

Facilitating Effective Disaster Management in the Caribbean

A response from the

***Caribbean Information and Communications Technology
Community***

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Abstract

The hurricane season of 2004 will be long remembered for the tremendous devastation that was caused throughout the Caribbean. There was loss of life and still to be estimated loss of property and related infrastructure. ICT infrastructure and support, because of its lack of robustness for disasters of this nature, also sustained extensive damage during this period. Grenada was unable to communicate effectively after the hurricane and is still way below its normal capacity to provide the relevant ICT services and support. In Jamaica, although the telecommunication infrastructure remained relatively intact, satisfactory internet connectivity wasn't restored until about 6-7 days later. Post evaluations of the disaster period indicate that had Trinidad & Tobago and Barbados been hit directly by Ivan, there is a likelihood that they would have been reduced to the same level despite their relatively advanced state of communication and connectivity. The Caribbean media also failed to cover the hurricanes independently, instead offering information from CNN.

A review of national ICT plans within the region show very little if any, concentration on the role of ICT in disaster management. Although the CARICOM Connectivity Agenda for ICT recognized infrastructure as a fundamental pillar in ICT development and evolution, it is only with the adoption of a new development orientated regional strategy that disaster management has been identified as a priority issue. That strategy and the flagship programmes within it, take note of the need to ensure that there are preventative and proactive policies to protect for infrastructure and people from physical threat.

It is against this background that a group of Caribbean based ICT professionals began the process of developing a series of recommendations on how ICT technologies and methods could be used to improve the ability of Caribbean states to respond to disasters, including actions that are necessary before, during and after disasters of this nature occur.

These ideas evolved into a technical blueprint that outlines the role of ICT in the following areas:

- Information Dissemination and Communication for Disaster Preparedness
- Improvements in Regional and National ICT infrastructures and Applications for disaster mitigation and responsiveness.
- ICTs and Effective Emergency Management and Response Systems
- ICT in Post disaster reconstruction
- Summary Recommendations

This document will provide a brief overview of all of these themes put forward some suggestions about the way forward given the realities, economic, social and physical, that are faced in this region. It should be noted therefore that all of the recommendations made in this document are able to be done within the region; and that the implementation of these recommendations within the region through local organizations and community will further reinforce the safety of our region.

Methodology

The concepts and ideas in this document were developed by a group by ICT professionals who use the virtual forum called the Caribbean IC T virtual community (CIVIC) as a means for regular networking.

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CIVIC was created initially after the gathering of participants of the Caribbean ICT Roundtable held in Barbados in October 2002 and received financial support from the Institute of Connectivity for the Americas, a Canadian development initiative associated with the IDRC.

CIVIC is now a permanent virtual forum of Caribbean ICT stakeholders. It is a venue for sharing information, holding discussions, networking and linking ideas, actors, projects or initiatives on ICTs and development in the Caribbean. It also aims to contribute in the building of a common vision/perspective on ICTs, and to promote a Caribbean strategy and/or regional Caribbean-wide actions. CIVIC is a Caribbean managed and owned virtual community based on upon an asynchronous, electronic conferencing platform, the ICA Caribbean mailing lists and its related web tools (currently hosted on the Dgroup virtual platform.)

The creation and develop of this document and its resulting consensus was conducted entirely through an online collaborative exercise facilitated by the CIVIC virtual forum.

The production of this advocacy brief is an instance of pro-active engagement by Caribbean professionals to articulate solutions to Caribbean development challenges. The approach that has been taken is to recommend solutions that are cost-effective and manageable and that would be implemented on the basis of cost-sharing between national ICT budget allocations and financial resources from international partners.

A companion funding proposal provides further discussion of financial implications and operational requirements for the solutions recommended in this brief.

I. Information Dissemination and Communication For Disaster Preparedness

The review shows that although there was much use of ICT throughout the region as the hurricanes approached there is considerable room for improvement. On the various islands throughout the Caribbean, people listened to their radios, watched their televisions and awaited word on what they should do. The Barbadian response to Ivan for example was coordinated through the use of cellular phones in the communities. Radio and television broadcasts were also used to keep the public abreast during and after the passage of Ivan. Cellular phones were also the primary mode of communication between the thirty District Emergency Organisations (DEOs) covering the entire island.

