Interim Concept Paper:

Specifications of a National All-Hazards Warning System for Sri Lanka

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5 February 2005

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Background of Concept Paper

The goal of this concept paper is to provide recommendations for the parameters and specifications of a national all-hazards warning system appropriate for Sri Lanka, with adequate regional and global linkages capable of conveying warning messages of any scale or type in the event of an impending hazard.

Initial ideas and options developed by local researchers and an international expert on disaster communication were presented at an Expert Consultation held on January 26th 2005 in Colombo. The consultation was organized to obtain broad input from Sri Lankans with disaster management expertise (see Annex 1). The program is given as Annex 2. The qualifications of the international expert and the leader of the Sri Lankan team are given in Annex 3. The invitees to the consultation included alumni of the Asian Disaster Preparedness Centre in Bangkok and those who responded to newspaper advertisements (Annex 4). The Consultation was attended by approximately 60 persons (an attendance list will be provided in the final report). Further valuable input from experts in hazard warning and related subjects are now being sought through a referee process, in addition to public comment.

This **interim** concept paper is being made available on the Internet at http://www.vanguardfoundation.com and http://www.lirneasia.net for a period of **fourteen days** from February 5th 2005. Input received at this juncture will be given due consideration and integrated into the final concept paper, which will be submitted to the appropriate authorities in government on February 26th 2004, two months to the day from Sri Lanka's greatest calamity, a calamity that killed 1 in 500 of our population and affected one in twenty.

Acknowledgements

The authors would like to thank the following people for their valuable input and contributions to this paper: Malathy Knight-John, Lakshaman Bandaranayake, Cathie Hickson, Harsha de Silva, Luxman Siriwardena, Chanuka Wattegama, Sabina Fernando, Vajira Premawardhana, Nishantha Kamaladasa and the participants of the Expert Consultation held on January 26th 2005.

Vanguard Foundation

http://www.vanguardfoundationlanka.org/

Vanguard Management Services (Pvt) Limited, floated Vanguard Foundation, to conceptualize and implement its corporate efforts in the areas of disaster relief, rehabilitation and preparedness. The Vanguard Foundation would promote activities, polices, and market based initiatives that would improve national disaster preparedness, mitigation strategies, and the flow of expertise to meet and deal with a wide variety of national disasters.

LIRNEasia

http://www.lirneasia.net

LIRNEasia, a regional ICT policy and regulation capacity building organization, incorporated as a non-profit organization under section 21 of the Companies Act,

No. 17 of 1982 in 2004 and funded at present by the International Development Research Centre of Canada and *info*Dev, a unit of the World Bank. The organization is physically located in Colombo but works throughout the Asian region. Its primary functions are research, training and informed intervention in policy and regulatory proceedings. Its current projects include research in India, Nepal, Bangladesh and Indonesia.

Executive Summary

0.1 The tragic and unprecedented loss of life in the 2004 Indian Ocean tsunami has highlighted the critical importance of an effective public hazard warning system for Sri Lanka. Public warning is a system not a technology, constituting the identification, detection and risk assessment of a hazard, the accurate identification of the vulnerability of a population to whom a warning needs to be directed and finally the communication of information to specific recipients about the threat in sufficient time and clarity so that they take action to avert negative consequences. In short warning allow people to act in order to prevent hazards from becoming disasters. Effective public warning saves lives, reduces economic loss, reduces trauma and disruption in society and instills confidence and a sense of security in the public.

0.2 Effective warning is just one of the critical parts of a comprehensive risk management system that includes mitigation, preparedness, response and recovery. While recognizing this, the focus of this concept paper is on the warning component. Warning is a crucial component of the overall risk management system that failed in the 2004 Indian Ocean tsunami and which needs urgent strengthening in order for the country to benefit from the proposed improvements in the regional hazard detection systems. Linkages to local, regional and international hazard detection systems are extremely important for an effective national warning system. The efficacy of the warning system rests on public education and awareness raising, planning and testing and assessment.

0.3 Pubic warning of hazards is not simply a technology, but rather a unified system constituted by four critical and inter-related elements:

- Hazard identification, risk assessment and vulnerability analysis
- Detection and monitoring
- Emergency management structure
- Local dissemination

0.4 Further, in addition to warning the public, an effective warning system also must provide information about how to prevent and protect against disasters and information and knowledge to aid timely relief, recovery and rehabilitation efforts.

0.5 Sri Lanka should resist the temptation of a special purpose tsunami public warning dissemination network, which would not have the advantage of regular use, testing and maintenance that comes with a multi-hazard warning system. A single national multi-hazard warning system that incorporates all new and existing warning systems is likely to be more effective and sustainable because it will be central to daily life. For warnings to be available for all Sri Lankans at risk, no matter what they are doing or where they are at any time of day or night, the warning capability must be ubiquitous and accessible. Obviously, no single method will reach all people and an infrastructure is needed to integrate and support multiple methods and channels to disseminate messages. The government cannot provide this on its own. While the warnings may be issued by government mandated authorities, the means to disseminate the warnings are dependent upon private network infrastructures and human resources. Consequently, to ensure universal access to warnings, public/private partnerships are required to develop the policies for and implementation of a national warning system that leverages and integrates the nation's existing and emerging networking capabilities.

0.6 The telecommunications industry and the electronic broadcasting industry play crucial roles in the effective dissemination of warnings. With regard to telecommunications, it is essential that the recommendations of the 1999 Telecommunications Regulatory Commission Report be implemented, with additional measures taken on mobilizing the potential of new services and capabilities such as SMS and cell broadcasting. With over 75 per cent of households having a TV and/or a radio, electronic broadcasting plays a central role in hazard warning. However the plethora of channels and stations requires that attention be paid to prior planning and coordination to ensure the timely and orderly dissemination of warning and watch messages. The potential of remotely activating radio and TV sets in the event of emergencies must be explored.

0.7 Public hazard warning is a public good that will not be supplied by the market. Its supply has to be funded by government. However, as experience has shown, the Sri Lankan government has failed to effectively supply this public good to its citizens. In the event the government is to undertake this task in the aftermath of the tsunami catastrophe, it is necessary that safeguards to ensure high levels of performance on the lines of those adopted for regulatory agencies such as the Public Utilities Commission of Sri Lanka be set in place. This would include provisions for:

- the deployment of proper expertise and equipment,
- adequate levels of funding, and
- insulation from day-to-day political interference, and
- transparency and accountability.

0.8 Hazard warnings are based on incomplete information and judgment. In many societies, the final decisions on warnings and especially on evacuations are taken by political authorities, who can be held accountable through the ballot box. They, of course, take these decisions on the basis of independent and professional advice of experts. In the present circumstances of Sri Lanka, there would be little support for a politician making the final call. However, it is worth emphasizing that there is no easy method of holding an expert accountable for a lapse of judgment.

0.9 The alternative to government supply of the public good of the hazard warning is its supply through the market by bundling it with a private good. The insurance industry may have incentives to operate a national all-hazards warning system, given its interests in minimizing losses to life and property. However, the relatively low penetration of insurance in Sri Lanka suggests that the industry will hesitate to bundle the costs of a public good that benefits the entire population with its private good which is purchased by a small percentage of the population. Another industry that may have an interest in supplying hazard warnings is the tourism industry. However in this case, it is unlikely that a national all-hazards warning system will be created, with hotels operating regionally specific hazard warning systems for the benefit of their guests. In cases where non-government entities operate hazard warning systems, the government may yet be required to facilitate their activities by enabling them to obtain hazard detection data and by providing them with indemnity.

0.10 In light of the delays and difficulties likely to affect government action to establish an effective national all-hazard warning system, it is recommended that private and civil-society sector initiatives still be undertaken. Localized and partial actions that reflect the ground realities of different industries can provide second or third best solutions while the government assembles an appropriate strategy and may even contribute to the design of an effective national system.

Section I: Introduction and Rationale

Vision

1.1 What will Sri Lanka look like the next time a hazard of large magnitude strikes us? How will we react? Are we ready to face the next flash floods? Cyclone? Earthquake? Dam breach? Epidemic?

1.2 If Sri Lanka takes this opportunity and acts quickly to implement a national all-hazards warning system for Sri Lanka, here's what could happen:

Mid 2007…

This year the Ratnapura district saw the heaviest rainfall in over a decade. However, unlike in the past, damage was minimal, and no human life was lost. The early flood-watch system, run in conjunction with the National All-Hazards Warning Center and local community and business leaders was responsible.

Started almost two years ago, the system noted levels of rainfall approaching higher-than-average levels, sending out 'watch' signals to the local and surrounding areas. Once rainfall levels reached the critical level, the 'watch' became a warning. Awareness created in these areas through media and community programs was clearly demonstrated—especially among those living in previously demarcated 'vulnerable' areas, making preparations for evacuation, should the rain levels increase to flood levels.

Disaster recovery services were on standby. The rainfall continued for days, getting heavier and heavier. While everyone was on guard and ready to evacuate as was necessary last year, the need fortunately did not arise. The mitigation measures implemented over the last year successfully redirected the rainfall away from populated areas. Only one minor land-slide was reported along a main road, but the vigilant townspeople stayed off the roads and no one was harmed.…

2016

Twelve years after the great devastation of the tsunami of 2004, history has repeated itself. Stress built up along plate boundaries off the western coast of Sumatra caused the earth to shake violently at 1515 hrs last Sunday afternoon. The quake, originating in the Sunda Trench on the ocean floor, sent tsunami waves sweeping across the Indian Ocean once again.

Sri Lanka was aware of the earthquake immediately through its own basic seismic equipment at the Geological Survey of Sri Lanka, and within four minutes more detailed data received by the National All-Hazards Warning Center (NAHWC) through a bulletin from the International Tsunami Warning System. The bulletin confirmed the earthquake, its magnitude and location and included a tsunami watch message. A second bulletin with a warning five minutes later confirmed increased sea levels, indicating a tsunami heading westwards, estimating that the tsunami could reach Sri Lankan coasts anywhere within 2-3 hours. NAHWC took immediate action, disseminating warnings according to contingency plans for (the albeit less likely of the many hazards) tsunami situations.

