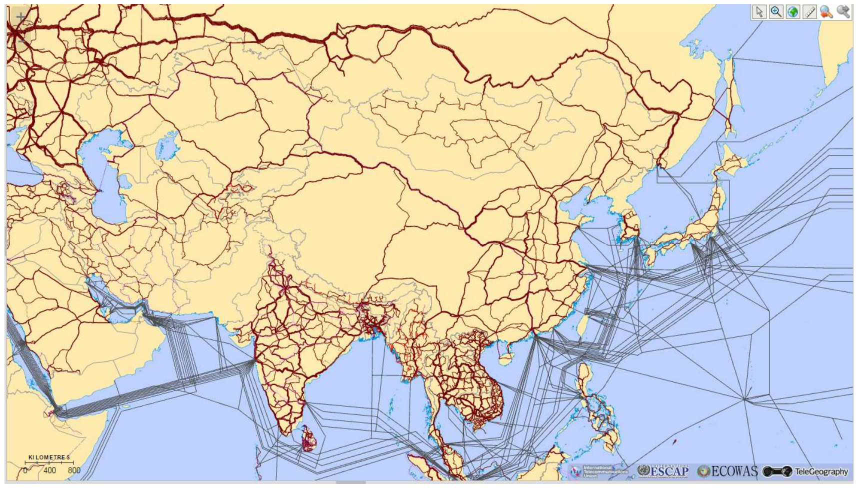


Figure 2-Asia-Pacific Information Superhighway maps

Source: ITU-ESCAP, AP-IS map (2013). Available at http://www.unescap.org/our-work/ict-disaster-risk-reduction/asia-pacific-information-superhighway

In view of the above and taking into account recent socioeconomic damage caused by natural disasters, the Asia Pacific Disaster Report 2015[4] concluded that ICT could do more to deliver the right information to the right people at the right time, while ensuring resilience of ICT systems. More specifically, the report identified the below five essential steps which need to be supported across the region:

1) understanding risk;

2) having data and information sharing policies;

3) generating actionable information;

4) customizing information and reaching out to people at risk; and

5) using real-time information

The APDR illustrates the above elements in the below diagram.

[4] ESCAP (2015). Asia Pacific Disaster Report 2015. Available from http://www.unescap.org/resources/asia-pacific-disaster-report-2015

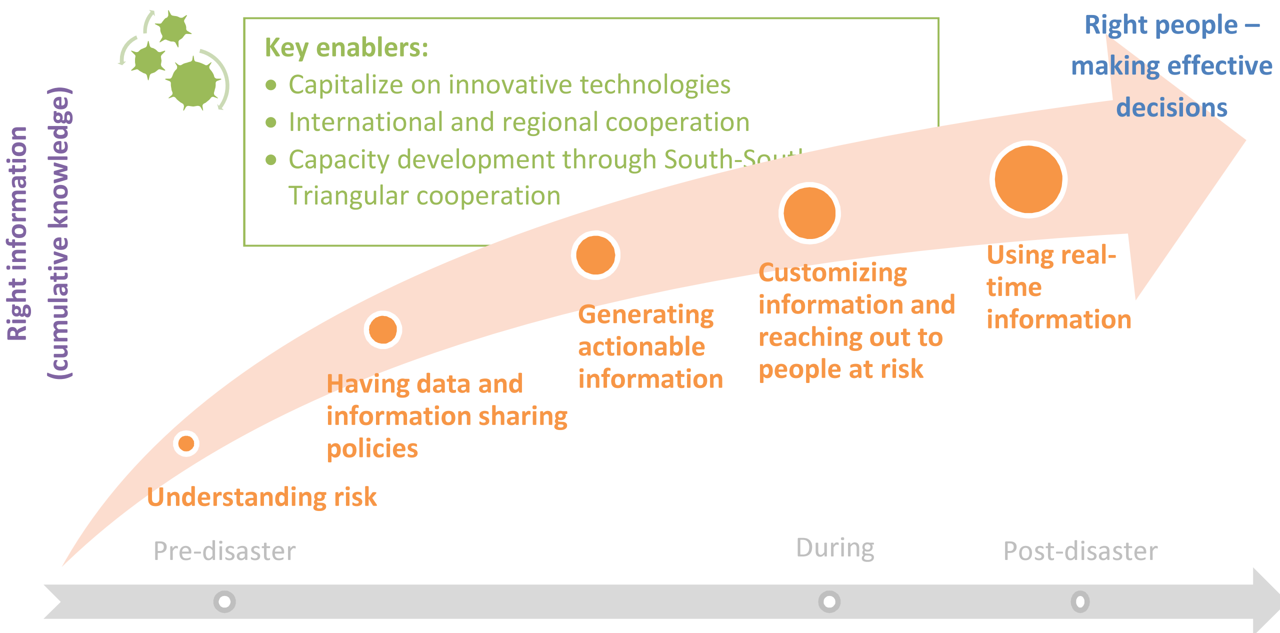


Figure 3 – A roadmap to disaster information management

Source: APDR (2015)

Objectives

In this context, this technical brief aims to identify critical factors which can contribute to enhancing resilience of ICT infrastructure, especially in the area of protecting the vital ICT infrastructure and networks taking into account various disaster risks as well as promoting the use of ICT in disaster risk reduction to deliver the right information to the right people at the right time. As such, this technical brief targets policy and decision makers, NGOs/CSOs, academia, mass media in the ICT and disaster management sectors.

