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## Synthesis

Every year, millions of people face disaster and its terrifying consequences. An emergency situation is any unexpected crisis that could cause serious injury or death, or seriously damage infrastructure. It can strike anytime, anywhere in any form – a tsunami, a hurricane, an earthquake, a tornado, a flood, a fire, an act of nature, or an act of terrorism. It builds over days or weeks; or hits suddenly, without warning.

Disasters, both natural and man-made alike, often led to high death tolls, environmental destruction, communication breakdown, and civilian displacement. In crisis situations, people are often left without food, shelter, or healthcare services.

Rescue operations need to be carried out to help alleviate human suffering and save lives, empower the victims and their next of kin and better enable them to help themselves. Successful rescue operations – whether small or large scale – require effective communication and coordination. However, disaster situations often result in the loss of traditional communication systems. Infrastructure may be seriously damaged or completely destroyed. Fixed telephone, mobile communications, and local Internet access may be rendered unusable.

Hence a reliable communication system becomes the most important challenge in responding to both natural and man-made disasters. An alternate communication network should be available and accessible immediately during a disaster to support the rescue and recovery activities.

It has become necessary to explore suitable communication technologies that could be set up immediately and used in emergencies. Local operators and other civilians should be adequately trained. This technology, and training should be open and easily accessible to everyone. A higher percentage of operators will ensure that someone will be able to operate the system in the event of an emergency.

DUMBO (Digital Ubiquitous Broadband OLSR) – “Wireless 'DUMBO'” is an emergency communication system that turns ordinary laptops/ PDAs into life-saving network devices without relying on any fixed infrastructure and gives a platform for effective rescue and recovery operations.

The motivation behind DUMBO’s development arose during the 2004 post-tsunami period. DUMBO, one of interERLab’s prominent research projects, was jointly undertaken by the Internet Research and Education Laboratory of AIT (Thailand), the HIPERCOM Project of INRIA (France) and the WIDE Project (Japan). Project DUMBO deploys mobile wireless networks on an ad hoc basis for emergency conditions; when a fixed network infrastructure is not available or has been destroyed.



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The aim of the project “Emergency Networks Training and Tools Kit” is to develop an easily manageable emergency communication system. This would also require a training manual that anyone who with very limited technological knowledge could understand. In particular, the target audience of the training manual is experienced in post-disaster recovery and resettlement operations. To serve this purpose, we aim to make the DUMBO system more easily manageable, so that non-technical people can participate in developing their own communication network out of the box in an emergency situation following few simple steps.

The research findings and training components will mostly benefit the Internet community at large, thus enabling the project to progress for further research and conduct DUMBO “Train-the-Trainers” programs for thousands of people to enhance community-based disaster recovery preparedness.



Photos: Equipment is ready to work. (Netbook, Mobile Router, Wireless Access point-Clockwise)



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Part of this project has been to organize wireless emergency communication technology training. The training began with an overview of how the community can respond to emergencies and then covered specialized training for search and rescue operations, damage assessment, and resettlement activities. Upon completion, the trainees should possess the necessary skills to take part in emergency preparedness and response in remote disaster areas.

If a community wants to further enhance its response capacity after a disaster, civilians can volunteer for auxiliary training. These auxiliary groups may include neighborhood, business, or government teams to provide immediate assistance to victims in their area. These teams will be able to organize spontaneous volunteers who have not had the training and collect disaster intelligence that will assist professional responders with prioritization and allocation of resources following a disaster.

## Objectives

The project objectives can be summarized as:

- Address infrastructure and technology-related connectivity problems
  - Introduce mobile ad hoc wireless communication network;
- Educate the community to make this platform accessible as an open source;
- Create a website to disseminate information on how to build and deploy a DUMBO system;
- Develop an out-of-box tools package (software), reference guide/manuals, training materials, and case study; and
- Identify and manage the relationships with local technical personnel
  - Assist local training partners in delivering training courses to volunteers or field operators

## Development Problem

Project DUMBO deploys mobile wireless network on an ad hoc basis for emergency conditions, such as after a natural disaster when a fixed network infrastructure is not available or had been destroyed.