These organisations worked well because of the way they were organised into Units. For example, there is a Shelter Unit to man the shelters and ensure that they are equipped before any disaster. There is also a Road Clearance and Rescue Unit which operate during the emergency to clear roads and keep remote areas accessible as well as rescue victims. Other units include First Aid, Feeding, etc.

What made these teams effective is communications. For example, reports of emergencies were received by a Coordinator at a central location and these were dispatched to the teams according to the assistance required. All of this, during and after Ivan was done primarily using cell phones.

The Internet proved to be a very useful mechanism for tracking storms and hurricanes right up to the time of the actual strike and even during the worst effects of the hurricane. The Internet channels provided accurate and updated information on the exact location and strength of the weather systems and included predictions of when the hurricane would reach land allowing deployment of human and other adequate resources to the specifically affected areas in a timely manner. Regional websites like the one managed by the Caribbean Disaster Emergency Response Agency (CDERA) and the independent sites like stormcarib.com provided valuable information on disaster relief efforts and events as they occurred during and after the disaster.

The review further reveals however that although ICT provided effective support during the period during and after the disaster, there were inherent weaknesses in the mechanisms used.

The common shortcomings that were identified were that the **communication systems used for information dissemination would not have withstood full wrath of the hurricane**. For example, had Hurricane Ivan hit Barbados with full force, it is questionable that cell phone relays would have been useful. In hurricane winds, telephone landlines and cell phone repeaters would probably not have survived. The Internet, which also depends on national ICT grid would also not have been accessible. Had Barbados been hit directly by Hurricane Ivan, there is likelihood that it would have been as *incommunicado* as Grenada was after the same hurricane.

In addition it would appear that information on changing weather patterns and the path of the hurricanes were not tracked in real-time. For example, even as Hurricane Jeanne

was approaching Haiti, it became apparent to many people that the North side of the island would be hit worse than the South side of the island. However, this information was not transmitted to the Northern coastline of Haiti on a timely basis – or if it did, it was ignored.

Information when it was delivered was often incomplete and not comprehensive. . In the case of Trinidad and Tobago, people were made aware that they should be prepared to go to the hurricane shelters by the media – but the media itself did not describe where the shelters were. Although the information was available on the Internet – if one had access, and if one knew where the website was, and if one had Adobe Acrobat Reader already installed, the national emergency response agencies were caught short

There was also lack of integration among information sources. In particular, the formal emergency management organisations and agencies did not appear to have access to the best sources of information. In well-connected households, people throughout the region monitored the hurricane by way of the Internet, with access to the same information that the media had.

In the case of hurricanes, up to the minute information is of significant importance – it can mean the difference between life and death. Regional news media did not appear to have independent news coverage capability and were reliant on international feeds and networks such as CNN.

Despite the weaknesses however there were success stories that can be used to build upon for better disaster preparedness in the future. The HAM radio community was able to maintain communication throughout the hurricane and served as a connectors, even with the airplanes as they flew through the hurricanes. This small group of people who are little known should have been better integrated into the formal emergency management response system, yet even without those mechanisms, the HAM radio community were able to provide information that saved lives.

Because HAM radio proved to be the most reliable means of communication during the recent hurricane and there are only a limited by the number of operators, there should be programmes put in place to support and expand HAM radio and other amateur radio associations and to better integrate these into national emergency and regional emergency systems.

It may also be desirable to locate a web server, outside of the Caribbean to host posts from HAM operators. This would permit HAM radio operators outside of the region as well as within the region to post information quickly and accurately such that there is a rapid transmission of data to every aid agency and country within the region.

Subsequently, more people need to have access to the Internet to have this information.