It is hoped that the content of this technical brief will contribute to the development of resilient regional and national infrastructure, such as the Asia-Pacific Information Superhighway, and to the process of better integrating ICT in disaster management and risk reduction efforts. More specifically, it is anticipated that the Open-ended Working Group of the Asia-Pacific Information Superhighway[5] as well as other inter-governmental bodies of ESCAP take into consideration as a basis for policy discussion and recommendations.

[5] ESCAP (2015). Asia Pacific Disaster Report 2015. Available from http://www.unescap.org/news/asia-pacific-region-rallies-around-asia-pacific-information-superhighway

Critical Factors for E-resilience

1. Shortening the time needed for restoration

In the immediate aftermath of a disaster, effective information management is a crucial element of the relief and recovery effort. In a disaster situation, the first 72 hours after the event are considered to be the most crucial period in saving lives and providing relief services to those injured or otherwise affected.[6] Afterwards, the task shifts to recovery.

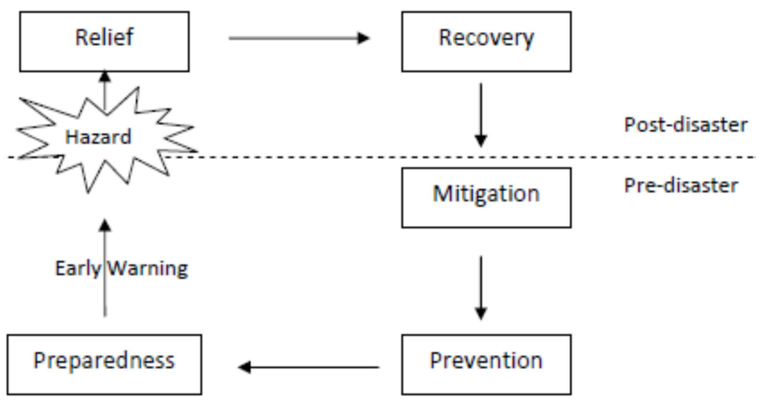


Figure 4- The Resilience of ICT Infrastructure and its Role during Disasters

Source: ESCAP (2013)

When the telecommunication infrastructure or services are affected by disasters, the restoration of critical telecommunication services as soon as possible is of paramount importance. The timely re-establishment of telecommunication networks facilitates the delivery of food, water, and building supplies by governments and humanitarian organizations in a coordinated, efficient and effective manner.[7]

Moreover, the types of use cases in a disaster response scenario—sharing high resolution GIS maps, streaming video, and large amounts of voice communication—necessitate high-bandwidth and low-latency connections.[8] This aspect of "e-resilience"—the minimization of the time needed to restore critical communications infrastructure—should form the basis of any e-resilience plan. While ensuring this level of functionality in the national network as a whole is significantly more expensive, it helps ensure that these systems are reliable and resilient at a time of crisis when telecommunications infrastructure is needed most.

[6] [7]UNOCHA: Information Management: http://www.unocha.org/what-we-do/information-management/overview
[8] Yap (2011): Disaster Management, Developing Country Communities & Climate Change:The Role of ICTs

2. Designing for resilience

In the event of disaster, there are two major causes for the disruption of services. First, damage to physical backbone or last-mile telecommunications infrastructure or loss of power can result in a partially degraded network service. On top of this, coordination efforts by governments, emergency responders, and citizens put higher-than-average load on these networks.[9]Ideally, telecommunications infrastructure will be designed to reliably scale to handle the increased load. However, this is typically not the case, and these networks become congested, hampering recovery efforts.

Proactive steps to reduce the probability of service outages, known as ‘hardening’ should be complemented by efforts to reduce the amount of time necessary to restore services after a disaster strikes. For example, the rapid growth and adoption of these technologies mean that telecommunications infrastructure must be consistently enhanced in order to keep up with demand. Some industry groups have estimated that demand for bandwidth will grow at an estimated rate of approximately 400% between 2010 and 2015. If national networks are not able to keep up with growing bandwidth demands, network congestion will negatively impact these performance indicators as the strain on existing infrastructure grows more severe even under normal circumstances. From a disaster management perspective, it is therefore very important to ensure that upgrades and enhancements are keeping pace with user demand, while redundancy is to be considered not only for normal network traffic management but also as part of ICT resilience efforts.