DUMBO allows streaming video, VoIP and short messages to be simultaneously transmitted from a number of mobile laptops to the central command center, or to the other rescuers at the same or different disaster sites. The DUMBO command center has a face recognition module that identifies potential matches between unknown victims' face photos taken from the field and a collection of known face images stored at the command center. In addition, sensors can be deployed to measure such environmental data as temperature and humidity. Data from the sensors can be sent to the command



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center which analyzes or passes it on to the other mobile nodes. The command center can flexibly be located either in the disaster areas or anywhere with Internet access.

The main focus is on providing technical assistance and ad-hoc communication infrastructure to volunteers when aiding victims and performing rescue operations in disaster situations. Effective Communication medium/ services may not be able to meet overwhelming immediate needs during a disaster.

Emergency network is a network which can be deployed in any emergency situation such as for rescue operations after an occurrence of a natural disaster. It does not rely on fixed telecommunication infrastructure hence can be set up within a relatively short period of time and with little effort. The network should sufficiently serve the demand of rescue operation and the disaster recovery communications. A mesh network is reliable and offers redundancy.

DUMBO training begins with an overview of how the community can respond to emergencies and then moves onto specialized training for search and rescue operations, damage assessment, and resettlement activities. After the training, the volunteers and rescue operators can possess the skills necessary to be part of emergency preparedness and response in technologically challenged disaster areas.

The DUMBO training enables the disaster responders to be better prepared to respond to and cope with the aftermath of a disaster. Additionally, if a community wants to supplement its response capability after a disaster, civilians can be recruited and trained as neighborhood, business, and government teams that, in essence, will be auxiliary responders. These groups can provide immediate assistance to victims in their area, organize spontaneous volunteers who have not had the training, and collect disaster intelligence that will assist professional responders with prioritization and allocation of resources following a disaster.

The project aimed to develop an easily manageable communication network for community use. This network must be simple enough for people with non-technical backgrounds to understand and operate efficiently, but the target audience is experienced in disaster recovery and rescue.

## Project Process

We have completed the following activities during the last 12 months:

1. Experimented with the wireless ad hoc technologies to find solutions to post disaster communications issues. We have come up with some possibilities—some relying on infrastructure, some not—as well as some associated



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organizations that have been using these technologies or provide the respective services. We categorized the technologies into three classes: short, medium, and long-range networks.

Existing infrastructure networks include: Cellular, PSTN network, or WiMAX; Community, Trunked, or Citizen Band radio; and Satellite Communications, Mobile Ad Hoc Network, Sahana etc.

If the infrastructure technologies are available, they can aid rescue and recovery operations. If any networks are damaged they can be repaired, but in the event that all communications networks are unavailable or seriously damaged, alternative technologies can be deployed depending on the requirements. Each option has been described briefly in the following table, to give users an easy reference to emergency communications deployment.

Tool	Service/s	Fixed or portable?	Connectivity to the Internet?	Range of Coverage	Uses of the service	Carrier technology
<b>PSTN/Fixed Landline phone</b>	Voice	Fixed	Yes	Long range technology (Few kilometers to Hundreds of kilometers)	Voice communication	PSTN
	Internet/ email				Web browsing, sending SMS via web, email, chat, Skype etc (Internet based services)	PSTN
	Fax				Sending documents	PSTN
	Voice				Voice communication	PSTN
<b>Mobile phone</b>	Voice	portable	Yes	Long range technology (Few kilometers to Hundreds of kilometers)	Direct communication, i.e. to local communities within range.	Cellular network
	data – SMS				as above	Cellular Network
	data - Digital pictures				instant transfer of images	MMS via Cellular network



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	data – Internet services				Internet based services	GPRS or EDGE or 3G (via cellular network)
Satellite phones	Voice	portable	Yes	Long range technology (Few kilometers to Hundreds of kilometers)	(Voice) communication in extremely remote places or others not served by cellular Network or landline infrastructure	Satellite
	data – SMS					
	data – Internet services				Internet based Communication services	Satellite
CB radio	Voice	portable	No	Few kilometers	Low-cost voice communication over distance	Typically unlicensed Radio Frequency
Community Radio	Voice	portable	Yes	Few Kilometers	Broadcast reception or two way interaction.	Licensed Radio Frequency or Cellular Network/ PSTN
	Data-SMS				Individual Communication	Cellular Network/ PSTN
	Data-Video				Broadcast Video reception	Cable television Network
	Data-Internet Data				Internet based services	Long Distance WiFi
TETRA	Data-Voice	Portable	Yes	Can be extended form few kilometers to few hundred kilometers	Individual and group Communication	Licensed Radio Frequency
	Data-Internet Data				Internet Based services	PSTN, Satellite, WiMAX,