Based on this review, the following specific recommendations are made for improving information dissemination and communication for disaster preparedness:

Exploiting Communications Capabilities There is a need to utilize the broad range of communications capabilities that are currently deployed or that could be made available

to the public and the disaster community.

This task requires that the existing and potential capabilities be explored and that where necessary, negotiations with providers, governing bodies, governments (within and outside the region) be initiated. These negotiations should optimally lead to agreements that guarantee the regional disaster community with cost-effective and reliable links, which in turn support, the needs of a more highly functional community.

Such a task envisages a number of negotiation processes that culminate in arrangements for access to communications channels with carriers.

- Internet service providers - to provide the bandwidth and quality of service levels for videoconferencing and streamed multimedia
- Telephone service providers – to offer preferential rates for voice and cell phone local and long distance tariffs in support of clients and the disaster community (precedent set by providers in Jamaica during Hurricane Ivan.
- Satellite Phones – arrangements to acquire and use this technology where /when situations warrant
- VHF / UHF / Citizens Band radio – arrangements to receive and “re-broadcast” live dialog where and when appropriate

Utilizing the broadcast media These considerable broadcast resources remain largely unavailable for use by disaster management community in the region. The use of these media – even during disasters – will require changes in conventions and possibly technologies with broadcasters, and will require legislative changes at the various national levels. Such systemic changes will require the management of regional bodies such as the Caribbean Broadcast Union (CBU) and the International Telecommunications Union) ITU) as well as ECTEL (if spectrum changes are required).

Automatic media broadcasts There is a need for all public broadcast media to propagate brief storm warning messages using textual, audio and graphic modes automatically as the responsible weather services determine that need. This facility is presently employed in North America by way of the Emergency Broadcast System (EBS) to which all public broadcasters subscribe.

Interpreted meteorological information. Presently public broadcast media provide short “weather clips” delivered by their “weather announcers”. However these items are insufficient for the purpose of properly informing listeners in the general public or the national disaster community.

These target listeners require much more appropriate information for decision-making which is detailed, frequent and timely.

Real-time broadcast during event onset Provide for one or more public broadcast (AM. / FM radio stations) to deliver continuous “public affairs” program format that would include:

-A hosted “Talk Show”

-Live interviews with professionals from the DM community with the objective of interpreting the meaning of meteorological messages in relevant and understandable ways.

Other General recommendations

- Upgrade the capacity of radio and television stations to penetrate the region, including by exploring the feasibility of leasing dedicated satellite capacity for transmitting information and facilitating communications throughout the Caribbean region under any extreme weather conditions.
- Provide for one or more public broadcast (AM. / FM radio stations) to deliver continuous “public affairs” program format that would include for example a hosted “Talk Show” with live interviews with professionals from the DM community with the objective of interpreting the meaning of meteorological messages in relevant and understandable ways.
- Develop a method of streaming or beaming all broadcasts so that television and radio stations in the region have real-time access to all broadcasts in the region in times of natural disasters.
- Facilitate and improve media access to the Internet, including dedicated weather channels and disaster management sites. Identify and train volunteers and civil society personnel in weather patterns and meteorological systems so that they can be of assistance during emergencies, including in the reading and interpretation of satellite imagery as it relates to weather systems.
- Develop training programmes in the use of the Internet and other communications medium for disaster preparedness and management.
- Provide widespread training courses in HAM radio operations to increase the population of HAM radio operators and the availability of HAM radios during an emergency and integrate HAM radio operators and equipment to the national and regional emergency responses systems including assignment to hurricane shelters.
- There is need for a satellite that would facilitate the penetration of all types of communications throughout the Caribbean region under any extreme weather conditions.

II. Upgrading regional and national ICT Infrastructures and Applications to cope with natural disasters (Hurricanes)

With recent hurricanes creating devastation throughout the Caribbean and the Southern United States, the robustness of the ICT infrastructure has come under scrutiny. When Grenada was devastated by Hurricane Ivan, the island was unable to effectively communicate internally or externally. Landlines communication on the island (as at the preparation of this brief) was still limited and was in the process of being restored.

