Clear-up after Hurricane Katrina. Photo courtesy of iStockphoto.com

Satellite-based disaster recovery – a toolkit

Over the past few years, the world has suffered a series of natural and manmade disasters and acts of terrorism that have left mankind feeling vulnerable. In the aftermath of these disasters, satellite communications prove themselves time and time again to be invaluable. Satellite Evolution establishes why and looks at the systems that help devastated areas get back on their feet.

The Asian tsunami, 9/11, earthquakes in Peru and Pakistan, hurricanes in the United States – just a few examples of the disasters experienced by the human race in very recent memory. These occurrences are now part of our everyday lives and are tipped to become more frequent as a result of global warming and climate change. In the event of a disaster communications are of paramount importance. Without them, requirements of the victims and organisations deployed there to assist cannot be met. Information must be allowed

to flow in and out of the zone quickly, easily and efficiently and a line of communication must be open at all times. Without this aid and equipment, help cannot reach those that need it most.

Administrations and businesses alike are now putting preparedness at the top of their lists. There is an emphasis put on ensuring that plans are in place before a disaster occurs instead of waiting for it to happen. Businesses in particular are looking for backup or 'failover' systems in the event of terrestrial infrastructure failure. So what is this backup? It is satellite. Let's look at why and what capabilities are available.

The scenario

Once a disaster has occurred the first thing that must be re-established is communications. The Asian tsunami provides for us a comprehensive example of what first responders face in the aftermath of a devastating natural disaster. The following is an eyewitness account at one of the worst affected areas after the tsunami.

"I had seen some footage on television, but this paled in front of what I saw in Banda Aceh. We visited an area 15km in from the shoreline; it was completely destroyed. It was as if the water, in unimaginable rage, had washed away the lives of the people, and with them, their memories and their history.

"The sea washed away houses; it carried sea vessels from the ocean and deposited them on top of buildings and bridges; it carried tractors, coaches, all types of vehicles, into the middle of rice fields; it carried dead bodies everywhere. Massive concrete structures and multi-storey buildings were reduced to rubble. Every few hundred yards there were lines of corpses in body bags.

"I have seen the effects of war in Bosnia, Kosovo Chechnya, Iraq, Palestine and Afghanistan, but this is far worse. Destruction by weapons of war, however devastating, is not as complete as the destruction caused by the tsunami. When the water came, it came at once across the entire coastline and took everything with it." said Dr. Hany El Banna, President, Islamic Relief.

The tsunami completely wiped out any means of communication where it initially existed. The wave flattened everything leaving complete devastation. It was vitally important to restore communications so that the devastated area could communicate with the outside world to secure aid for the survivors and to begin the clean-up effort. There are many considerations to be taken into account at this point. Issues such as what, if any, infrastructure is left, the weather, terrain, gaining access to the area, safety, security – these must all be taken into account when deciding on the most effective means of communication to be used.

What is it about satellite?

It cannot be disputed that satellite-based solutions are often the only option available in times of crisis. Satellite technology also facilitates the re-establishment of communications and is the most suitable means of communications in hostile and unstable conditions because:

- A natural disaster will often take out the available terrestrial infrastructure in an area and therefore there are no means of communication available to first responders acting on the spot. The beauty of satellite communications is that they may be easily transported to the area where they are required and deployed extremely quickly, often within minutes, so that communications are restored. The size and weight of equipment enable it to be flown and/or driven to its destination;
- Satellite communications have an independent and instant infrastructure. Once deployed in various locations via a star or mesh topology, they establish a network instantly;
- Interoperability is vitally important. The satellite network must be able to operate even using different equipment or solutions;
- Facilitate shared capacity;
- Satellite terminals are robust and hard wearing so that they may withstand even the harshest of conditions. They have been specially tested and modified to cope with all varieties of weather conditions; and
- A satellite network is a reliable network. Due to the situation of the network of satellites in Low Earth Orbit or Geosynchrous Orbit, there is excellent coverage of affected areas.