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						WLAN, 3G or any other Data Network.
<b>MANET</b>	Data-Voice, video	Portable	Yes	Can be extended form few hundred meters to few kilometers	Individual and group Communication	MANET
	Data-Internet Data				Internet Based services	Satellite, WiMAX, WLAN etc.
<b>DUMBO</b>	Data-Voice, Video	Portable	Yes	Can be extended form few hundred meters to few kilometers	Individual and group Communication	MANET
	Data-Text				Individual and group Chat	MANET
	Data-Video				Individual and group Video Communication	MANET
	Data-Internet Data				Internet Based services	Satellite, WiMAX, WLAN, 3G etc.
<b>WiMAX</b>	Data-Internet Data	Portable	Yes	1-20 Kilometers	Internet Based services	WiMAX (Licensed Radio Frequency)
<b>WiFi</b>	Data-Internet Data	Portable	Yes	Medium Range Technology (100-200 Meters)	Internet Based Services	Unlicensed Radio Frequency
<b>Bluetooth</b>	Data	Portable	No	Short Range Technology (1-100 Meters)	Exchange data among fixed and mobile devices	Unlicensed Radio Frequency

2. The out-of-box tools package, including software and training manual, for DUMBO networks are ready for use and are available on the website. DUMBO employs the mobile ad hoc network (MANET) principle and is effective for multimedia communication services including voice, video, and text messaging.



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The DUMBO system can be divided into two components:

- a. Hardware Components
  - Wireless Coverage devices (Powerstation2/Nanostation2)
  - Terminal nodes (Netbook/PDA/ Laptop)
  - Tunnel server
  - Gateway
  - Layer 2 Switch
  - Wireless Card
  - Webcam
  - GPS Device
- b. Software Components
  - Easy Disaster Communication (EasyDC)
  - GPS Location Service
  - Link monitoring System

The terminal nodes form a MANET and run the software components, and the wireless devices extend the coverage . Gateway connects the MANET to the Internet. The EasyDC application provides multimedia communication facilities, and GPS Location Service plots the position of each node in the network. The link monitoring system gives information about availability and quality of links.

Some critical features such as ease of deployment, short set up time, comparatively cheaper equipment, and multimedia services have made DUMBO an attractive choice for an emergency communication network.

3. Internet Education and Research Laboratory (intERLab), AIT together with the State Ministry for Research and Technology of Indonesia (RISTEK Indonesia) and the National Electronics and Computer Technology Center of Thailand (NECTEC), organized the *WirelessU: Wireless Internet-Emergency Network Workshops* that took place from 12-16 October 2009, at the AIT Conference Center.

Participants joined from Myanmar, Cambodia, Laos, Indonesia, Nepal, Bangladesh, and Thailand. The five-day workshop provided hands-on experience with WiMAX technology and mobile wireless network (DUMBO) deployment on an ad hoc basis in emergency situations. This training program aimed to focus on collaboration with our partners in the region to reinforce the overall emergency response capacity with the help of communications and information technologies.



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Photos: Participants and trainers are busy with hands on experience.

4. The website <http://dumbo-isif.interlab.ait.ac.th> has been built to serve as the one-stop information and coordination center. Here, users can find the technical details regarding deployment of DUMBO networks. Equipment specifications, software, and the training manual are already available.

We have included additional features that were not promised in the proposal, but were seen as necessary to make it a comprehensive information and coordination center for a wide range of disasters. This website provides detailed information about the project's background, objectives, activities, different types of natural and man-made disasters, and some basic preparation guidelines. The site also includes details of both local and international aid organizations that specialize in food delivery, emergency medical help, and the provision of other supplies. Visitors to the website who wish to donate their time, money, goods, or services to any of the organizations listed may contact these organizations directly or via intERLab.

Another aspect of the site is a section on emergency communications technologies and some examples of related organizations currently using them. For example, satellite communication technology can be a good choice for post-disaster communication. The non-profit, non-government organization, Telecom Sans Frontiers (TSF) provides the service.

Moreover, the website contains information about recent emergencies and affected areas so that the respondents and volunteers can work together to help the victims.