The warning was sent out to emergency services, armed forces, district administrative authorities, hotel groups, media, travel operators, telecom operators, transport companies and other disseminating agents along the coasts. Mobile operators sent out warning cell broadcasts from all their coastal cell-sites; national and community radio broadcasts issued warning; TV sets were remotely activated and warnings disseminated; armed forces took to the streets warning people; the sound of sirens wailing, church bells ringing, temple and mosque loudspeakers and community megaphones announcing could be heard all through the coast. By around 1645 hrs, when the sea began its encroachment of the land, beaches were cleared; coastal settlements and hotels were

evacuated. Media coverage ensured that people stayed away for two-three hours, until the waves subsided and an all-clear was sounded.
Although this tsunami was almost as powerful as its predecessor, casualties did not exceed 300, and damage to property has been estimated as significantly less. A week later, Sri Lankan lives are returning to normalcy. Sri Lanka can safely say it has learnt its lesson.

What is Public Warning?

1.3 Warning is the communication of information of a hazard or threat to a population at risk, in order for them to take appropriate actions to mitigate any potentially negative impacts on themselves, those in their care and their property.

1.4 The occurrence of a hazard does not necessarily result in a disaster. While hazards cannot be avoided, their negative impacts can be mitigated, and hence disasters may be prevented or at least alleviated; the goal of public warning is to ensure to the greatest extent possible that the hazard does not become a disaster.

1.5 When 'time is of the essence' public warning delivers essential information that people need to make potentially life or death decisions. Public warning should at the very least convey what, where, when and how severe the hazard is and how likely it is to occur. It can also incorporate what actions are appropriate – i.e., stay indoors, get to higher ground, go inland, etc.

1.6 The warning must be unambiguous, and communicate succinctly the risks and necessary guidance. The success of a warning can be measured by the actions that people take. It is a public good that is generally delivered through privately-owned communication networks and devices. It is important to note that warning is a system not a technology, constituting the identification, detection and risk assessment of the hazard, the accurate identification of the vulnerability of a population to whom a warning needs to be directed and finally the communication of information to specific recipients about the threat in sufficient time and clarity so that they take action to avert negative consequences. This final component underscores the importance of education and awareness in the population, so that they may know what the appropriate actions at that time are. The system is only as strong as its weakest link.

1.7 In a multi-hazard approach, the detection component will be different for different kinds of hazard. But the warning system should be capable of carrying warnings for all kinds of hazards to the population at risk, i.e., an 'all-hazards' warning system.

1.8 It is also important to note that effective warning is just one of the critical parts of a comprehensive risk management system that includes mitigation, preparedness, response and recovery. While recognizing this, the focus of this concept paper is on the warning component. Warning is a crucial component of the overall risk management system that failed in the 2004 Indian Ocean tsunami and which needs urgent strengthening in order for the country to benefit from the proposed improvements in the regional hazard detection systems.

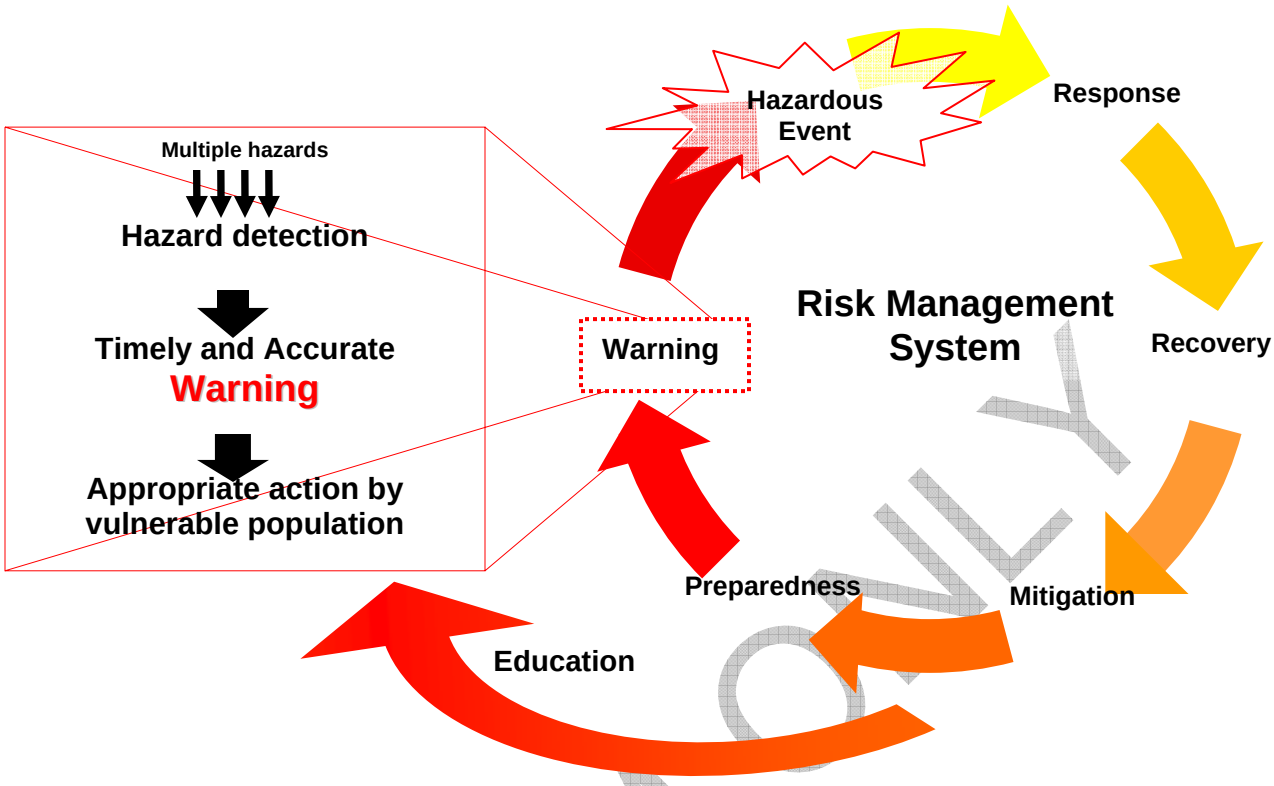

Figure 1.0: Effective warning as a part of a risk management system

1.9 Local, national, regional and international linkages of a national system are extremely important. The national warning system cannot stand alone, it must be sufficiently linked to multiple detection entities –national, regional and global warning systems to be most effective.

1.10 Other key components of a warning system include public education and awareness raising, planning and testing and assessment.

The Critical Need for a Public Warning System

1.11 Safety and security is necessary for the functioning and continued development of any society. Public warning thus is essential to any society.

1.12 The objective of public warning is to empower individuals, communities, businesses and industry to make decisions on their actions to reduce losses from hazards. People need accurate, timely information in order to decide whether to leave their homes, close their shops, move their boats in or out, or whatever it may be. It is critical that people know what risks they are facing to prepare themselves, their loved ones, their property, belongings and livelihoods. It is critical to the long-term stability and development of any society.

1.13 The value of timely and effective warnings in averting losses and protecting resources becomes increasingly apparent as countries incorporate disaster reduction policies into their national social and economic development plans, establish effective preparedness measures and improve their response capacities.

1.14 Early warning is imperative for, amongst others, the following reasons

- *Humanitarian:* The most obvious reason for an early warning system is to avoid needless loss of life and injury, giving people the necessary information to mitigate these risks. This has been demonstrated historically and globally.

- *Economic:* Effective warning can prevent much economic loss to individuals, businesses and industries. Warning enables these groups to prepare for and mitigate the impacts of hazards that may affect them. Furthermore, the lack of mechanisms for hazard warnings can harm investor (local and foreign) and business confidence as well as the tourism industry in Sri Lanka's case, and hence stifle economic development of a country. Added to this, public warning can also be a protector of the poor, given that the sectors of the economy most vulnerable to disaster are often the poorest.
- *Social:* effective early warning allows populations at risk to take necessary actions that will reduce the impact on their lives and property. Not having a warning system can have disruptive effects on a society, causing much chaos and confusion should a hazard strike, including large scale displacement of people, disease outbreak, disruption of schooling, etc. Public warning enables speedier disaster recovery than otherwise. Public warning systems also provide citizens with a sense of security and provide order to society.

1.15 Furthermore, peoples' confidence in the government can easily be broken by the mismanagement of a national disaster, starting from the lack of a warning system. This is summed up in the words of former US President Bill Clinton: "Voters don't choose a President based on how he'll handle disasters, but if they're faced with one it quickly becomes the most important issue in their lives."[1]

1.16 Public warning is needed not just for natural hazards, but for acts of war, accidents, health concerns and acts of terrorism.

1.17 Modern technologies allow for a great deal of prediction and forecasting of hazards, and ICTs provide effective means to provide more access to information, faster. But the potential of these technologies cannot be realized because of the lack of a public warning system to convey this information to the potentially affected public.

1.18 The examples of cataclysmic human, economic and social loss as a consequence of no public warning system are numerous; the recent Indian Ocean tsunami in which more than 30,000 perished in Sri Lanka alone, perhaps being the most striking in recent memory. In sum, effective public warning saves lives, reduces economic loss, reduces trauma and disruption in society and instils confidence and a sense of security in the public.

Importance of Partnerships

1.19 An effective warning system has to reach all the people at risk. While neither the government nor anyone can ensure complete protection of citizens from all hazards, whether through prediction or otherwise, it is the core business of government to protect it citizens to the best of its ability.

1.20 From an economic standpoint, the very nature of public warning – a classic public good – tells us that the market will not supply it in socially desirable quantities. To overcome this, the government traditionally provides such goods.

1.21 In the Sri Lankan case, and many other developing countries, government action is constrained by numerous competing claims on scarce resources. Dedicating large amounts of resources for protection against something that may only occur in the unspecified future, or possibly not ever, may not seem like a justified priority. The government cannot do it alone.

1.22 The private sector offers resources and usually the necessary infrastructure (e.g., telecom networks) that are needed for disseminating warnings; civil society provides further social-infrastructure necessary at the grass roots. The use of already existing capacities is not only cost-effective, but ensures the continuity and maintenance of the system during periods where there are no hazards. The cost to the government of implementing a nation-

[1] Clinton, Bill: *My Life*, (New York: Random House, 2004), p. 428.

wide warning system is significantly less when all stakeholders shoulder the costs for maintenance, management and service.

1.23 Successful partnerships can be fostered by identifying the key benefactors of a warning system, such as the hotel industry and the insurance industry. The government can work with them in implementing a warning system. The government can provide authority for the system, while the private and civil society sectors provide the mechanisms to get the warning out as fast as possible to all the potentially affected people.

1.24 Authority is something that has to come from the government. The government has to take the ultimate responsibility for the issuance of a warning. People need assurance that a warning message is legitimate before making the decision to abandon all their possessions and run for their lives. They cannot afford to waste precious minutes verifying warning messages, to ensure that they are making the right decision. False alarms cost money and breed cynicism.