Properties inherent to the design of information systems can make them more or less amenable to resisting disruption. The Internet is built on TCP/IP, a set of protocols for sharing information among network nodes using so-called “packet-switching”. Typically, voice information on a telephone call is transmitted using a circuit-switched network which is prone to overload as multiple callers vie for the same communication pathways. In recognition of this and in the wake of the Great East Japan Earthquake of 2011, innovative services were developed to address this need, such as an application called Disaster Kit. This software allows users to register their current safety state and send and receive voice messages to and from their friends and family through their packet-switched data network. By encouraging users to rely more heavily on the more resilient packet-switched network instead of adding to the load on the circuit-switched voice network, network operators can provide better service guarantees for communication that truly needs to be real-time.[10]In addition, instant messaging systems such as Line were developed and have proved highly popular independent of its role in disaster information management.

Because addressing the resilience of a nation-wide telecommunications network requires significant resources, stakeholders involved in early response should be equipped with dedicated communications networks which are specifically designed for their needs, such as terrestrial trunked radio, as part of emergency communication plans, if not done yet. These smaller-scale networks can provide dedicated

[9] [10] Fionan McGrath, GSMA (2014). Innovations in Mobile Technology for Disaster Response; Part I. Available from http://www.gsma.com/mobilefordevelopment/innovations-in-mobile-technology-for-disaster-response-part-i

communications infrastructure that ensures services for the most critical response personnel. However, in order to reach the individuals impacted by disaster on a larger scale and to take advantage of emerging technologies, the e-resilience requirements should be taken into account from an early designing and planning stage of telecommunications infrastructure development, in particular backbones and access networks.

3. Ensuring last mile connectivity

It should be emphasized that telecommunications networks are highly interdependent systems, including fiber optic backbone components, neighborhood switches, and end-user services. Commonly, technologies for delivering mobile services, such as cell phone towers are of increasing importance for delivery of data in developing countries. Recent disasters in the ESCAP region, such as experienced by Nepal, have demonstrated that while a properly planned and implemented fiber optic backbone can be quite disaster resilient, delivery of services in the last kilometer can be much more problematic.

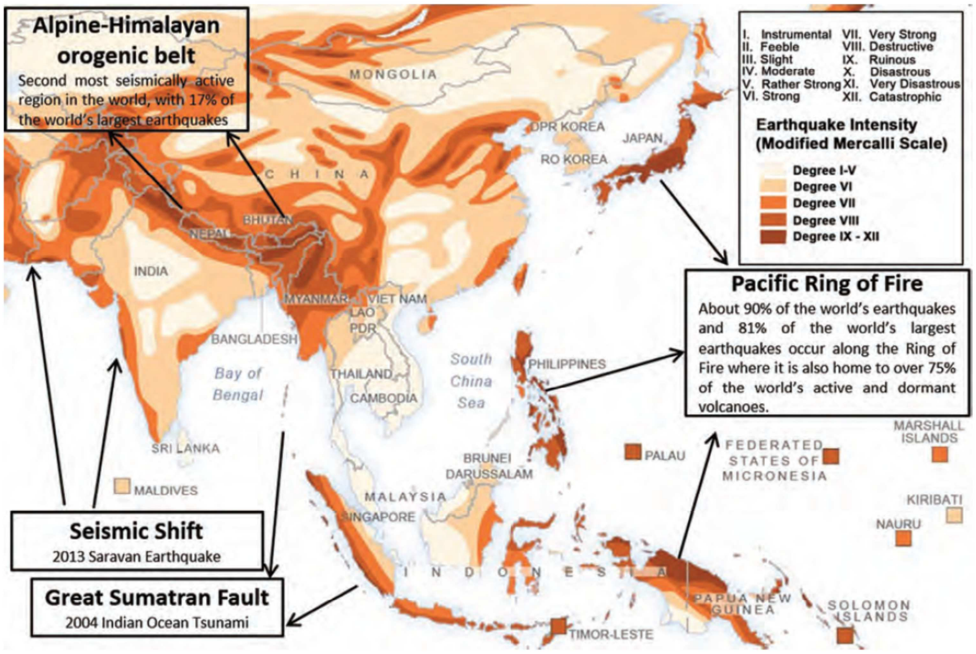
In the case of Nepal, the national core telecommunications backbone, which has seen significant improvements in network performance, stayed functional during the recent earthquake. However, other components of their network, such as cell phone towers, suffered significant damage, making it very difficult to restore communications to hard-hit areas of the country. This experience helps illustrate the importance of proactive investment, as in the case of their fiber optic backbone, as well as a system approach which examines the complete service delivery chain.

Given the increasing relevance of gathering data submitted by persons affected by disasters, as well as the usefulness of cellphones for disaster information dissemination, it is desirable to promote resilience in public telecommunications networks as well as emergency coordination networks. Particularly because of the capacities of smart phones to function as mobile sensor networks, retaining the ability to use these networks offers strong advantages.