National and regional Information and Communication Technology (ICT) infrastructure, which plays a critical role in transmitting information and facilitating communication, faces no greater test than in an emergency situation where lives are at risk. Under conditions of severe weather, communications equipment, which makes up the national and regional ICT infrastructure comes under stress and is subject to failure. This requires that the providers of national and regional ICT infrastructure take the principles of redundancy and reliability into account when designing networks. For adequate *redundancy*; there should be multiple independent methods of communication available to assure that if there is a failure, other means of communication are available. There is also need to ensure *reliability* of the communications equipment under severe weather conditions by setting design parameters that are suitable for the Caribbean environment. Introducing improved levels of equipment reliability would in some manner also reduce the need for alternative networks and reduce the cost of providing full system redundancy. In telecommunications networks, having good and regular maintenance routines also improves reliability; this is particularly true for outside plant and other transmission facilities.

In the event of an emergency that disrupts 'regular' ICT infrastructure, it is also likely that other infrastructure systems such as electricity will be affected. Caribbean ICT providers would be well advised to consider integrating use of renewable energy sources to improve redundancy. In addition devices that can be used to re-charge cellphones without access to electricity grid should be made available in emergency shelters and distributed locations.

Specific recommendations for improving reliability of national and regional ICT infrastructures include:

- Ensure that all Caribbean cell phone towers are built to specifications that can withstand hurricane force winds over 200 miles/hour.
- Introduce of dedicated emergency communication infrastructure which might include “ruggedised” handsets that integrate different types of communications, e.g. two-way radio, Internet access, phone.
- Introduce communications equipment into emergency shelters so that during actual emergency and in reconstruction real-time coordination is improved. At minimum all emergency shelters and other emergency locations should be provided with dedicated secure landlines, assuring highly reliable communications and better coordination of emergency responses during

disasters. Other desirable communications equipment would at least one computer with Internet access, and a HAM radio. Spare parts should be available within the area for these systems, and regular checks on their usability should be made. Assuring that each disaster shelter has communications equipment such that coordination can occur from the safety of a shelter, and planning for post-disaster scenarios can be done in real time.

- Assign of specific or a range of frequencies in case of natural disasters, as part of a national frequency management policy. This would enable HAM radio operators to function as part of the emergency communication network, since these technologies are more likely to survive the effects of a hurricane or similar natural disaster.
- Ensure widespread access to backup power systems, including inverters and marine deep cycle batteries for backup power.
- Deploy Peer To Peer (P2P) technologies communications between shelters on a separate network, which can be connected to the Internet.
- Introduce cell broadcasting across GSM/TDMA systems
- Internet connectivity throughout the Caribbean region. For example, Peer To Peer (P2P) technologies may be useful for internal communications between shelters on a separate network, which can be connected to the Internet.
- Ensure improved access to marine communication ability and improve deployability within the region, as well as response times.

III. ICTs and Effective Emergency Management and Response Systems

The recommendations on how ICTs can be used to improve disaster management are predicated on the assumption that the regional disaster management community operates under a well defined disaster management policy, and that their respective organizational frameworks supports strategic and tactical functions.

It is believed therefore that the most effective implementation of disaster management will revolves around four core phases: mitigation, preparedness, response, and recovery. A disaster-related information infrastructure must support each phase of activity. Each phase is unique involving differing:

- data sources and volumes
- timeliness and specificity of information
- target users – differing locations and levels of sophistication

Mitigation Phase.

This includes activities to reduce the impacts of disasters when they occur, such as city/town /rural planning and building codes. It also includes data, analyses, and models (often map-based) indicating risk and hazard assessment and the relative vulnerabilities of communities. Planners and the DM community share in mitigation responsibilities. These activities are not time-critical, but require the transfer of large quantities of data, and connectivity among several organizations.