1.25 The participation of all stakeholders at the community level is also crucial in developing a warning system. Community-level organizations and existing structures/systems can be integrated into the national warning system, to ensure the warning gets across the very last mile (for e.g., through the use of temple or church bells, or public announcement systems, etc.). Community-level organizations can also play a major and highly effective role in awareness-raising.

1.26 Partnership with other regional and global warning systems is a must. Access to global hazard information must be accessible to Sri Lanka, especially where the cost of generating this information on its own is prohibitively high– there is no sense in reinventing the wheel.

Key Points

- **The objective of public warning is to prevent a hazard from becoming a disaster by empowering individuals, communities, businesses and industry to make decisions on their actions to reduce losses from hazards.**
- **Warning is a system, involving the detection and assessment of a hazard, and effective communication of this information to the vulnerable population so that they may take appropriate action**
- **Public safety is the core business of the government but partnerships with the private sector and civil society are crucial to effective public warning**
- **An effective warning system must have linkages to local, regional and global warning systems**
- **Partnerships with the private sector are necessary and essential components of the design of a National All-Hazards Warning System**

Section II: Parameters of a National All-Hazards Warning System

2.1 Warning systems typically involve the installation of a range of instruments and technologies to ensure early detection and monitoring of hazards. They also involve scientific and organizational structures for analyzing the collected data to determine associated risk exposure and probable impacts, and processes for notifying those at risk in a timely fashion. For tsunamis, these arrangements include the installation of a network of seismometers, sea level gauges and deep sea sensors that provide around-the-clock, real-time data for detecting earthquakes and ocean water movements. Scientist use this data to predict the possibility of tsunami waves and to model their anticipated arrival times and on-shore impacts. Advanced telecommunications networks enable this data to be shared world-wide and warnings to be transmitted to designated national warning authorities. It is the responsibility of the national authority to determine whether or not to issue a warning, tailor the content of the warning, target those at risk and disseminate the warning message(s).

2.2 While advances in science and technology have expanded the possibilities of anticipating the effects of hazards, the actual design and operation of detection and monitoring system components may vary to account for unique characteristics of different hazards. Even with sophisticated technologies, it is often beyond the means of a country to detect and monitor all hazards, especially those of a localized nature. Many hazard warnings, in fact, are triggered by affected local residents alerting families, neighbors and local officials.

2.3 Regardless of system design, a common goal of all warning systems is to prevent hazard events from becoming disasters. However, it remains a challenge to ensure that warnings can be accessible to, understood by, and acted upon by local communities and the people most directly affected by threatened disasters.

2.4 The absence of a domestic tsunami warning capability exemplifies the seriousness of this challenge for Sri Lanka's overall warning capability. Today, different warning systems, most of questionable performance, function independently of each other, are not interoperable, use ad hoc warning terminologies and do not reach everyone at risk. Bringing these diverse warning resources together and focusing on an integrated national all-hazards warning system capable of articulation with regional and global warning will significantly improve the effectiveness of all warnings, especially when coupled with public education and awareness programs.

2.5 In this way, warning must be viewed not simply as a technology, but rather as a unified system constituted by four critical and inter-related elements:

- Hazard identification, risk assessment and vulnerability analysis
- Detection and monitoring
- Emergency management structure
- Local dissemination

Further, in addition to warning the public, an effective warning system also must provide information about how to prevent and protect against disasters and information and knowledge to aid timely relief, recovery and rehabilitation efforts.

2.6 For public warning to be effective various pre-requisites first must be in place, including:

- Planning. Before hazard events occur, the appropriate authorities must develop plans and procedures for when and how warnings will be issued.
- Education. The public must be educated about the nature of hazards and their effects, who and what is at risk, how people will be warned, what the warnings mean and what actions must be taken.

- Testing and Assessment. Warning systems must be tested regularly, both to ensure that the system works and that the public understands its purpose and messages.

Taking this a step further, an effective warning system must be viewed as an element of international, national and local strategies and programs for ongoing disaster reduction, supported by appropriate legislation and linked to appropriate institutional focal points.

Best practices in the design of warning systems

2.7 International best practices reveal a series of key principles that underpin the design of effective warning systems that include:

2.7.1 **Relevance**. Relevance is achieved through ongoing education of the public in order to establish a continuous "presence of mind" related to risk and response to warnings.

2.7.2 **Timing**. There are appropriate windows of opportunity to capture the attention of people in order to encourage appropriate action. In the case of quick-onset hazards – such as a locally generated landslide – warning information must be provided well in advance through an education strategy that informs those potentially at risk how to respond to warning signs in the natural environment (e.g., heavy rainfall, earthquake, shifting landscape, etc.). In the case of slow-onset hazards, such as a teletsunami, timing considerations will vary according on the specific community and local response requirements.

2.7.3 **Redundancy**. Redundancy refers to the delivery of warning messages across a variety of technological systems, such that messages are more likely to reach people according to their activities, be they indoor or outdoor, overnight or during the day.

2.7.4 **Clarity**. Clarity is needed in two dimensions. The first is the need for warning messages to clearly convey key pieces of information: the type of hazard, its probability, affected areas, estimated time of occurrence, and instructions for further action. Information may consist of a variety of visual or auditory symbols (both text and non-verbal forms) that are organized in a logical and coherent structure. Clarity also includes the need in some instances to issue warnings that can be understood by many different people across a range of diverse communities, including transient and seasonal populations. Language and cultural barriers are primary considerations.

2.7.5 **Credibility**. Credibility refers to recognition and acceptance of the source of the warning message. A high degree of credibility must attach to the organization that has detected the hazard, the organizations that are conveying the message, and trust in the information about the hazard that is being conveyed, including any instructions for a proactive response. Contradictory messages or misinformation may threaten credibility in both the short and long terms but best practices indicate that unwarranted withholding of information is equally problematic.

2.7.6 **Action-oriented**. The final principle of designing effective warnings is that they should be action-oriented. This means that warnings must alert and provide follow-up information and instructions for a proactive response. A well-designed warning will clearly alert a local population to the hazard and provide for clear instructions on what measures must be taken and under what circumstances. This response orientation also includes an emphasis on all-clear notifications, which may be of significance for tsunami hazards when multiple waves often occur over several hours.

Any system is only as effective as its weakest links

2.8 Despite best efforts to design effective warning systems, most systems can fail for any one or more technical and non-technical reasons, including:

- a failure of detecting or forecasting, such as a failure to accurately locate a hazard in time or space;

- ignorance of prevailing conditions of vulnerability determined by physical, social or economic inadequacies;
- a failure of the warning system infrastructure;
- a failure to communicate the threat accurately or in sufficient time;
- a failure of the warned population to understand the message, to believe it or to take suitable action
- Constrained capacity within government or communities to respond.

2.9 Adequate human, material and technical resources are needed therefore to establish and operate warning systems properly. The temptation to focus on improving the technical identification, detection and modeling of hazards without expanding and enhancing the capabilities and procedures for warning and response management is common. Without such improvements, communication from detection agencies to warning authorities to vulnerable communities will remain as the weakest links in the overall warning system.

2.10 When reviewing Sri Lanka's tsunami tragedy, these deficiencies become very apparent. Telecommunications systems were available in many areas of the country that could have transmitted warning information in advance of the tsunami waves but were not used because the institutional arrangements (organizational systems, agreements, protocols) necessary to transmit such messages to emergency authorities and local residents were not in place. Even without a formal system in place, had authorities on one coast communicated the ongoing events to national authorities, at least 7000 lives on the other coast may have been saved.[2]

Toward an Integrated All-Hazards Approach to Public Warning

2.11 Throughout the Indian Ocean Region much attention is now being paid to the need for advanced warning systems. The need for such capabilities, however, extends beyond tsunamis and is equally important in the contexts of many other hazards such as cyclones, floods and even pandemics.

2.12 As countries move forward to develop a new tsunami warning system, they must ensure that such efforts are carefully matched with existing regional and national warning capacities in order to enable interoperability with other warning systems and ensure social and cultural relevance.

2.13 At the domestic level, the temptation, however great at the moment, to invest in an autonomous, special purpose tsunami public warning dissemination network, should be resisted. Instead, all new and existing warning systems should be incorporated into a single national multi-hazard warning system that is likely to be more effective and sustainable because it will be central to daily life.

2.14 For warnings to be available for all Sri Lankans at risk, no matter what they are doing or where they are at any time of day or night, the warning capability must be ubiquitous and accessible. Obviously, no single method will reach all people and an infrastructure is needed to integrate and support multiple methods and channels to disseminate messages. The government cannot provide this on its own. While the warnings may be issued by government mandated authorities, the means to disseminate the warnings are dependent upon private network infrastructures and human resources. Consequently, to ensure universal access to warnings, public/private partnerships are required to develop the policies for and implementation of a national warning system that leverages and integrates the nation's existing and emerging networking capabilities.

[2] See Annex 7: Timeline of Events

The Role of the Communications Industry

2.15 The industry and government wide participatory process that led to the Final Report of the Pilot Study on the Use of Telecommunications in Disaster and Emergency Situations in Sri Lanka of January 1999[3] provides a good starting point. The recommendations included:

- Automatic load shedding/filtering system to be considered, with strict adherence to an 80% switch loading level to be mandated by the Telecom Regulatory Commission.
- A general call prioritization scheme to be studied for implementation across all networks.
- Consideration of a dedicated network for emergency service providers.
- Harnessing the radio amateurs.
- Implementation of free short codes for emergency service access.
- Clarification of the operators' emergency obligations by the TRC.
- The Commission to establish a 24-hour access number for use by telecom operators and disaster management personnel.
- A universal emergency short code to be established.
- The TRC to prepare its own disaster management plan and then require all licensed operators to submit their own disaster management plans.
- Preparation of emergency telecom kits by all operators.
- Issuance of special identity cards to designated telecom service personnel to facilitate emergency applications and service restoration
- Prior identification of suitable sites for temporary base stations and other emergency telecom facilities.

In addition, there may be value in looking at the potential of SMS, cell broadcast and other telecom applications that were not in broad use when the TRC Report was written.