4. Knowing disaster risks

Knowing disaster risks also help enhance e-resilience. Significant efforts have been made in the past to understand disaster risks in the region which is prone to multiple natural hazards. The above mentioned APDR produced the below seismic risks and transboundary flood risks in the region.

Seismic risk in Asia and the Pacific

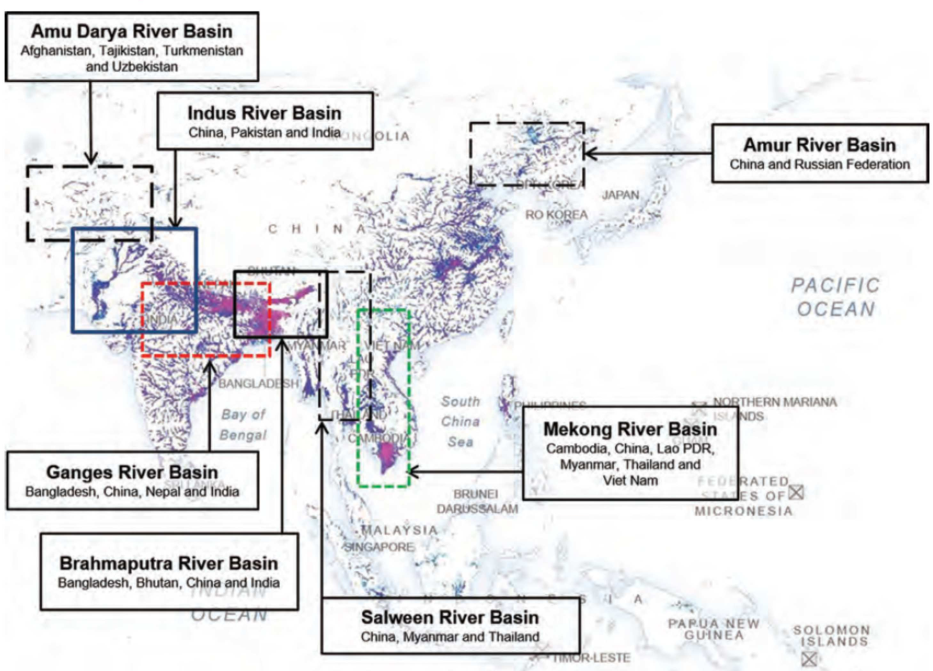


Source: Based on Asia-Pacific: Earthquake Risk – Modified Mercalli Scale, OCHA, 2014. Available from http://reliefweb.int/sites/reliefweb.int/files/resources/map_613.pdf.

Figure 5- Seismic risk in Asia and the Pacific

Source: ESCAP (2015) APDR 2015

Transboundary flood risk in Asia and the Pacific

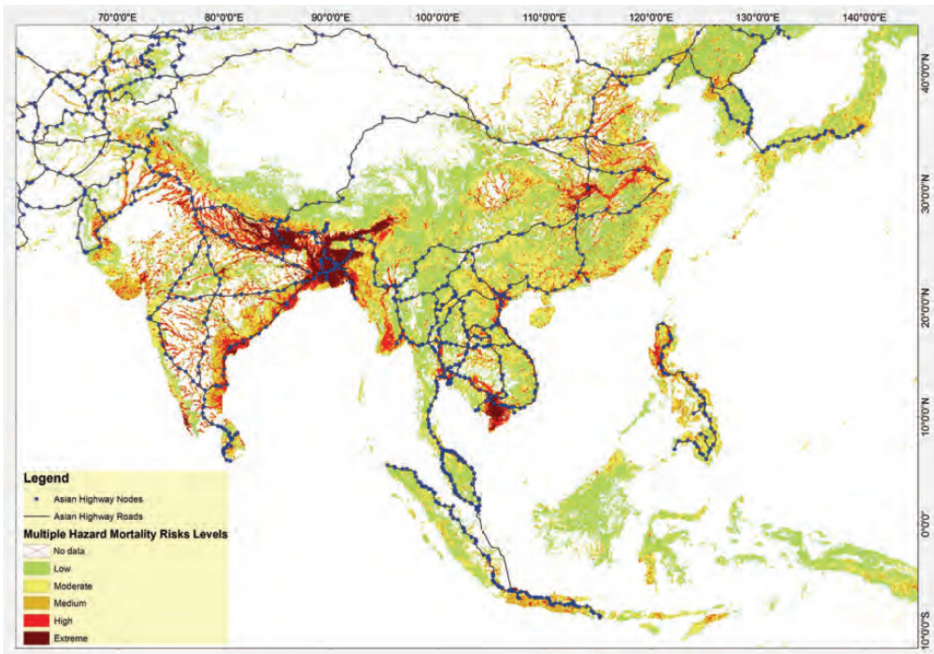


Source: Based on Asia-Pacific: Flood Risk, OCHA, 2014. Available from http://reliefweb.int/sites/reliefweb.int/files/resources/map_616.pdf, with river basin data from ICIMOD.