Requirements

- The main requirement is to provide for the capacity (bandwidth) to support required data transfers between information providers and users.
- Data providers must store data so as to provide integrity and access as required
- Inter-agency collaboration and training activities will need to make use of electronic mail and interactive video conferencing. Hence compliant messaging and multi-media protocols among agencies is a necessity.
- Communications Providers should be required to comply / cooperate by constructing “hardened” cell-phone towers and antennae to withstand hurricane strength winds. Retrofitting existing towers could be relatively cheap (\$5,000 to \$10,000 US each)
- The dilemma to alternative communications providers, created by monopoly providers, could be resolved by the implementation of emerging “island wide” WiFi technologies that boost communications ranges from approximately 10 miles to 100 miles.
- Deploy peer-to-peer links between shelters and local response agencies (possibly via the WiFi systems described above), to maintain continuous vital communications.
- Require Cell-phone providers to implement capabilities for cell broadcasting to GSM / TDMA cellphones! This will facilitate fast locally targeted “broadcasts to mobile users.
- Support marine operators and pleasure craft by integrating marine-bands into the DM broadcast network.

- Equip emergency shelters (prior to onset) with mobile PC/ communications devices (such as the PDAs described above). In addition, consider the installation of backup phone lines.
- Shelters (and shelter personnel) should be frequently contacted and briefed to ensure readiness to support both response and post-disaster recovery efforts.
- Assignment of specific bands of the broadcast spectrum. For example, the National Emergency Broadcast System -NEBS – in North America) requires that all public broadcasters configure their facilities so that independent of regularly scheduled programming, listeners can receive severe weather messages via radio and TV.
- Implement RSS News summaries for the broadcast media and for relevant Internet news sites.
- Alternative broadcasters such as “Amateur radio operators”, and local meteorological services might be allowed to transmit brief messages via some of the above mechanisms.

Preparedness Phase.

These activities include logistical support, supply, and resource management systems needed for disaster response. It also includes early warning and monitoring activities preceding onset. The distribution of warnings during the preparedness phase is intense, and timeliness is essential. Public awareness through broadcast announcements and access to disaster web pages is key. Community awareness is also a key requirement.

Requirements

During the onset of recent hurricanes in Grenada, Cayman Islands and The Bahamas, many elements of the region’s infrastructure ceased to function. The following are measures to mitigate against infrastructure and data failures during the preparedness phase:

Infrastructure reliability:

- Provide for reliable electricity supplies by way of generators, inverters and deep-cycle battery storage, as a standby to national electricity grids. In the event of outages, vital equipment and services at DM agencies will be uninterrupted.
- Employ higher design standards to minimize structural failure of outdoor antennae and cabling linkages so as to minimize loss of access to communications services.
- Employ higher construction standards to reduce Wind / rain / flood damage to equipment installations.

System loads and monitoring procedures

- Provide for secondary and standby alternatives to primary communications links to handle unanticipated communications traffic
- Establish more stringent service level agreements (SLAs) with service providers such in order to avoid loss of ancillary services on the networks and ensure against degradation or loss of primary service
- Institute both increased training as well as documented procedures and operations manuals to prevent human failure to perform needed system monitoring and management activities.

Co-location and virtual hosting

- Where possible implement arrangements for location of core technologies at hardened service provider sites) Co-location).
- Re-design data repositories and web sites so that they can be “flipped” to other “mirror” sites in the region on a dynamic and “as-needed” basis. This will allow for the immediate “re-location” of key information services in the event that the primary site is impacted.

Electronic data integrity

- Implement appropriate infrastructure to safeguard the integrity and continued functioning of data repository facilities
- Implement appropriate management software and processes that would provide a combination of backup, co-location, and archiving for critical disaster-related electronic information.

Response Phase.

Rapid Response to disaster events is vital. Logistics, resource allocation options, damage assessment surveys, situation reporting, equipment, human resources, and funds management must be made available responders and the wider disaster community. Communications between response teams and the public is critical.

Rapid, reliable, secure communication is vital to efficient disaster response operations. (cell phones, satellite phones, VHF/UHF etc) Power loss and normal facility destruction, traffic peaks, an increased number of mobile users, and sensitive data place inordinate pressures on existing communications infrastructures It is envisaged that future applications such as the exchange of property and casualty data, resource information, and response priorities will require special access capabilities beyond normal commercial telephone/ Internet services.