Satellite can be deployed and operational in such a short period of time and can provide the vital services that are required in such situations such as voice, data and video through the use of various types of terminals. Satellite may provide narrowband and broadband IP communications for voice, data and video helping to move critical information around and in and out of a disaster zone.

The stages of a disaster

Once an NGO or government or humanitarian agency arrives at the scene of a disaster, decisions need to be made on how to progress. One such organisation is NetHope.

Nethope is based in the United States and is a non-for-profit IT consortium of leading NGOs, serving beneficiaries in over 150 countries every year.

NetHope began as an informal collaboration and now operates as a non-profit corporation governed by its member NGOs. Their members have well-established information and communications

Uganda flood victims receive telecommunication links - ITU deploys satellite terminals in affected districts

The International Telecommunication Union deployed 25 satellite terminals to help restore vital communication links in the aftermath of the floods that have affected the eastern and northern regions of Uganda since August 2007. Several districts were ravaged by torrential rains and flash floods that swept through the country taking lives, marooning over 140 000 people, destroying road and communication links, and submerging crops, compelling the Government to declare a state of emergency. With the restoration of communication links, designated government officials and other humanitarian agencies were able to more efficiently coordinate relief operations. The mobile terminals were transported by helicopter to serve people most in need.

"I noted with concern and sadness, the suffering and destruction that has been caused by floods that hit the eastern and northern regions of Uganda," said Sami Al Basheer Al Morshid, Director of ITU's Telecommunication Development Bureau. "There is no doubt that communication links are essential to ensure a more effective and coordinated relief effort. This is why we quickly deployed the resources at our disposal."

Mr Patrick Masambu, Executive Director for the Uganda Communications Commission said: "The satellite terminals to used in the areas which were severely affected by the floods is very timely and will go a long way in facilitating the relief efforts in the affected areas."

Cosmas Zavazava, Head of ITU's Division for Emergency Telecommunications said, "It is clear that we are making a difference on the ground. For the past three months, we have had to deploy telecommunications resources for disaster mitigation in three different regions. In August, we deployed in Peru following an earthquake; in September we deployed in Bangladesh where floods had wreaked havoc; and now we have had to intervene in Uganda. Telecommunications can save lives when natural disasters strike."

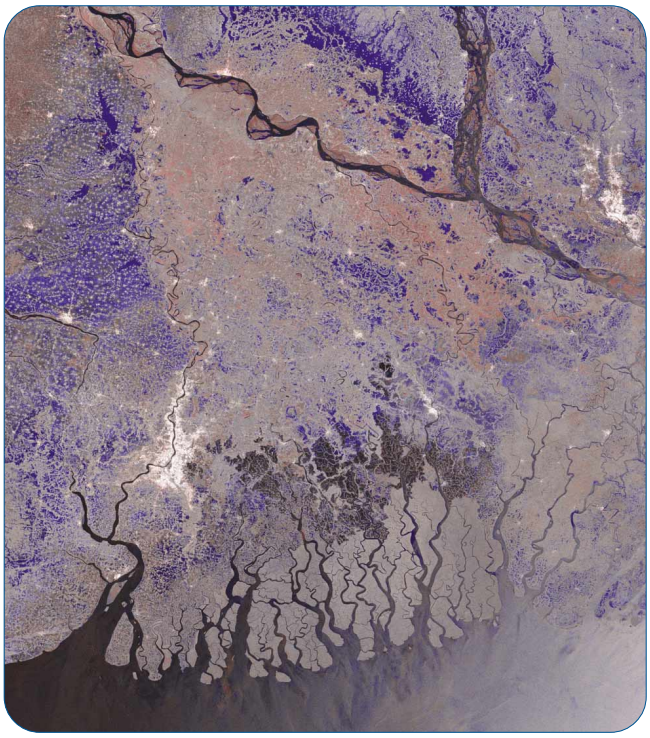
ITU is providing both Thuraya hand-held satellite phones and Inmarsat Global Area Network (GAN) terminals. The Thuraya satellite phones use both satellite and GSM networks and also provide accurate GPS positioning coordinates to aid relief and rescue. The Inmarsat GAN terminals are mainly used for voice communications and, in some cases, can be used for high-speed data. ITU pays for all expenses, including transportation of the equipment and usage.