Figure 6 – *Transboundary flood risk in Asia and the Pacific*

Source: ESCAP (2015) APDR 2015

In other infrastructure sectors, such as transport, the analysis on disaster risks on roads and railways has progressed to deepen our understanding, as shown in the below map of Asian Highway, overlaid with disaster risk maps.



Source: ESCAP based on the map from UNEP, GRID and ESCAP, Asian Highway Database.

Figure 7 - *Map of Asian Highway, overlaid with disaster risk maps*

Source: ESCAP (2015) APDR 2015

Figure 8- Map of ICT backbone networks
Source: Asia-Pacific Information Superhighway

As part of the Asia-Pacific Information Superhighway (see below), a comprehensive map of ICT backbone networks has been developed in collaboration with ITU[11]. It is high time that hazard risks are considered when ICT infrastructure, in particular backbone and broadband networks, is planned and developed, while ensuring that these risks are taken into account in the protection and maintenance of existing infrastructure.

At the same time, it should be noted that not all the assessed natural hazards are expected to impact the functioning of telecommunications infrastructure equally. Although droughts and el Nino have been gaining increasing regional attention, they would not have as severe impacts as earthquakes, glacier lake outbursts, floods or volcanic eruptions on telecommunications infrastructure

5. Use of mobile base stations and cellular phones

Mobile networks can offer a degree of redundancy. In case one cellular base station (BTS) fails, a neighboring node can still provide some service to the affected area. In addition, mobile networks have the characteristic of being able to be scaled up quickly using mobile base stations or “cells on wheels” (COW).[12] The use of these stations can help restore telecommunications services in the immediate aftermath of a disaster. When doing so, it is also important to ensure an appropriate supply of electricity for mobile base stations and other backup systems. In disasters such as the great Japan earthquake of 2011, base stations suffered from an insufficient power supply. As part of the lessons learned from that experience, new designs featuring longer-lasting fuel cell technology have been developed.

In the aftermath of Hurricane Katrina, in the early days of 3G cellular technology, ViaSat and Qualcomm staff transported mobile base stations to provide cellular connectivity for first-responders in New Orleans. Calls were allowed for communication both within and outside the network. External calls were routed via a ViaSat IP Satcom Flyaway Terminal. In order to cover a wider area, it is advantageous for these base stations to be located on high vantage points, generally this takes the form of either towers

[11] ESCAP (2013). Asia-Pacific Information Superhighway Maps. Available from http://www.unescap.org/our-work/ict-disaster-risk-reduction/asia-pacific-information-superhighway/asia-pacific-information-superhighway-maps.
[12] Justin Waller, GSMA (2012). For Telecoms companies, disaster preparedness begins to reap rewards. Available from http://www.gsma.com/mobilefordevelopment/for-telecoms-companies-disaster-preparedness-begins-to-reap-rewards.

or buildings. In the case of New Orleans, high-rise buildings were available.[13] This advantage will not always be available, particularly in rural areas, or urban settings affected by floods or earthquakes. In such cases, the use or airborne antennas can offer a valuable supplementation to ground based options.

6. Airborne base stations

Recent research has pointed to the potential of using Small Unmanned Aerial Vehicles (SUAVs) for the provision of temporary cellular coverage in disaster scenarios where other options would be impossible or impractical.[14] In these cases, miniaturized cell phone technology, commonly referred to as decode and forward relays, can extend the coverage of mobile services to include hard to reach areas. This can facilitate the delivery of services to large crowds, such as in relief camp scenarios, hard to reach urban areas, or rural locations where land transportation has been disrupted. While each UAV would be able to service a limited area, but by operating several units simultaneously, a chain can be formed in which service can be deployed at greater ranges from a functioning base station. Further, because the positioning of UAVs can be easily adjusted, communications services can be more flexibly deployed as populations move or other portions of infrastructure require reinforcement. Additionally, these units are typically more affordably priced for developing countries, which often face limited options due to resource constraints.

In addition to powered UAV platforms, research into lighter than air technology is ongoing. The Internet search giant Google first announced plans to deploy Internet service via balloons in June 2013. The project—called "Project Loon"—has since progressed considerably: a single balloon can now stay aloft for more than six months, providing cellular service for an area of around 3,000 square kilometers. While the stated intention is to get more people from developing countries using the Internet—and by extension Google's services—there is considerable latitude for providing coverage during a disaster. As currently implemented in test, Project Loon depends on a functional telecommunications network in place for its upstream connection.[15] In addition companies such as Motorola are also developing lighter than air platforms which can help member countries rapidly deploy communications services in scenarios where large scale damage has been inflicted on terrestrial infrastructure such as roads and fixed base stations. In so doing, communications services can be more quickly restored for marginalized communities in rural areas.