2.16 The role of the broadcast industry is crucial in any hazards warning system. According to the latest Consumer survey conducted by the Central Bank of Sri Lanka 75 per cent of Sri Lankan households have electricity; 80 per cent have a radio; and 75 per cent have a TV set. A small percentage of non-electric households power their TVs from car batteries. In the largest single natural disaster that Sri Lanka experienced prior to the 2004 tsunami, the two cyclones of 1978, very effective use was made of radio, with casualties in the cyclone that actually hit the East Coast amounting to only 915 despite 250,000 families being displaced by the wind and massive tidal surges. The difference between 1978 and 2005 is the proliferation of media outlets. At that time the only electronic medium that was available in Sri Lanka was radio broadcasting; and the government monopolized radio broadcasting, offering a total of six channels in three languages, all of which got their news from a single news room. Effective use of electronic broadcasting for hazard management purposes will require a significant amount of prior coordination and preparation, ranging from the establishment reliable communication channels between the warning center and the broadcast stations to the education of media personnel.

2.17 The possibilities of remotely activating radios and television sets in the event of a disaster must be explored. In light of these capabilities being available in Japan and the predominance of Japanese branded TV sets in Sri Lanka, the possibilities of low-cost implementation are high.

Key Points

- **Planning, education, testing and assessment are prerequisites to effective public warning**

[3] Telecommunications Regulatory Commission of Sri Lanka; interim report available at http://www.reliefweb.int/telecoms/tampere/slcs.html

- **Best practices in the design of an effective warning system indicate that a warning system should be relevant to the population; warning should be given in appropriate time; warning must be delivered across multiple technologies and channels; warning must be clear and understood by all relevant people; warning must come from a credible authority; warning must be action-oriented.**
- **All new and existing warning systems should be incorporated into the nation's multi-purpose communication systems that are likely to be more effective and maintained because they are central to daily life; this demands partnership with private network infrastructure operators and human resources.**
- **Significant contributions towards enhanced national warning capabilities can be made by the telecom and broadcasting industries; action to enable this should be explored**

Section 3: Implementation and governance[4]

3.1 An all-hazards warning system is a powerful and important instrument in any society. The lack of one cost Sri Lanka one in every 500 of its citizens on December 26th, 2004.

3.2 An all-hazards warning system produces a public good that is non-rivalrous (consumption by one does not prevent consumption by another) and non-excludable (a user cannot be excluded without significant effort) in nature. Therefore, basic economics tells us that it will not, by itself, be supplied by the market. It has to be funded and maintained outside the market. Therefore, its design must include the manner of constitution as an operational entity, a basis of sustainable financing, the means of performing its functions effectively and efficiently and mechanisms of accountability.

3.3 The two classic solutions to the problem of funding the supply of public goods are taxation and the bundling of a public good with a private good. In the former case, the government may itself supply the public good or it may pay a private supplier for the supply of the public good. In the latter case, a market-based supplier may supply the public good (e.g., a port operates the adjacent lighthouse and covers its costs from port charges). There are pros and cons to the various modes of supply, depending on the specific circumstances. This section presents the options of government supply through public-private partnership as Plan A and the option of private supply as Plan B.

Plan A: Government supply of hazard warnings

3.4 All citizens, rich and poor, benefit from hazard warnings. Therefore, it is a classic candidate for financing through taxation. This does not necessarily require direct government supply. However, the principal-agent problem of ensuring that the private supplier (agent) faithfully executes the wishes of the government (principal) is quite difficult in the case of supplying hazard warnings, where spikes of intense action will interrupt long periods of inactivity. The costs of hazard warning are difficult to predict in advance and the quality of the warning activity is difficult to guarantee. The response to these problems is the internalization of the principal-agent problem, whereby the government directly supplies the service.[5] In addition, the consequences of warnings (e.g., unnecessary evacuations can have tremendous costs socially as well as individually) are such that citizens require them to be issued with the imprimatur of the state. Therefore, in most if not all countries, government directly supplies hazard warnings.

3.5 In well-governed countries, direct supply of hazard warnings by government works. Periodically, there may be concerns about quality and cost, but overall the government manages the internalized principal-agent problem and ensures that effective hazard warnings are produced by its employees. As evidenced by the total lack of warning experienced in Sri Lanka on December 26th, 2004, even when the Naval Base in Trincomalee experienced the tsunami effects more than 30 minutes prior to it hitting the western coastal belt,[6] Sri Lanka does not fall within the category of well-governed countries, at least with regard to disaster warnings. In the polite terminology of the international donor agencies, "the early warning . . .

[4] This section was authored by Rohan Samarajiva who takes full responsibility for its contents.

[5] It must be noted that this does not result in the principal-agent problem being eliminated; it simply converts it into a different form.

[6] See Annex 7: Timeline of events. In an interview with Ranjith Ananda Jayasinghe in the *Lankadeepa* (Sinhala daily) of 26 January 2005, Mr Lalith Weeratunge, Secretary to the Prime Minister and senior civil servant in charge of the immediate response to the tsunami, conceded that more could have been done with the information on the sea coming into shore on the East Coast.

system needs to be strengthened in the light of recent disaster experiences."[7] Experience with floods and other hazards further supports this conclusion.[8]

3.6 Therefore, a proposal that hazard warnings be directly supplied by the government of Sri Lanka would have to include design elements and safeguards to ensure high levels of performance on the lines of those adopted for regulatory agencies such as the Public Utilities Commission of Sri Lanka. This would include provisions for:

- the deployment of proper expertise and equipment,
- adequate levels of funding,
- insulation from day-to-day political interference, and
- transparency and accountability.

In short, the entity supplying the hazard warnings would have to constitute an island of good governance, separated from the ocean of poor governance that currently exists in Sri Lanka. The problem is, in fact, similar to the problem of creating and sustaining effective regulatory agencies.

3.6.1 **Access to Data:** An effective all-hazard warning center would require access to timely and accurate hazard data (e.g., readings from seismographs and tide gauges). In some cases, this would require the acquisition and maintenance of equipment by the center, including the periodic upgrading of the equipment as technology advances. In other cases, it would require the means to obtain hazard data from regional or international entities such as the World Meteorological Organization, namely the ability to enter into agreements with these entities and access to robust telecommunications links.

3.6.2 **Professionalism:** Most importantly, the warning center would require expert personnel who can interpret the data because in almost all cases the likelihood of a hazard is not perfectly foretold by the data; humans must exercise judgment on the basis of incomplete information in order to generate timely warnings. The essential requirements are adequate and predictable funding and the existence of an environment conducive to the exercise of professional judgment. In the case of Sri Lanka, this means the ability to pay the expert personnel at rates significantly higher than those of government employees, to procure equipment and services without undue delay, and a degree of insulation from the vagaries of budgetary allocations. Because differential compensation schemes create friction, it would also be necessary to insulate the organization from the rest of government. This necessitates an independent hazard warning agency.

3.6.3 **Funding:** If the funds do not come from the general budget and the Parliamentary appropriations process, they will have to come from some form of levy. It will be necessary to identify a few industries such as tourism and insurance that most directly benefit from the existence of a credible and effective National All-Hazards Warning System and to impose levies upon them for funding the supply of warnings.

3.6.4 **Independence:** Especially when the compensation levels are high and funds are less constrained, organizations attract the attentions of politicians and bureaucrats who wish to partake of the bounty. This tendency would have to be countered by a strong dike of independence against political and bureaucratic interference in hiring and in the day-to-day operations of the center. This would require a strong statute that requires the appointment of the key decision makers by the Constitutional Council, with very limited powers left to a Minister, if at all. Generally, it may be advisable to have a collegial decision making body, with a majority of members from the private and civil society sectors, for the overall functioning of the center. Warning-related functions should be delegated to a single person. It may also be useful to specify the qualifications of the

[7] Asian Development Bank, Japan Bank for International Cooperation and World Bank, Sri Lanka 2005 post-tsunami recovery program: Preliminary damage and needs assessment, Annex 15, paragraph 11 (February 2005).

[8] E.g., Champika Liyanaarachchi, "Disaster management: Preventive side nil," *Daily Mirror*, 21 May 2003. At: http://www.dailymirror.lk/2003/05/21/opinion/1.html

key decision makers in the statute itself and prescribe staggered appointments to ensure continuity and bipartisanship.

3.6.5 **Organizational Transparency and Accountability:** Freedom from political oversight and government rules may lead to abuse. Therefore, it is essential that the above freedoms be balanced by significant safeguards in terms of transparency and accountability. For example, it must be possible to remove the key decision makers for specified and proved misconduct. The financial and procurement activities of the Center must be more transparent than in a conventional government department. There must be significant accountability requirements, not only with regard to finances but also with regard to performance.

3.6.6 **Performance Accountability:** The question of performance accountability requires special attention. Hazard warnings are based on incomplete information and judgment. If the warnings are issued too hastily, considerable costs in terms of evacuations, looting, etc. will be incurred and the populace will resist responding to future warnings. If warnings are not issued in a timely manner, there can be massive losses to lives and property. In many societies, the final decisions on warnings and especially on evacuations are taken by political authorities, who can be held accountable through the ballot box. They, of course, take these decisions on the basis of independent and professional advice of experts. In the present circumstances of Sri Lanka, there would be little support for a politician making the final call. However, it is worth emphasizing that there is no easy method of holding an expert accountable for a lapse of judgment.

3.7 If Plan A is implemented and government supplies hazard warnings, it is important that adequate attention be paid to the internal organizational structure of this national all-hazards warning center. The Sri Lankan public service is for the most part poorly managed with archaic, hierarchical structures, lack of procedures and adherence to procedures (where they exist) and a high degree of caste-like segregation and mutual hostilities among different professions and levels, especially when they have to co-exist within one organization. It may be necessary to stipulate certain internal organizational design elements even in the enabling statute, for example requiring cross-functional task teams and the publication of procedures and manuals within set periods.

3.8 It is understood that successful supply of warnings with government involvement being limited to supply of national weather information and contribution to funding exists in Bangladesh. Here the Bangladesh Red Crescent Society operates a successful community-based cyclone warning system where the melding of nationally-obtained weather information and community awareness has resulted in a radical reduction of casualties. It is possible for such a model to be implemented in Sri Lanka, with some form of industry contributions replacing or complementing the government and charity components of the funding. It is likely that the government would still have to enact indemnifying legislation for this model to work.

Plan B: Non-governmental supply of warnings

3.9 The above discussion has demonstrated the necessity, but also the difficulties of ensuring the efficacy and efficiency, of a National All-Hazards Warning Center operated by government in Sri Lanka. The alternative is non-governmental supply. As the product of the warning system is a public good, this would require the bundling of warnings with a private good.