AIT's intERLab has developed and deployed DUMBO into Myanmar starting from May 2008. This program was deployed on an ad hoc basis. We trained the engineers from Myanmar and provided, with the help of our partners, the necessary equipment for the first phase of deployment. The program is still ongoing and we gained some valuable



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insight during the process. From this experience, we needed to focus on the limitations of the system and extend current research to overcome the drawbacks.



Photo: DUMBO team working to test the performance.

From the field implementation we experienced the following problems:

- We found that the wireless equipment performance is highly affected by the surrounding environment.
- The terminal nodes need to be recharged at regular intervals; there must be a power supply.
- Different wireless chipsets or different operating systems (Linux/ windows) cannot form a MANET (mobile ad hoc network).
  - We need to use same wireless cards and same operating system in all the terminal nodes to make the network work properly.
- During training, we found that even though the training manual was very clear and the trainers were guiding the participants to install and use the system, some participants were facing difficulties, as they did not have any basic technical knowledge about IP network or wireless equipments, especially with troubleshooting. Unexpected issues required the assistance of the trainers.

## Fulfillment of Objectives

The objectives outlined in the abstracts contained in the proposal are:

- **To address infrastructures and technology-related connectivity problems by coupling advances in mobile ad hoc wireless communication network:** We have worked throughout the project period to fulfil the first objective. This objective has been achieved to the extent that, the emergency network DUMBO



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has been established and is performing satisfactorily. Additionally, we have come up with some other wireless technologies as alternative solutions to emergency communications support.

- **To create a website to disseminate information on how to build and deploy a DUMBO system:** The software, the training manual, and system setup instructions are already available on the website. This website provides detailed information about the project objectives, activities, technical details regarding DUMBO deployment, and equipment specifications.
- **Development of the Out-of-box tools package including software and reference guide/manuals:** Software and installation manual for DUMBO network are prepared and available in the website.
- **To deliver technology know-how to the community and make this platform accessible as an open source:** The *WirelessU: Wireless Internet-Emergency Workshops* were held during 12-16 October 2009, at the AIT Conference Center and supported by its partner organizations. The participants were from Myanmar, Cambodia, Laos, Indonesia, Nepal, Bangladesh, and Thailand; this delegation also reflected a range of technical experience. The five-day workshop provided hands-on experience with WiMAX and ad hoc mobile wireless network (DUMBO) deployment in emergency conditions. The participants were able to set up the system, as well as deploy and make use of this platform when the workshop was over. They were provided with both a hard copy and soft copy of the training manual. All updated information on the platform and related documents will be shared via the mailing list and updated on the website as they become available. Technical support will also be provided upon request.
- **To identify and manage the relationships with local technical resource persons and to assist local training partners in delivering training courses to volunteers or field operators:** Through interERLab's existing partners and close working relationships with local NGOs in the region, we can easily identify the required resources and train the trainers from local community-based organizations. These trainers will then be able to deliver hands-on training courses to volunteers and field operators. We participated in the THNG (Thailand Networking Group) camp from 5-7 March 2010. During the camp, we conducted hands-on DUMBO training with the manual and equipment prepared for dumbo-isif. This action can be regarded as an outreach activity of dumbo-isif.



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Figure: Participants in THNG camp walking through the trails and communicating with each other.

## Project Design and Implementation

Starting from July 2009 with the support of ISIF.asia, the website for dumbo-isif is now complete. Along with the objectives as mentioned in the proposal, we have added a few more features to the website. This website can be regarded as the home of community-based disaster information, coordination, and preparedness. The website also provides



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avenues of assistance for post-disaster recovery operations as well as information regarding the special needs of vulnerable populations in disaster areas. Essentially, the site is designed to assist anyone preparing a disaster response plan for any remote community.