[13] Robert Varga, Milsat Magazine (2009). COMM-OPS: UAV Cellular Payload for First Responder Emergency Teams. Available from http://www.milsatmagazine.com/story.php?number=1435005486.
[14] Guo, Devine, and Wang (2014): Performance Analysis of Micro Unmanned Airborne Communication Relays for Cellular Networks.
[15] Jon Brodkin, Ars Technica (2015). Google balloons, "cell towers in the sky," can serve 4G to a whole state. Available from http://arstechnica.com/information-technology/2015/03/google-balloons-cell-towers-in-the-sky-can-serve-4g-to-a-whole-state/.

7. Smart phones and mobile devices for disaster data collection and early warning

Thanks to advances in technology, current smart phones can collect a large amount of incidental data, including location, through embedded sensors. Particularly in areas with high mobile phone use, this presents the opportunity for collection of data which can be quite useful, both before and after disaster events. In order to properly benefit from this opportunity, the resilience of commercial telecommunications networks takes on new significance. For example, disseminating early warning information, as well as collecting information on disaster impact, requires networks capable of not only functioning during disruptive events, but being able to handle high usage spikes. Particularly in the aftermath of disaster events, networks in affected areas typically receive very high volumes of incoming calls and data.

The volume of data produced by these means has been referred to as mobile network big data (MNBD). So-called "big data" has been defined as very large datasets—e.g. from electronic transactions, social media—that exceed the processing capabilities of traditional techniques and applications. Given access to the streams of data that result from the movement of mobile phones across a network, analysts can provide insights that would be otherwise challenging to attain. While most practical applications of this data in disaster scenarios are experimental, useful cases can be seen in incidents such as the Haitian earthquake in 2010. In one study using call detail records (CDR) from Haiti, researchers were able to determine where most of the residents relocated—as well as the spread of cholera—as a result of the earthquake.[16] Other cases include using text messages to distribute early warnings of incoming disasters, and the use of citizen-submitted imagery of damage and impact in the aftermath of a disaster event.

The effective use of these technologies has been made more complex by the fast-paced changing nature of this field. While standard cell phone calls and text messages have remained relatively unchanged for many years, the use of instant messaging, social media and rich content such as pictures and videos shows that user behavior changes very quickly. In general, a specific application would be unlikely to have a useful lifespan of more than five to ten years. While this is quite a reasonable period of time from the perspective of consumer technology, this is generally a far shorter lifespan than governments tend to invest in for programmes and products.

Some organizations have already started developing tools to consolidate GIS, satellite images, social media posts and text messages, so as to have access to the real time data and information which can be verified from a variety of sources and support real-time decision making[17]. Such timely information would also assume that the underlying telecommunications infrastructure is intact and operating at an optimal speed. These requirements for various data and information at a time of disaster and crisis

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[16] International Telecommunications Union (2014). Measuring the Information Society Report, The role of big data for ICT monitoring and for development. Available from http://www.unglobalpulse.org/sites/default/files/Pages%20from%20MIS2014%20-%20Big%20Data%20Chapter.pdf

[17] One example is a risk management tool developed by Smart Data Science.

should be factored in when e-resilience plan is developed, taking into account an appropriate level of privacy and data confidentiality.

8. Crowd sourcing

In recent years, more attention has been paid to involving affected citizens in the disaster management process. From preparedness and planning to emergency response and rebuilding, enhancing the involvement of individuals can provide better tangible results, better preserve development gains, and promote a citizen-centric approach to governance. From a perspective of effectiveness of aid, the ability to efficiently collect data and information from a wider range of sources in the aftermath of a disaster can be highly useful. Because consumer level technologies such as smart phones can provide information such as photographs of disaster impact, these tools could provide important data in the immediate aftermath of a disaster. However, the ability to use the collected data and information in timely and effective decision making and coordination is a process that has not yet been sufficiently developed. In addition, as noted above, being able to provide telecommunications at the consumer level in the aftermath of a significant disaster can be a daunting and expensive task, particularly for infrastructure constrained developing countries.

As a point of general classification, efforts to obtain disaster related data from persons affected by disaster involve two categories of applications. Purpose-specific, usually custom developed software, and social media applications which have been developed for general purpose information sharing. In the case of custom developed software, the advantages include being able to specifically format the data in way which are more actionable, such as inclusion of location tagging, and description data. These functions make the incoming information more easily understood by aid workers, thus making it possible to respond more quickly and effectively. However, these applications are typically not widely dispersed or used by a sufficiently large user base, thus reducing the coverage and robustness of the information. Conversely, social media applications tend to have broader adoption, but with other difficulties such as unstructured data, difficulty of access by decision makers and proprietary interfaces. As described above, a new generation of disaster and crisis management tools are emerging which consolidate data and information into one decision-support platform.