Requirements

The following needs were identified:

- Redundant communications systems – Regional commercial providers be required to incorporate the highest levels of reliability into their systems.
- DM sites and Internet hosting services configure their systems to enable their services to be “mirrored” on equivalent sites outside of the impact zone.
- DM agencies seek alternative arrangements for both hosting and communications so that they can exercise these alternatives in the event of outages to primary providers. In this regard, provisions should be available under telecommunications regimes to allow for alternatives to a monopoly provider (ECTEL).
- In times of crisis, routine maintenance procedures are sometimes overlooked. All maintenance and support staff at DM agencies should be both adequately trained in procedures for maintaining vital equipment during extreme conditions, this should be effected through a combination of training and written procedures and checklists.

Recovery Phase.

The data needs during recovery include significant onsite data collection related to rebuilding, claims processing, and documentation of lessons learned. Feedback on the mitigation process and historical databases is important to prevent the same mistakes in the future. Timeliness concerns are relaxed in favor of efficiency, and the Internet is often ideal for such transfers.

The goal of this phases will be to advocate and champion the implementation of accepted international standards for ICT implementation in the disaster management community and to maintain the integrity of vital disaster-related data in regional repositories. A specific implementable objective might be to strive for “five nines” reliability on all core DM services among regional entities.

IV. ICT and Post Disaster Reconstruction

ICT can provide the widest range of assistance and support in the post disaster reconstruction period. Governments and the relevant authorities must be able to quickly reestablish the highest possible levels of connectivity with their neighbours and further afield. Indeed, even while the disaster is happening, communications between shelters is required so that proper planning of evacuations and relocations can take place. Communication is required to provide real time status reports allowing for planning and coordination of activities which can mitigate risk to the community.

Reconstruction can be used as an opportunity to use new methodologies to leapfrog old concepts that might have been in existence before. Capacity building efforts during reconstruction should focus on acquiring expertise that facilitates new approaches to societal management including the application of ICT.

The reconstruction period also provides an opportunity for application of scientific research practices to assist with disaster mitigation and responsiveness. During the reconstruction period, mechanisms to distil lessons learned and to introduce innovative practices ought to be maximised.

Pre-disaster data and supporting systems, located in storm reinforced information centers can assist the authorities with policy and decision making and even with the dissemination of relevant information to citizens living in very difficult circumstances.

Specific support must also include the following:

- The use of information and communications technology to support the continuation of government after the disaster.
- The reestablishment of communication between the administration and governmental agencies
- The restoration of connectivity with the regional governments and beyond
- Logistic support for the effective dissemination of relief supplies.
- The provision of relevant data to quickly locate members of the population
- Establish links with the people within the country
- The dissemination of information quickly and effectively so as to reduce the chaos and confusion that would occur.

All assistance must be provided quickly and with least amount of drain on existing resources during this period.

Data Protection and Preservation

The ability of ICT to effectively support the requirements of the post disaster period is a direct function of what is available infrastructure wise after the event. It is a stark reality that ICT infrastructure will be damaged along with everything else during a disaster. The overall strategy therefore has to be the introduction of methodologies to reduce the

amount of damage done to ICT infrastructure during the disaster itself.

As part of this strategy member states should consider the creation of National Data Centers. The characteristics of these data centers would be as follows:

- Located in weather proofed reinforced buildings (a good example of this is the underground data center that Cable and Wireless has in Bermuda)
- Responsible for housing all vital electronic legacy (e.g. Financial records, City Plans, Housing Plans and Deeds, Maps, Medical Information, Government Information etc, NIS,)
- The ability to quickly restore connectivity with neighboring territories and governments.
- The establishment of prearranged frequencies/ protocols with Ham Radio operators so to restore communication within the territory
- Access to robust, reliable and redundant ICT infrastructure and alternate power sources (i.e. Generator Sets, Inverters and Deep Cycle Batteries etc.)