<i>Activity</i>	<i>Period</i>	<i>Status</i>
Explore the wireless technology	Throughout the Project period	We have identified and categorized different technologies suitable for emergency communication. Based on available resources and required services, users can choose the most suitable one from a range of technologies such as PSTN, cellular network or WiMAX, or satellite communications. We have tried to show some case studies, where different technologies have been used in various disaster affected areas.
Develop out-of-box tool	Throughout the project	DUMBO has been given as an emergency communication solution that provides multimedia communications among the active nodes. Additionally it provides the GPS location service, which allows the user to see the position of all the nodes in the network. The complete software for DUMBO is available.
Training Manual	August 2009-October 2009	Done. Available online.
Deliver Technology Know how to the community	Throughout the project	<i>WirelessU: Wireless Internet-Emergency Network Workshops</i> were held during 12-16 October 2009, at the AIT Conference. Provided hands-on experience with WiMAX and ad hoc mobile wireless network DUMBO deployment. THNG camp, Thailand from 5-7 March 2010: conducted hands-on DUMBO training in the deep forest trails of Khao Yai National Park.
Some additional features of the website which includes: <ul style="list-style-type: none"> <li>Types of Disasters</li> </ul>	Throughout the project	Done.



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<ul style="list-style-type: none"> <li>• Preparedness Information</li> <li>• AID organizations to help the victims</li> <li>• Emergency Needs of the disaster victims</li> <li>• Few case studies on post disaster Communication</li> </ul>		
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### Project Outputs and Dissemination

1. The software package is developed.
2. Created a website (<http://dumbo-isif.interlab.ait.ac.th>), where the software packages and training manuals are available.
3. Training – Internet Education and Research Laboratory (intERLab), AIT together with the State Ministry for Research and Technology of Indonesia (RISTEK Indonesia) and the National Electronics and Computer Technology Center (NECTEC), Thailand organized *WirelessU: Wireless Internet-Emergency Network Workshops* held during 12-16 October 2009 at the AIT Conference Center. Information about these training sessions is available in the following web links:
  - a. <http://www.ait.ac.th/news-and-events/2009/news/ait-holds-training-on-ad-hoc-communication-networks-for-post-disaster-missions/view>
  - b. [http://interlab.ait.asia/news\\_events/2009/wireless-u-ws.html](http://interlab.ait.asia/news_events/2009/wireless-u-ws.html)
4. THNG (Thailand Networking Group) camp, Thailand from 5-7th March, 2010 to conduct hands-on DUMBO training with the manual and equipment prepared for dumbbo-isif. Please refer to the following web link for more information: <http://dumbo-isif.interlab.ait.ac.th/dumbo2-thng-camp>

### Capacity Building



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The *Wireless Internet-Emergency Networks Workshop* was successfully organized by Internet Education and Research Laboratory (intERLab), AIT on 12 – 16 October 2009, with support from the State Ministry for Research and Technology of Indonesia (RISTEK Indonesia) and the National Electronics and Computer Technology Center (NECTEC), Thailand. We trained around 30 professionals with varying technical backgrounds from across the region. The objective was to build a network of humanitarian professionals trained in emergency life-saving mobile wireless network development, who are able to coordinate their efforts and increase the impact of emergency response. The travel expenses, lodging, local transportation, and other associated costs for the participants from Laos, Cambodia, Myanmar, and Nepal was supported by NetworkTheWorld.org and the NSRC, whereas the RISTEK supported a part of Indonesian trainers' expenses. The trainer's team was formed with resource personnel from RISTEK/Indonesia [WiMAX], intERLab/AIT [MANET], Gram Vaani/IIT [Community Radio, Delhi], and the Nepal Wireless Networking Project [Wireless Mesh].

The following topics were covered in the workshop:

- WiMAX Overview and Technology
- Configuration & Connection
- Typical Setup of Outdoor WiFi including
- DUMBO [Mobile Ad hoc Network] Overview and Technology
- DUMBO Network topology and application
- DUMBO Activities Monitoring
- DUMBO network setup
- Demonstrate DUMBO network activities
- Troubleshooting

The training program directly benefited the humanitarian organizations active in the region and indirectly touches many other emergency responders through partnerships and information sharing. Participating organizations were trained to respond to emergency communication issues in crisis zones.

Different forms of educational material were distributed during the training sessions. In addition, a web portal has been developed to provide important information and technical advice, as well as to keep partners updated on developments in wireless technology.

The program aimed to help the emergency respondents ensure the security of their teams onsite and enable greater coordination of relief efforts. Participants are expected to spread the knowledge and skills acquired during the training to their respective organizations and local partners. They are expected to put the acquired knowledge into practice in the context of their organizations' activities and to exchange information on mobile wireless network and emergency situations. Continued technical support by the



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DUMBO team is available and all relevant technical material and related documents will be available and archived on the web portal as they become available.