Use of mobile phones as data conduits also confronts a classic problem in the use of ICTs – the tendency to empower the connected and further disenfranchise marginalized communities. Developing countries with lower adoption rates for mobile phones are particular vulnerable to these types of effects. Problematically, this can also have gender-related complications as women are less likely to have access to mobile phones in these contexts. Therefore, promotion and use of these tools should be undertaken in a manner which is sensitive to issues of access and marginalization. In practical terms, the use of mobile phones for information dissemination, such as tsunami warning, is likely to be an effective tool, even in cases where cell phone adoption is comparatively low. In these scenarios, information may propagate through households and communities even if specific individuals do not have handsets. Ultimately, it is likely that lives will be saved, making these tools a useful, if not uniformly fair methodology. Nevertheless, governments should undertake reasonable due diligence to resolve access and use gaps in order to ensure that early warning and other disaster-related applications are available to all.

Asia-Pacific Information Superhighway (AP-IS)

In order to address the underlying gaps in broadband access and digital divide, the member countries in the ESCAP region have decided to develop the Asia-Pacific Information Superhighway (AP-IS)[18].

AP-IS is

- a regional broadband network covering 62 ESCAP Member countries and associate Member countries from Turkey to Kiribati

Figure 9- ESCAP Resolution 71/10

ESCAP Resolution 71/10

- (a) To promote the sharing of experiences, good practices and lessons learned in ICT for DRR, management and response, and building e-resilience;
- (b) To provide the necessary support to facilitate the work of the open-ended working group on the Asia-Pacific information superhighway;
- (c) To continue the fact-finding initiatives and analysis on the Asia-Pacific information superhighway, including by enhancing its maps, through partnerships with ITU and regional policy research institutions;
- (d) To continue working on the Asia-Pacific information superhighway in collaboration with international and regional partners
- (e) To promote, in collaboration with national, regional and international development partners, civil society and the private sector, the exchange of best practices and experiences and knowledge related to the development of ICT infrastructure, including in-depth analysis of the policy and regulatory barriers that may impede efforts to synchronize the deployment of infrastructure across the region in a seamless manner;
- (f) To explore further ways to harness cross-sectoral synergies, including through the review of best practices to recommend solutions to leverage synergies among ICT, energy and transport infrastructures across the region

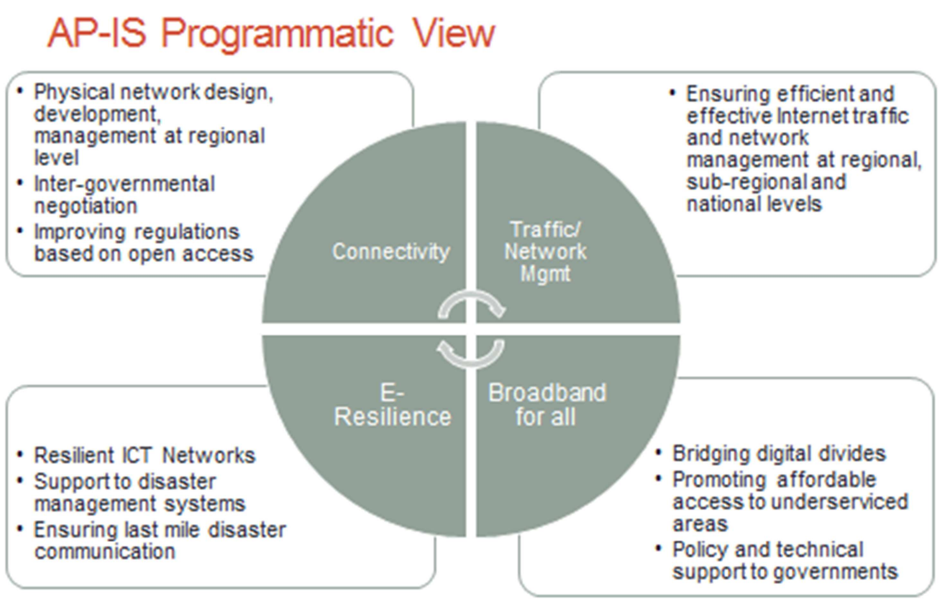
Source: ESCAP-IDS

- a pillar in regional connectivity initiatives which aim to facilitate movement of people, goods, money, information and knowledge for sustainable socioeconomic development in the region
- …which addresses the causes of digital divides, develops Internet ecosystem which supports SDGs and stimulates digital economy

AP-IS presents a holistic view of broadband network infrastructure, consisting of the below four components:

[18] ESCAP. Available from http://www.unescap.org/our-work/ict-disaster-risk-reduction/asia-pacific-information-superhighway