3.10 Given the insurance industry's obvious interest in reducing the loss of life, the limitation of injury and minimization of property losses, it is an obvious candidate to operate a National All-Hazards Warning System. Its incentive structures may cause the over supply of warnings, but this bias is likely to be corrected by the consequences of false warnings: lowered response rate from the public. The biggest flaw in assigning the operation of a National All-Hazards Warning System to the insurance industry is the very low percentage of Sri Lankans who are insured, even relative to countries such as India. The industry may hesitate, justifiably, from imposing the costs of supplying warnings that benefit the entire

population to a miniscule minority who insure themselves and their property. In this case, it may be necessary for other partners such as the tourism industry to join with the insurance industry to make the solution work.

3.11 In the event the private sector takes on the task of supplying nationwide, all-hazard warnings, the government may have to enable that activity by

- Allowing the private-sector entity to obtain hazard data from international and regional inter-governmental organizations such as the World Meteorological Organization and a future Indian Ocean Tsunami Warning Center.
- Enacting umbrella legislation that indemnifies the private-sector warning center for actions taken in good faith in the pursuance of its objectives will be necessary.

3.12 The tourism industry may take upon itself the responsibility of establishing a credible warning system for the benefit of its guests, employees and immediate neighbors funded through a levy or simply the bundling of "free" warning services with priced tourism services. It is unlikely that this will be an all-hazards system. A tourism-industry warning system is likely to focus on the particular hazards that threaten particular hotels. So, for example, the beach hotels may collaborate on cyclone and tsunami warnings, while those in the interior may focus on floods and landslides. Such a system will of course not have nationwide coverage.

3.13 It is to be emphasized that something is better than nothing. Given the difficulties and delays associated with getting legislation approved, let alone getting the right kind of warning center established, it would be unwise for the private sector, particularly the most significantly affected industries such as tourism and insurance, to do nothing. Localized and partial actions that reflect the ground realities of different industries can provide second or third best solutions while the government assembles an appropriate strategy and may even contribute to the design of an effective national system.

Key Points

- **Hazard warnings are a public good that will not be provided by the market. It has to be provided by government directly or indirectly, funded through taxation (Plan A) or by private entities who will bundle it with private goods (Plan B).**
- **Plan A: The government supplies or commissions the supply of warnings (Public-private partnership). The requirements for government provision of hazard warnings in Sri Lanka include sufficient measures and safeguards to ensure the deployment of the proper expertise and equipment, adequate levels of funding, insulation from day-to-day political interference, transparency and accountability**
- **Plan B: The supply of warnings is undertaken by the private sector. Industries that have a direct stake in timely and effective public warning, such as the Insurance and Tourism industries can be mobilized to provide this, with the support of the government in providing indemnifying legislation and authority to obtain national and international hazard data, for example.**
- **Until a nation-wide strategy is implemented, localized and partial efforts, that focus on hazards relevant to that particular industry/entity, can be implemented as a second or third-best solution**

Annexes

Annex 1: Input from Expert Consultation

January 26 2005, Taj Samudra, Colombo (3-7pm)

Comment/Suggestion and Source	Response	Explanation
Credibility		
Credibility must be built into institutions, to avoid false warnings, and to ensure that people take warnings seriously *Vajira Premawardhana* *Dr. S.P.F Senaratne, Consultant Anthropologist* *Dr. Buddhi Weerasinghe, Formerly with Asian Disaster Preparedness Centre*	***Accepted***	
Governance/leadership		
National hazard warning system should be provided entirely by the private sector: Private sector is capable and can be motivated through profits; Government is incapable of providing and lacks stronger motive than 'altruism' and should be excluded. At the most government can provide a legal umbrella under which non government actors can do the job. *Luxman Siriwardena, Director, External Relations –* LIRNE*asia*	***Partially accepted***	The government is the only entity that can and should take the ultimate responsibility of making the 'final call.' Private sector will not want to do this, and people may not see such an entity as an 'authoritative' source of warning. The mechanisms and functioning of the system can be taken on by private/civil sectors, but government must take ultimate responsibility.
System has to be resilient to government change. *Luxman Siriwardena, Director, External Relations –* LIRNE*asia*	***Accepted***	
Central authority is needed to issue warning in order to ensure credibility *Upali Mallawaarachchi Consultant engineer: ADB Projects Division, Road Development Authority*	***Accepted***	
System has to come from government, while appreciating the role of NGOs *Geethi Karunaratne, Consultant*	***Partially accepted***	System should be a partnership between the government *and* other public (including NGOs) and private entities
Need a good piece of legislation that cuts across all relevant subject areas affected by hazards *Dr. Buddhi Weerasinghe, Formerly with Asian Disaster Preparedness Centre*	***Outside the scope of present activity***	
Disaster warning system should be part of broader national disaster management organization; should be institutionalized; para-government organizations – like Securities and Exchange commission, responsible only to parliament, with the head (a professional) appointed by parliament. Final call responsibility should be on him. Disaster managing authority should be empowered to direct all resources in emergency *Vajira Premawardene*	***Partially accepted; some parts outside the scope***	

Disaster Management Bill (drafted in 2003) should be enacted and implemented. *Ramraj Narandram, D.R.M, UNDP*	***Not accepted***	Warning cannot be left to the government. System with public private partnerships is needed, ensuring independence from political idiosyncrasies, etc. State-centric system has failed once and will fail again.
Maintenance / Continuity		
System needs to be maintained once implemented; need mechanisms to ensure continual maintenance of the system at all times *Upali Mallawaarachchi Consultant engineer: ADB Projects Division, Road Development Authority* *M.C.M Farook, Assistant Director, TRCSL*	***Accepted***	
Regional / Global integration		
System must make use of existing regional and global warning systems. *Upali Mallawaarachchi Consultant engineer: ADB Projects Division, Road Development Authority*	***Accepted***	
Multi Hazard Approach		
System needs to be capable of handling all kinds of disasters: natural, man made (multi-hazard approach) *Hilru Siddeeque, Consultant/Director: Citigardens* *P.Karunaratne, Colombo Municipal Council*	***Accepted***	
Participation at all levels of society / by all stakeholders		
Warning system should be integrated throughout all levels of society – business sector *Chandra Jayaratne, Managing Director: Eagle Insurance*	***Accepted***	
Community needs to be integrated into the system *Upali Mallawaarachchi Consultant engineer: ADB Projects Division, Road Development Authority*	***Accepted***	
Need community based initiatives, as in Bangladesh cyclone warning system *Dr. Buddhi Weerasinghe, Formerly with Asian Disaster Preparedness Centre*	***Accepted***	
Make use of existing infrastructures and systems – church bells, mosques, etc *Sandya Salgado, CEO Ogilvy Outreach* *A.S Jayawardena, former Governor, Central Bank*	***Accepted***	
System has to be relevant to the population, otherwise it will fail Train those who have a stake in the community *Dr. Buddhi Weerasinghe, Former Asian Disaster Preparedness Centre*	***Accepted***	
Use what has worked best - community level mechanisms. Start from bottom and strengthen upwards. Technology that can be used by community must be adopted	***Accepted*** ***Accepted***	

Dr. Vinya Ariyaratne, Executive Director, Sarvodaya		
Public-private partnerships and cooperation with all sectors are important *E.S.Silva, Deputy Director, Department of Meteorology*	***Accepted***	
Certain stakeholder industries should be targeted, e.g. Insurance industry also has a role to play, influencing good practice in mitigation and preparation enforcing conditions on insurance seekers that will mitigate potential loss from hazards. Insurance industry can set up guidelines and benchmarks. Hotels can play role in education *Pradeep Fernando*	***Accepted***	
Hazards can be prioritized, based on statistical probability-- what the most likely disaster may be; this can be linked 'to whom'. Communities can be disaggregated. Prioritize education to the targeted areas. *Harsha de Silva, Senior Economist,* LIRNE*asia*	***Accepted***	
Education and Awareness Raising		
Education and awareness raising for people to understand and take appropriate action *Hilru Siddeeque, Consultant/Director: Citigardens*	***Accepted***	
Education has to be ensured at *all* levels of society *Upali Mallawaarachchi Consultant engineer: ADB Projects Division, Road Development Authority*	***Accepted***	
Education must be continuous *Sandya Salgado, CEO Ogilvy Outreach*	***Accepted***	
Culture and attitudes of people need to be changed *E.S.Silva, Deputy Director, Department of Meteorology*	***Accepted***	
Education must cover multiple hazards *Chanuka Wattegama, Researcher,* LIRNE*asia*	***Accepted***	
Education can be demand driven, if you focus on industries which have incentives to get involved in education initiatives. E.g. Hotel industry *Pradeep Fernando*	***Outside of scope***	
General; Approach		
Discussion of institutional model too early; first we need assessment of risk. We also need good piece of legislation that cuts across all affected areas *Dr. Buddhi Weerasinghe, formerly with Asian Disaster Preparedness Centre*	***Not accepted***	Action is needed immediately, while memories are still fresh, otherwise it will get shelved as in the past.
Cannot treat early warning as independent of disaster management; they must be integrated, or else the result will be 'reaction' rather than 'prevention.' Early warning should also be integrated with risk reduction. *Ramraj Narandram, D.R.M, UNDP*	***Not accepted***	It is recognized that early warning is but a single component in a risk management system; however the scope of this concept paper is warning only, because it is an accomplishable/ manageable component, in which the Vanguard/LIRNEasia collaboration has capacity and expertise. Where government is dysfunctional, small,

	workable areas must be carved out and fixed.
Existing Systems	
Mahaweli: hand-operated sirens for signaling flood water release were used in addition to loud speakers vehicles in instance of release of water from dam (Pologolla) *Chandra Perera, Executive Director, Mahaweli Authority of Sri Lanka*	
Real-time flood warning system in Sri Lanka existed, 20 years ago in Nilwala basin: fully automatic – when water levels went over a certain amount, a warning was issued; when a flood was imminent, a warning was issued to related organizations (GA's, Police stations, Irrigation Dept., etc) for them to take mitigation action. *Chinthaka Wijayaweera, Monitoring Officer: Irrigation Department* Need to take lessons from why that system was discontinued *N. Kamaladasa, Director, Center for Housing Planning and Building*	

Annex 2: Program of the Expert Consultation

Expert Consultation on National All Hazards Warning System (NAHWS) Vanguard Foundation-LIRNE*asia* Crystal Room (Lower), Taj Samudra January 26th , 2005			
	Time	**Description**	**Moderator/ speaker**
1	3.00 -3.00	Arrival of participants and Tea	
2	3.30 – 3.45 3.45 - 4.00 4.00 - 4.30	Welcome and introduction Opening Remarks • What lessons were learnt from 2004 Tsunami? Discussion	Lakshaman Bandaranayake A S Jayewardena Harsha de Silva
3	4.30-4.45 4.45 – 5.15	• What are the parameters of DWS? Discussion	Peter Anderson
4	5.15-5.30	Tea Break	
5	5.30-5.45 5.45- 6.15	• What governance and implementation models? Discussion	Malathy Knight-John
6	6.15-6.30	• What is the role of Communication Industry?	Rohan Samarajiva
7	6.30-6.50	• Open Forum	Chandra Jayaratne
8	6.50-7.00	• Summary and conclusion	Cathie Hickson