It may be prudent to investigate co-location in an offshore facility of non-sensitive material where there is less of a threat

Scientific research and training for enhanced decision support

When Hurricane Gilbert (1988) wreaked damage to 20% of all buildings and to 50% of the housing stock on the island of Jamaica, primary losses were attributable to roof structure loss, and weak connection details. The effect of this storm and Hurricane Hugo's landfall on Montserrat the following year, resulted in significant damages to housing and infrastructure amounting to US\$1 billion in economic losses and increases in insurance premiums. These losses also galvanized Caribbean engineering professionals to react, and numerous projects were initiated to address the problems, including the Cyclone-Resistant Housing (Caribbean) project 1990.

Hurricanes are frequent occurrences in the Caribbean where damage occurs annually through the effects of extreme winds, storm surge and flooding. The extensive rain and cloud bands of a tropical cyclone may affect islands far removed from the eye of a storm through rainfall induced flooding and landslides. In addition, the Caribbean is subject to numerous other natural hazards both geological (earthquakes, volcanic activity and landslides) and meteorological (hurricanes, storm surge, and torrential rain and flooding) that make the infrastructure especially vulnerable to the extensive damage that occurred to Grenada during Hurricane Ivan.

These hazards place vulnerable tourism facilities, essential facilities and housing at high risk of damage. Hurricane's Ivan's devastation on Grenada illustrates how a hurricane can destroy the backbone of small economies and create special problems of protection of human life when limited landmass makes evacuation an unrealistic option.

Given these elevated risk levels, coupled with building code practices that do not address critical wind-resistant components, there is an urgency to educate engineers, risk managers and building professionals on island states regarding the demands that mitigation of natural hazards should be the highest priority.

V. Summary Recommendations

It is clear that much more can be done with ICTs, across the region, even recognizing the variation in context and capabilities across countries. There is also room for harmonization of approaches and scope for improved effectiveness of regional institutions. The recommendations therefore include the following:

1. The Creation of a Caribbean ICT & Disaster Management Network

The goal of this network will be to provide relevant disaster information in a form that is understandable to a wide audience, and upon which agencies, responders and the general public may make timely decisions to minimize loss of life and economic assets. Ideally this network will be established as an operational unit (either within or closely associated with) CDERA, and will acquire available real-time information such as remotely sensed data, risk models, meteorological forecasts, and interpretations by professionals in the Disaster Management community. Its informatic sources will be both regional and international.

2. Information System Design for Comprehensive Disaster Management

This task will include both a complex information needs assessment, and the implementation steps that derive from that needs assessment, combined with the priorities imposed on that needs assessment by the national disaster office. Most of the resources to conduct the information system design will need to be contracted or provided by professional ICT personnel from the government agencies.

The information needs assessment would demonstrate how sustainable development decision making can be fed information on disaster management issues, and how that process can be monitored by national disaster offices. Major data for that process includes:

- mapping of hazard vulnerability and risks;
- the national physical development plan-as planned and as built;
- environmental and hazard impact assessments;
- road, utility and communication networks;
- emergency shelters, supplies and public or private warehousing facilities;
- public and private heavy equipment sources;
- key personnel and contact systems;
- monitoring, assessment and revision systems.

3. Continuous Training

During non-emergencies there should be widespread training on use of communications systems. In times of disasters there should be efforts to develop community-level responses and this should include training community level leaders in first aid and interpretation of meteorological data.

4. Post Disaster Reconstruction

Introduce ICT-enabled systems for post-disaster reconstruction efforts including establishment of national data centres for mission-critical data; scientific research and training for identifying disaster mitigation practices including in building codes and physical planning systems.

5. Improve Media Capacity in the region

There is a clear and urgent need to strengthen the regional footprint of broadcast media and to reduce the dependence on extra-regional news networks as a source of up-to-date information on the Caribbean. This strengthening must not focus only on the traditional broadcast media (i.e. Radio and Television), but should also include amateur Radio and Cellular broadcasting as well.