It is also a great learning experience for all those involved including researchers, resource personnel, and humanitarian professionals who have experience working in disaster-affected areas.

As a result of an increase in efficiency among emergency respondents, humanitarian action in the field will reach affected populations to a greater extent.

## **Project Management**

The administration, scientific, and technical management of the project was undertaken by Prof. Kanchana Kanchanasut, School of Engineering and Technology and Director of the Internet Education and Research Laboratory (intERLab), with the support of Wit Hmone Tin Latt and Amina Akhter. Wit Hmone Tin Latt left intERLab at the end of December 2009 and in this regard, no more changes are expected to the project management to be incorporated during the rest of the project life.

## **Impact**

This project aims to support post-disaster emergency communication by exploring the wireless communication technologies and by developing an infrastructure-free communication network.

Anyone who has Internet access can use the DUMBO-isif website to learn about the latest communication technologies such as WiMAX and the older PSTN technology. Users can compare the variations of technologies based on different criteria such as coverage area; wireless, fixed, or mobile networks; costs; ease of deployment; etc. They can develop technical knowledge that is useful for post disaster communication and areas without existing communication infrastructure. DUMBO, which supports multimedia communication and allows users to move freely, can be regarded as a complete solution for emergency communication; it can connect to the Internet as well.

Furthermore, this website provides information about different kinds of natural and man-made disasters as well as preparedness information, making the site a one-stop information and coordination center for disaster response planning. Among this information are details of various aid organizations ready to assist communities. There is an option for site users to donate money, supplies, or volunteer time with any of the organizations listed. There is also information about the recent disasters across the



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region for research purposes. This website intends to be useful for the disaster survivors, the respondents, the volunteers, and researchers or educators.

The training program benefited humanitarian organizations and emergency response workers in the Asia Pacific region. Participants were trained to use the emergency communication platform, DUMBO, and enable greater coordination of relief efforts. Different types of educational materials were distributed during the training sessions. In addition, a web portal has been built to provide important information and technical advice, as well as to keep partners updated on developments in wireless technology.

This training will benefit any researchers, resource personnel, and humanitarian professionals who work in disaster-affected areas. The most important benefit to focus on, however, is that this project will ultimately help marginalized people in remote communities in the following ways: education about different kinds of disasters, disaster planning, and communications technologies including cheaper and technically viable alternatives.

## Overall Assessment

This project focuses on the critical issue of “Emergency Communication” that is currently not adequately unaddressed in the developing areas of Asia Pacific region.

When disasters strike, people need food, shelter, blankets, and medicine. In the absence of an effective communications network, supplies are left undelivered, and relief workers are unable to do their jobs. Hence a communication infrastructure is very important to assist emergency relief workers so that they can respond more quickly and effectively and reunite families separated by disaster. This project has focused on a vital component of disaster management that is often overlooked.

The strength of this project is that it will help people across all socioeconomic backgrounds and can be operated by all levels of technical experience. A weakness is that anyone involved in the deployment of any communication methods provided in the website, s/he needs some prior technical experience or knowledge.

## Recommendations

To help alleviate the suffering of the disaster survivors, we need to focus on Capacity Building to develop a network of humanitarian professionals. To this end, more trainings and workshops should be organized so that participants from across the Asia Pacific region may become more familiar with these emergency communication technologies and bring this knowledge back to their communities for local deployment. ISIF and its



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funding partners can work together to provide the financial assistance to organize future training and workshops.

### **Project Sustainability**

DUMBO training will be conducted regularly at intERLab, AIT, Thailand or in any other location in the region with the support of other humanitarian organizations. Any interested individuals are welcome to take part in training onsite, on location, or at other regional conferences and workshops in the future.

Thanks to the NSRC, for providing the technical equipments such as access points, antennae, network equipments, power supplies, etc. to carry out training programs and research and development purposes.

We also welcome support from individuals and foundations for raising awareness of and increasing the response to disaster survivors' needs in the region. We will only be able to ensure these technologies serve the genuine requirements of various communities with the application of deeper, local analyses.

Networking with related research and development institutions and funding organizations is also vital for the sustainability and growth of our project. The private sector offers an important potential for additional support through funding, technology, and research exchange. In return, private business can benefit from the locally appropriate nature of innovations developed, as well as through technology transfer and expertise. Such partnerships may offer potential for the growth and expansion of this project.



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