Annex 3: Qualifications of International Expert and Leader of Sri Lanka Team

(a) International Expert: Associate Professor Peter Anderson, Director, Telematics Research Lab, School of Communication, Simon Fraser University, Canada
(b) Leader of Sri Lanka Team: Professor Rohan Samarajiva, Executive Director, LIRNE*asia*, Sri Lanka

(a) Peter Anderson

1987 -1990	Development and implementation of the Emergency Preparedness Information Exchange (EPIX) - Canada's first national emergency planning computer bulletin board system. System utilized a personal computer that was accessible through a dial-up modem connection (sponsored by Emergency Preparedness Canada).
1990 - 1992	Design and implementation of the Australian Disaster Management Information Network (ADMIN), world's first fully distributed national disaster management computer information network (based on EPIX). Over a three year period, a network of bulletin board systems was constructed to interconnect 29 agencies from across Australia, including the key federal and state emergency management agencies. (Project was coordinated and implemented through Centre for International Research on Communication and Information Technologies, in conjunction with Australian counter-disaster agencies.
1993	Migration of original EPIX PC-based BBS to the Internet as a text-based "gopher" service. EPIX becomes world's first Internet-based disaster management information server and the primary portal for accessing all known sources of hazard and disaster information on the Internet at that time. Was utilized by the UN, international and national agencies as a catalyst for developing their own services.
1993 - 2003	Implementation at SFU of world's first Internet gateway to distribute internationally all disaster situation reports and appeals for assistance on behalf of the United Nations. Was the exclusive distribution system for first five years, and gradually became the back up system as UN took over this function. After 10 years of service, we officially switched off our server in 2003.
1993 - 1995	Study of the use of microcomputers and computer networks in emergency management. Research included a survey of Canadian local government emergency planners and emergency social services directors to determine current computer usage patterns and to identify support requirements for participation in the development of a new provincial emergency management information system.
1994	January 17 Northridge Earthquake, California. EPIX becomes the mirror (backup) site for California Governor's Office of Emergency Services for distributing near-real time State emergency information to response agencies and news media. Bulletins were posted and archived on the EPIX gopher server beginning with the first North Ridge Earthquake bulletin. System was used as an alternate site for other California incident information for three years following Northridge. One of the world's first examples of electronic mutual aid via the Internet.

1994	Evaluator of telecommunications needs and operations during CANATEX 2, a Canadian national emergency exercise to test the National Earthquake Support Plan for British Columbia and its interface with the British Columbia Earthquake Response Plan – with Doug Elliot, former network manager for B.C. Tel (commissioned by Industry Canada).
1995	Study of the requirements for an integrated national emergency management information system (commissioned by Emergency Preparedness Canada).
1995	Design, implementation and hosting of Internet sites at SFU for Emergency Preparedness Canada, Industry Canada-Emergency Telecommunications, and Transport Canada-Aviation Safety (Pacific Region). Canada's first federal emergency management Internet services.
1994-1995	Prototype design for the United Nations International Emergency Readiness, Response and Recovery Information System (IERRRIS) (in collaboration with United Nations Department of Humanitarian Affairs). Successor became known as ReliefWeb.
1995 -2003	Implementation and hosting of Internet sites at SFU for the United Nations International Decade for Natural Disaster Reduction (IDNR) and current successor International Strategy for Disaster Reduction (ISDR) programs.
1995-1998	Design, implementation and hosting of HazardNet, a United Nations International Decade for Natural Disaster Reduction Demonstration Project to enhance the timeliness, quality, quantity, specificity and accessibility of information for persons and organizations world-wide concerned with preventing, mitigating or preparing for large-scale natural and technological emergencies (in collaboration with the UN Environment Programme, U.S. National Weather Service and IDNDR). This was one of the world's first attempts to use World Wide Web attributes (including graphics) to integrate hazard and disaster management activities on an international level, especially for early warning.
1995 - present	Collaboration and hosting of British Columbia Provincial Emergency Program Web Site – estimated to have had up to 1.5 million hits per day during the height of Firestorm 2003 wildland-urban interface fires.
1995 1998	Design and implementation of SAFEGUARD NET, an Internet-based information system to support Safe Guard, a national public recognition program aimed at increasing public awareness of emergency preparedness in Canada. (on behalf of Emergency Preparedness Canada).
1995	Design and testing of the Virtual Emergency Management Information System (VEMIS). VEMIS is an experimental alternative backbone networking system comprising both wireline and wireless components to provide robust, fault tolerant fixed and mobile communications to enable emergency managers to participate in critical decision-making processes regardless of physical location. First phase entailed the design and construction of a 56 Kbps wireless Internet system in 1995 to provide alternative Internet access throughout the B.C. Lower Mainland. Out-of-region communication was available via satellite. This was one of the first wide area wireless Internet systems developed for emergency management. One of the goals was to eventually link all key Emergency Operations Centres in the Lower Mainland. The current phase entails rolling out a broadband wireless IP network, interconnected to our national high speed fibre network as well as a special satellite gateway at SFU (collaboration between

	SFU Telematics Research Lab, federal Communications Research Centre and Industry Canada).
1996	Evaluation of information services strategies for the Asian Disaster Preparedness Center, Thailand.
1996	Design, implementation and hosting at SFU of NATO-Civil Protection Committee Internet-based system to facilitate civil emergency planning and mutual assistance among NATO and Partnership for Peace countries (developed in partnership with Industry Canada, Emergency Preparedness Canada and the U.S. Federal Emergency Management Agency).
1997-2000	Member, Scientific and Technical Committee of UN International Decade for Natural Disaster Reduction. We were the main advisory committee to the UN Secretary General and General Assembly on disaster reduction strategies during this period.
1997	Facilitator and manager of federal Emergency Preparedness Canada Internet site and associated services in support of federal government assistance to Manitoba flood victims.
1998	Examination of emergency communications requirements of the British Columbia Provincial Emergency Program (commissioned by B.C. Provincial Emergency Program).
1998	Advisor to British Columbia Provincial Emergency Program on emergency telecommunications requirements during Salmon Arm Forest Fire evacuation.
1999	Advisor to British Columbia Provincial Emergency Program on emergency telecommunications requirements for 1999 provincial flood emergency preparations and response.
1999	Examination of emergency communications requirements of the British Columbia Ministry of Social Development and Economic Security (commissioned by the Ministry).
1999/00	Development of a mirror (backup) WWW site and HF packet radio email gateway for Emergency Preparedness Canada in support of national Y2K preparedness activities.
1999/00	Study of the use of cellular telephones within the Canadian emergency management community (commissioned by Emergency Preparedness Canada). Available at: http://www.ocipep.gc.ca/research/resactivites/CI/1999-D005_e.asp
2001	Enhancing Canadian emergency information exchange through development of new media applications, including Internet gateways to cellular/PCS and other wireless services (study commissioned by Emergency Preparedness Canada).
2001	Member of a small project team that developed the requirements for a new national public emergency information system in Singapore.
2002	B.C. spring floods – traveled throughout flood threatened or impacted regions of B.C. with digital camera equipment and wireless communications to document potential and real flood impacts and relay images to the B.C. Provincial Regional Emergency Operations Centres and the Provincial Emergency Coordination Centre.

2002-2004 Real-time Emergency Management via Satellite (REMSAT). Provision of assured emergency network access using satellite gateways, terrestrial wireless WANs and new hand-held terminal technology at disaster sites (collaboration between SFU Telematics Research Lab, Telesat Canada, BC Forest Services, Communications Research Centre, BC Ambulance Service, Canadian Space Agency and European Space Agency). SFU provided conceptual and technical design input for key features of the REMSAT system, especially hand held terminal units. Also, in conjunction with B.C. Provincial Emergency Program, assisted in the development of a new concept of operations for use in flood events.

2003 Firestorm 2003. As a member of the Advance Planning Unit at the Kamloops Provincial Regional Emergency Operations Centre, I was responsible for identifying all critical communications infrastructure at risk from forest fires in the Central Region and developing plans for protecting sites, assessing impacts from their loss, and developing and implementing plans for back up communications arrangements. One breakthrough was the development of an electronic mapping system to facilitate this work as well as apply it to other critical infrastructure areas such dangerous goods, oil and gas pipelines, bridges, reception centres, etc.

Other SFU support included hosting the PEP primary and backup websites, providing special emergency Internet accounts, equipment and a special satellite link for BC Forest Services.

2003-2004 Member, Greater Vancouver Joint Emergency Liaison Committee - Emergency Telecommunications Sub-committee that is charged with researching and making recommendations for a next-generation wireless system to facilitate inter-municipal emergency communications in the Greater Vancouver Region.

2003-2004 Assessment of the B.C. Tsunami Warning System and Related Risk Reduction Practices. This study is intended to provide a baseline assessment of the B.C. tsunami warning system and related risk reduction practices (particularly as they affect rural and remote regions) along with recommendations for further enhancements in light of changing coastal social and economic conditions that now include expanded tourism (especially cruise ships and eco-tourism), aquiculture and possibly offshore oil and gas exploration in the next decade. (funded by Office of Critical Infrastructure Protection and Emergency Preparedness Canada and available at: http://www.ocipep.gc.ca/research/resactivites/CI/2003-D001_e.asp).

2004 Advanced Mobile Emergency Communications Prototype Project (AMEC). A specialized vehicle capable of rapidly deploying advanced communications throughout regions of British Columbia accessible by road. It is equipped with a range of facilities including terrestrial radio and satellite communications, telephone, video, Internet and other systems to enable the vehicle to become a field relay or gateway for critical communications from any location that the vehicle can access - in rural as well as urban areas. This prototype is one of the most advanced in Canada and is intended to serve the needs of British Columbia. The project is funded through a special grant from Western Economic Development Canada, with additional support from Industry Canada's Communications Research Centre, Canada Foundation for Innovation and SFU's Telematics Research Lab. Other collaborators and/or sponsors include the BC Provincial Emergency Program, Infosat, Mitel Corporation, Ralph's Radio and Mobile Satellite Ventures.

AMEC was successfully deployed for the first time at Boston Bar fires in August to support PEP and Office of the Fire Commissioner.