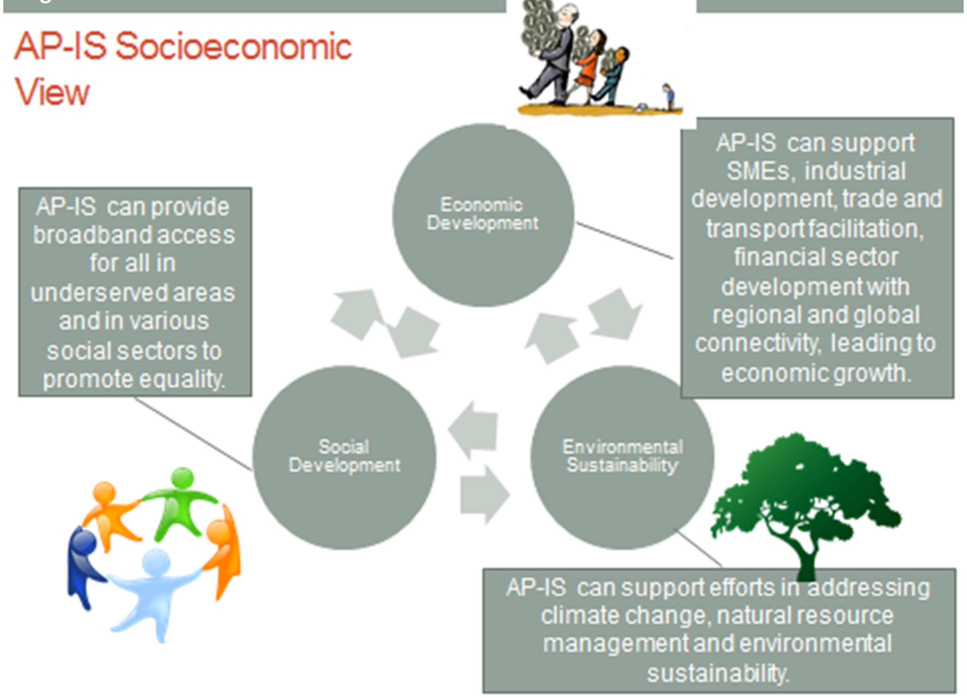
Figure 10- AP-IS Programmatic View



Source: ESCAP-IDS

It is also deeply rooted to support rendered to socioeconomic development as illustrated in the below diagram:

Figure 11- AP-IS Socioeconimic View



Source: ESCAP-IDS

It also signaled the recognition by member countries of the importance of e-resilience in their endorsement of the Asia-Pacific Information Superhighway. The Asia-Pacific Information Superhighway initiative is focused on promoting the resilience and performance of the network in order to facilitate seamless integration of submarine, terrestrial, microwave and other modes, including the so-called white-space spectrum.

In addition to physical network components, the Internet is heavily reliant on software and human resources to function smoothly. The routing of information and general management of these networks is just as important as the physical infrastructure and should be seen as specific area of focus for resilience efforts. In this regard, the AP-IS identifies Internet Traffic Management as a key issue, including such aspects as Internet Exchange Points and other governance issues. Taken together, these components will enhance physical connectivity, infrastructure integration and shared governance, resulting in a network which has great resilience, availability and reduced costs.

Conclusion:

ICTs have become a vital component of national infrastructure both as a means of communication and as embedded devices in other systems, such as power, water, transport, health care and law enforcement. As such, disaster management planners should give specific consideration to ICT communications as a critical infrastructure and ICT policy and decision makers should take hazard risks and vulnerabilities more systematically and holistically, based on recent incidents and studies and analyses done in the region. In order for these technologies to deliver increased efficiencies and enhanced resilience, it must be planned from the beginning for networks to support disaster resilient applications and systems. Improving network interconnectedness in backbone infrastructure, including such concepts as peering and redundancy through meshed terrestrial networks, will greatly improve the capacities of these assets to provide enhanced disaster management. The Asia-Pacific Information Superhighway is significant in this regard as it represents an opportunity to integrate and enhance these networks in the current and future infrastructure.

At the national level, governments should engage in active participation in regional efforts to create conducive environments for sustainable and resilient environments, while deepening an understanding of risks and vulnerabilities on their backbone/backhaul infrastructure, access networks and systems in case of a disaster. All aspects of development planning, not just that of the ministry responsible for disaster management but any developments in land-use, road networks, communications networks, electricity grids, the distribution networks of water for instance ought to integrate DRR in to the planning process. To facilitate this, an enabling environment for greater cooperation among different government entities needs to be created, keeping in mind the type of vertical and horizontal integration that is required, including local governments and community organizations. Taking into account technological innovations such as big data that can really enhance current DRM practices, governments should looking in to opening up data that can also benefit those responsible for disaster response. At a regional level, the Asia Pacific Information Superhighway provides a valuable resource for stakeholders to address the needed investments in protecting physical infrastructure, as well as addressing network management issues which will provide the enabling environment necessary to enhance the resilience of these critical communications infrastructure components. By acting on these principles, the cross-cutting value of ICTs will be able to reduce the damage and losses suffered when disasters strike.

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