2003-2004 Developing Internet access points for North Shore Rescue. We are creating a series of wireless Internet access hot spots at the strategic locations along the West and North Vancouver mountains and canyons from where North Shore Rescue stages its search and rescue operations. These arrangements enable the Rescue Communications vehicle to have instant Internet access upon arrival.

Other areas of support

Amateur and Search and Rescue Radio

- We host radio repeater sites and Internet gateways for Burnaby Amateur Radio Club and the key Vancouver area amateur television and packet radio clubs.
- We also host a repeater site for North Shore Rescue to help extend radio coverage in the Seymour Mountain and Indian Arm regions for SAR operations.

Web Hosting

Over the years, we have helped in the development and hosting of Internet sites for many local and regional organizations including:

- Emergency Preparedness for Industry and Commerce Committee (EPICC)
- Emergency Planners and Managers Association of BC (EPMA)
- Vancouver Emergency Preparedness Conference
- Emergency Social Services Association (ESSA)
- British Columbia Amateur Radio Coordination Council (BCARCC)
- SAR Info (for search and rescue interests).

With the exception of a few sites, we have supported almost all of these activities through our own research funding initiatives.

Related Teaching and Graduate Studies

- I teach a popular 4th year undergraduate course entitled, “Communication to Mitigate Disasters” that introduces soon-to-be-graduating students to contemporary emergency management concepts and practices – Over 500 students have taken this course. I also supervise graduate students at SFU and other universities in this field.

- Creation of scholarship fund to support graduate studies in this field - in conjunction with the Vancouver Emergency Preparedness Conference

Academic and Professional Research

- One of the many benefits of pursuing these activities from an academic perspective is the opportunity to promote socially important interdisciplinary research and cross-professional interaction. Most of the activities described above are applied research projects that embody these features. I continue to participate in a number of interdisciplinary academic research programs and publish in both professional and academic journals and books. I have been an invited speaker at many local, national and international conferences and workshops. International appearances have included

events in the U.S., Australia, Thailand, China, Singapore, Chile, Estonia, and Western Europe. Through the Telematics Research Lab and personal endeavours, we have also been very successful in attracting research funding that exceeds $3 million in the past decade

- **(b) Rohan Samarajiva**

- Participated in emergency broadcasts issuing warnings re the two cyclones of 1978 by the Sri Lanka Broadcasting Corporation, 1978.

- Organized an ICTs and disaster warning workshop for the Arthur C. Clarke Centre for Modern Technologies, 1986.

- Represented Sri Lanka at the Tampere Intergovernmental Conference on Emergency Telecommunications in Tampere, Finland, May 1998.

- Chaired ad hoc committee to resolve contentious language on the draft convention and succeeded in achieving a solution acceptable to all parties leading to adoption of the Tampere Convention on the Provision of Telecommunication Resources for Disaster Mitigation and Relief Operations, May 1998.

- Initiated and supervised the participatory process leading to the *Final Report of the Pilot Study on the Use of Telecommunications in Disaster and Emergency Situations in Sri Lanka*, January 1999.

- Contributed to the submission of the Cabinet Paper the led to decision to ratify the Tampere Convention on the Provision of Telecommunication Resources for Disaster Mitigation and Relief Operations and to assign disaster telecom responsibilities to the Telecom Regulatory Commission, 1999.

- Samarajiva, R. (2001). Disaster preparedness and recovery: A priority for telecom regulatory agencies in liberalized environments. *International Journal of Regulation and Governance*, 1(2): 1-16; also in *Proceedings of the Policy and Development Summit, ITU Telecom Africa 2001*. Johannesburg, December 2001. http://www.itu.int/TELECOM/aft2001/cfp/auth/4858/pap_4858.pdf

- Srivastava, L. and R. Samarajiva (2003), Regulatory design for disaster preparedness and recovery by infrastructure providers: South Asian experience, in *Critical infrastructures: State of the art in research and application*, eds. W. A. H. Thissen & P. M. Herder, pp. 103-120. Boston: Kluwer Academic Publishers.

- Samarajiva, R. "What happened in Sri Lanka and why it won't be so bad next time," presentation at closing plenary of Pacific Telecom Council conference, Honolulu, Hawai'i, 19th January 2005.

Annex 4: Newspaper advertisement inviting participants for Expert Consultation

Appeared in Sunday Times, January 22nd 2005

Vanguard Foundation

LIRNEasia
Learning Initiatives on Reforms for Network Economies

Warning System Expert Consultation

Vanguard foundation and LIRNE*asia* will conduct an "Expert Consultation" on 26th January, 2005 as part of the process of developing a concept paper and specifications for a Disaster Warning System with adequate regional and global linkages.

We earnestly request those who have expertise in the areas of Disaster Management to take part in this exercise.

Peter Anderson, an internationally recognized authority in disaster management, will be involved in facilitating the consultation process.

Associate Professor Peter Anderson is the Director of Telematics Research Lab and Associate Director of the Centre for Policy Research on Science and Technology at Simon Fraser University in Canada. He has extensive experience in disaster management related disciplines. He served on the Scientific and Technical Committee of the UN International Decade for Natural Disaster Reduction. In 2003/04 he conducted an assessment of the British Columbia Tsunami Warning System and Related Risk Reduction Practices. This study is intended to provide a baseline assessment of the B.C. tsunami warning system and related risk reduction practices.

The areas of discussions of the expert consultation session would include;

- What lessons were learnt from 2004 Tsunami?
- What are the parameters of a Disaster Warning System appropriate for Sri Lanka?
- What governance and implementation models?
- What is the role of Communication Industry?

We earnestly request those who have expertise in the disciplines relating to Disaster Management to take part at the this forum and contribute towards developing a concept paper on a national Disaster Warning System and specifications, which we intend to submit to the Government of Sri Lanka in February.

We earnestly request those who have expertise in the disciplines relating to Disaster Management to take part at the this forum and contribute towards developing a concept paper on a national Disaster Warning System and specifications, which we intend to submit to the Government of Sri Lanka in February.

Please send in details of your professional and academic background together with your contact details and how you could contribute towards the expert consultation.

email: vindhyap@vanguardlanka.com
Fax: 4614 376

(Sgd.) Lakshaman Bandaranayke
Executive Director
Vanguard Foundation
(Under incorporation)

(Sgd.) Rohan Samarajiva
Executive Director
LIRNEasia

Vanguard Foundation (under incorporation): Vanguard Management Services (Pvt) Limited, floated Vanguard Foundation (www.vanguardfoundationlanka.org), to conceptualize and implement its corporate efforts in the areas of disaster relief, rehabilitation and preparedness. The Vanguard Foundation would promote activities, policies, and market based initiatives that would improve national disaster preparedness, mitigation strategies, and the flow of expertise to meet and deal with a wide variety of national disasters.

LIRNE*asia*
LIRNE*asia*, a regional ICT policy and regulation capacity building organization, incorporated as a non-profit organization under section 21 of the Companies Act , No. 17 of 1982 in 2004 and funded at present by the International Development Research Center of Canada and infoDev, a unit of the World Bank. The organization is physically located in Colombo but works throughout the Asian Region. Its primary functions are research, training and informed intervention in policy and regulatory proceedings. Its current projects include research in India, Nepal, Bangladesh and Indonesia. More information: www.lirneasia.net

Annex 5: A Framework for Setting-Up a Disaster Warning System for Sri Lanka

Written input provided by Vajira Premawardhana, a participant at the Expert Consultation.

Introduction

There are a number of factors that has to be considered in preparing a framework for an appropriate Disaster Warning System (DWS) for Sri Lanka. Some of the main factors are as follows.

- Relative awareness and prior knowledge level of the population: *Can the population identify a possible disaster and respond fast?*

- Conceptual framework of the DWS
  - Organization structure ; *how to institutionalize the DWS*
  - Accountability structure ; *the degree of accountability of the institutionalized DWS*
  - Reporting structure; *to where / whom does the DWS report?*

- Physical infrastructure of the DWS; *data gathering points, data analysis and processing points, warning dissemination points, interconnections and relevant ICT.*

- Inputs and outputs
  - Sourcing of inputs; *from all over the country? World? Global networks?*
  - Dissemination of the output i.e. the warning. ; *When and how to issue a warning*

- Appropriateness of the disasters that are monitored.
  - What should we monitor? ; *Weather, diseases, terrorist activity?*

- Communication strategy
  - How do you communicate a warning to the public? ; *Through mass media? What would be the role of the state machinery, military, police, civilian organizations?*

- Financial limitations – availability of funding or the lack of It.; *who would fund DWS? Government, UN, private sector?*

- Disaster Management Strategy
  - After the warning what next? ; *Evacuations, settlements for displaced people, prevention of diseases?*

The rest of this document is an attempt at creating a basic framework for a DWS based on some of the lessons learnt after the tsunami. I have viewed the DWS from the perspective of a broader, institutionalized Disaster Management Strategy.

1. **What Lessons were Learnt from 2004 Tsunami?**

From many lessons that we learnt from the 2004 tsunami I believe that the following would be pertinent in relation to a DWS.

a. Lack of Preparedness to Face a Disaster

2004 tsunami highlighted that Sri Lanka was ill prepared to face a disaster, despite the fact that natural disasters such as floods and cyclones are a common occurrence in this country. The non-existence of proper and dedicated administration machinery for disaster management heightened the plight of the victims.

b. Low Level of Awareness and Prior Knowledge Among Sri Lankans About Potential Natural Disasters

There is a low level of awareness and prior knowledge among the general public about potential natural disasters and their possible destructive repercussions. For example a majority of Sri Lankans learnt about tsunamis only after 26th December 2004.

c. Delay in Reaction Time Due to Lack of Credibility in Information

The response/reaction by a majority of the general public to warnings of possible natural disasters is lethargic. This is due to Sri Lankans being not used to receiving reliable information or timely warnings about impending natural disasters in the past.

For example there is a common perception among the people that the weather report provided by the state meteorological department is inaccurate and hence cannot be relied upon. This has resulted in the general public usually not believing (weather) warnings issued by the met department.

d. Disasters Could be in the Form of Hitherto Unfamiliar Phenomena.

A disaster can take place due to phenomena hitherto unfamiliar to Sri Lankans. The most common occurrences such as floods or cyclones are easy to understand. However, a tsunami was a totally alien phenomenon to Sri Lankans, and hence most people were at a loss to understand what happened. Hence it would be essential to educate / enhance awareness about possible triggers of disasters and how to face/cope with such events.

For example, phenomena such as earthquakes, tornados, volcanic activity, rapidly propagating diseases or radiation hazards are alien to Sri Lankans. Sri Lankans must be educated on the potential threats posed by such occurrences.

2. **Parameters of a Disaster Warning System (DWS) Appropriate for Sri Lanka and a Proposed Governance and Implementation Model.**

The 2004 tsunami underscored the importance of having a credible, efficient and effective DWS in Sri Lanka. I have identified the following parameters and elements of a governance and an implementation model for a DWS appropriate for Sri Lanka.

a. It is of utmost importance that the Sri Lankans believe in the warnings issued by the DWS, to minimize the damage of a disaster. Hence the ***DWS must disseminate credible, timely information*** that would help minimize

damages. Every effort must be taken to ***ensure credibility and timeliness of information.***

b. DWS must be part of a much larger ***para-government organization*** (let's call it National Disaster Management Authority (NDA)) that would be administered without political influences. Hence, I believe that it should be molded on the lines of organizations such as Department of Elections or Securities and Exchange Commission of Sri Lanka and ***be given legislative authority to operate independent of a government minister***. ***The head of the NDA would be appointed by the Parliament and should report only to the Parliament.***

c. DWS must be set up to ***monitor all potential threats to the population of the country from natural causes*** (including biological causes). Qualified, experienced and dedicated personnel, who are exceptionally well remunerated, should staff DWS.

d. ***DWS must integrate itself*** with similar such global entities/networks to share and obtain necessary information.

e. ***DWS and NDA should be adequately empowered through legislative means to direct all necessary resources*** (such as media, military and civilian action groups) in the event of a potential disaster to minimize the damage.

f. ***DWS and NDA should be funded adequately by the Government*** (perhaps through an exclusive tax).

3. Role of the Communication Industry

The role of the communications industry could be viewed from two major angles.

a. Facilitation of obtaining primary data for the purpose of detecting a disaster.

b. Facilitating the dissemination of reliable, timely disaster warnings to the population.

Further, if one may take a broader perspective and look at the role of the ICT Industry, following points would become relevant.

c. Creating and maintaining a comprehensive database for the DWS and NDA.

d. Constructing models for data analysis and interpretation.

4. Conclusion

This brief note was an attempt at highlighting a few salient points pertaining to a DWS appropriate for Sri Lanka.

What would be really important is to set-up and implement a DWS (and in a broader sense, a NDA) that would benefit all Sri Lankans in the future. The important task should be to put the concept paper in to action and ensure the future safety of all of us.

Annex 6: Warning System – Issues

Written input provided by *Nishantha Kamaladasa, Director, Centre for Housing Planning and Building,* a participant at the Expert Forum

Governance

It may not be necessary to have a centralized warning system installed for all disasters. Met Dept could give warning about an impending cyclone (which they did quite well in the last cyclone as mentioned by Rohan), while the Irrigation Department could do so with floods, as it is done right now. NBRO could be entrusted the same with landslides and probably you may need to treat Tsunami separately. The point here it is that a single institutional mechanism may not be applicable to all disaster situations and also that those which could be of local in nature, need to have local mechanisms.

Hence it is suggested that each disaster situation be taken separately and under each disaster, separate mechanisms be created to detect the disaster, decide the vulnerability and disseminate the warning (Peterson's stages).

Sustenance

Any external solution imposed on someone will not stay, unless the solution has the blessings of the implementers. Hence it would be necessary that institutions that are likely to implement the warning system made a party in formulating the proposal.

For this to happen, you might need to consider appointing sub-committee for each disaster and get representation from organizations that are likely to get involve in the early warning system, in preparing the solution, for each disaster separately.

Associated operations

Early warning requires mobilizing certain other sections in to the area while removing vulnerable people. For example, police and army might have to be moved to the area to combat looting, etc., Rescue workers to help evacuation, etc. Hence warning system to work has to address other than vulnerable groups with an agenda of action.

Set of values

It would be necessary that a set of values be adhered by the people who get involve in disaster warnings, such as

1. Protecting life would be the primary concern and all other concerns (political, status, ownership, etc.) are secondary
2. Selfless commitment in discharging the duties
3. Etc and etc.

It would be necessary to agree on the set of values necessary by a team or you may even call for such through your web.

Indemnity

It is also necessary that people involve in the warning system can exercise their duty without having to face consequences later (law suits, etc.). Legislation needs to be formulated.

Apart from legal indemnity there should also be certain ethical protection from media and other pressure groups in the event of forecast become wrong so that the credibility of the warning system is not tarnished, unnecessarily.

Authority, Resources and facilities

The staff should also be provided with adequate resources to make them self sufficient in their operations (necessary equipments, finances, support staff, etc), access to the echelons of power, authority to decide and act, etc. and etc.

Though these sounds too obvious these are serious constraints that prevent officers from taking timely action, especially within the bureaucracy.

Annex 7: Timeline of events, 26 December 2004

From Lanka Business Online, based on a timeline developed by Rohan Samarajiva, Anuradha Samarajiva and Subhanu Samarajiva on January 2-3, 2005. All times were taken from the listed sources. Subsequent information shows some time were inexact: for example, it is now accepted that Kalmunai was hit at 0836 hrs, not at 0827 hrs.

--All times provisional--

Timeline to disaster.

First Hour

SL TIME	EVENT	DISTRICT	NUMBER DEAD	SOURCE
6:59	Large earthquake strikes off the tip of Sumatra, Indonesia			NYT multimedia
7:05	Tremors experienced in some parts of the country			Sunday Times, Jan 02, 2005,
7:06	Pallekele Seismological Station relays data of seaquake from seismometer to GSMB in Colombo			Sunday Times, Jan 02, 2005,
7:10	GSMB director feels tremor and alerts staff			Sunday Times, Jan 02, 2005,
7:14	Pacific Tsunami Warning Center (PTWC) issues bulletin about earthquake, estimates magnitude 8.0			Pacific Tsunami Warning Center
7:58	Agence France-Presse reports earthquake (not tsunami)			NYT multimedia

Second Hour

8:04	PTWC revises magnitude to 8.5, mentions potential for local tsunami			NYT multimedia
8:27	Kalmunai hit	Ampara	10436	Sunday Times, Jan 02, 2005,
8:30	Kattankudy, East coast Sri Lanka flooded by 9 feet of water			Tamil Net *Note: LTTE time 8:00am*
8:30	PTWC contacts Australia Emergency Management, already aware of earthquake			NYT multimedia

8:40	Batticaloa hit	Batticaloa	2254	Sunday Times, Jan 02, 2005,
8:52	Yala hit			Sunday Times, Jan 02, 2005,
8:55	Mullaitivu hit	Mullaitivu	2000	Sunday Times, Jan 02, 2005,
8:55	Trincomalee hit	Trincomalee	947	Sunday Times, Jan 02, 2005,
8:57	News agency report - earthquake sets off big waves on coast			NYT multimedia

Hour Three

9:00	AFP correspondent in Colombo gets first call from Trinco re: sea coming in			AFP correspondent
9:00	Velvettiturai hit	Jaffna	2640	Sunday Times, Jan 02, 2005,
9:00	Hambantota hit	Hambantota	4500	Sunday Times, Jan 02, 2005,
9:15	Washington Post correspondent reports tsunami hitting Weligama			Washingtonpost
9:15	Matara hit	Matara	1061	Sunday Times, Jan 02, 2005,
9:15	Galle hit	Galle	3724	Sunday Times, Jan 02, 2005,
9:15	Panadura hit?			Sunday Times, Jan 02, 2005,
9:20	News agency report - houses swept away in coastal regions of Aceh province, Indonesia			www.ukssc.org.uk
9:20	Kalutara hit	Kalutara	213	Sunday Times, Jan 02, 2005,
9:30	AFP correspondent in Colombo gets second call from Matara re: sea coming in			AFP correspondent

9:30	PTWC scientists see wire reports on Internet about Sri Lankan casualties			NYT multimedia
9:30	Negombo hit	Gampaha	7	Sunday Times, Jan 02, 2005,
9:34	1st Lankan news report - tidal wave hit Sri Lanka's coastal region, putting areas under water			Lanka Business Online
9:41	News agency report - flash flood hit Banda Aceh city and receded, origin of water unknown			NYT multimedia
9:46	AFP report - thousands displaced as massive tidal waves hit Sri Lanka			AFP correspondent

Hour Four

10:00	American Ambassador in Sri Lanka calls PTWC for notification of aftershocks			NYT multimedia
10:00	Waves hit Unawatuna, according to an eyewitness journalist			BBC South Asia
10:00	GSMB director receives confirmation of tsunami hitting Sri Lanka from US Geological Survey Bureau			Sunday Times, Jan 02, 2005,
10:06	News agency report - mild tremors on India's east coast, no reports of damage or death			NYT multimedia
10:13	News report - 500 feared dead in East and South coast of Sri Lanka			Tamil Net
10:27	News agency report - local police say it is not yet known if Indonesian earthquake and waves in Sri Lanka are related			NYT multimedia

Fifth Hour

11:25	Harvard University seismology department estimates earthquake magnitude at 8.9			NYT multimedia
11:39	News agency report - earthquake rocks Southeast Asia, setting off tsunamis that killed more than 150 in Sri Lanka, sent residents rushing to higher ground in Indonesia and washed into the Indian city of Madras and the Thai resort island of Phuket			NYT multimedia

Sixth Hour - Noon

12:00	PTWC advises US Pacific Command in Hawaii of potential for more tsunami impacts in western Indian Ocean			NYT multimedia
12:13	News agency report - Sri Lanka deploys military and asks India for help. Trincomalee submerged under several feet of water			NYT multimedia
12:42	News agency report - Thai PM orders evacuation of tsunami-hit area in three provinces, including tourist island Phuket			NYT multimedia
12:53	bbc.co.uk carries its first tsunami story			BBC South Asia

Seventh Hour - Afternoon

13:09	News agency report - Male', capital of Maldives is flooded			NYT multimedia
13:57	News agency report - Penang Island, Malaysia hit by tsunami. Six people dead			NYT multimedia
14:15	PTWC speaks with US State Department, advises of potential threat to Madagascar and Africa			NYT multimedia

Note - NYT Multimedia refers to: New York Times Online Multimedia Feature “A Disaster Unfolds” January 1, 2005 - NYT Multimedia

Note - time conversions found using online converter: http://www.timezoneconverter.com

	physical and scientific events
	events reported in media
	media events

Available at
http://www.lankabusinessonline.com/new_full_story.php?subcatcode=1&subcatname=&newscode=1259259104