technology departments that use technology strategically to support their programmes. They work together through NetHope to collectively solve common problems and leverage their technology investment to achieve higher levels of efficiency, quality and reach for their organisations' programmes so that communities in need can be better served.

NetHope enables member NGOs to deliver information and accelerate response to the most disadvantaged communities in remote developing areas by:

- Sharing ICT knowledge for rapid and effective deployment and efficient operations;
- Collaborating with non-profit and industry leaders to develop for best practices for public benefit technology deployment in the NGO world; and
- Facilitating innovative and cost-effective use of ICT.

NetHope aims to be a catalyst for collaboration in the International NGO community and enable best use of technology for connectivity in the developing parts of the world. NetHope has participated in the rehabilitation of areas affected by disasters and produced a compendium of learnings from their engagement in various parts of the world including Indonesia, Sri Lanka and Pakistan. They define clear stages of a disaster:



Flooding in Bangladesh. Photo courtesy of ESA.

- **Stage 1** – Within hours of disaster striking: First relief worker(s) arrive on the ground. The most urgent and immediate need in hostile environment is to survey and assess damage, transmit pictures, security information, relief material and personnel requirements to Head Offices. Agencies decide at this stage how deeply involved they will be with relief efforts. This stage is characterised by highly individualized, highly mobile, temporary and transient computing, communication and power solutions;
- **Stage 2** – Within two weeks of a disaster striking: Teams begin to arrive on the scene as risk of disease and malnutrition escalates. Requirements are continuous monitoring of disaster, assessment of victim needs, management of relief material deployment between and across aid agencies, personnel security, application and reporting of donated funds, uploading of case studies, pictures and relief reports. This stage is characterized by small (up to 10 people), often roving groups who need easy-to-setup-and-takedown computing, communication and power solutions; and
- **Stage 3** – From one month of a disaster striking to multiyear: Agencies provide resources for building reconstruction, counselling, family reunification, food distribution, water purification, etc and becoming part of the community over a long period of time. This stage is characterised by larger (20 or more people) groups in fixed office scenarios, with the potential of moving to different office locations as the situation unfolds.

What kind of satellite communication is required?

As we have seen, when an NGO or government agency is considering their options on arrival at a scene of devastation, it is important

GMV – Space solutions for disaster recovery

GMV was established in 1984 and has been providing high quality, innovative IT solutions for the space market ever since. GMV specialises in the areas of Global Navigation Satellite Systems and applications, flight dynamics, satellite monitoring and control, mission analysis, mission planning and scheduling, payload data segments, science operations centres, user segments and space applications, satellite communications technologies, simulation, systems engineering and GNC, and on-board and embedded software.

Over the years, GMV has had the opportunity to work with and supply systems, products and supporting services to space agencies, satellite operators and satellite manufacturers worldwide. Their systems and space applications are also serving the needs of an increasing community of users in different activity centres.

GMV has a significant role in the European navigation programs EGNOS and Galileo, for which it has provided key technologies. Their stakeholders include international organisations and agencies, multinational bodies, local and national governments, emergency response authorities and non-governmental organisations.

HARMLESS

In terms of Disaster Recovery, GMV are concerned that these stakeholders are able to share information, to co-ordinate effectively and to be interoperable on a technical level. GMV's work with the HARMLESS programme provides an example of how they are working to develop space applications that will help in the event of a disaster. GMV are ideally suited to lead the HARMLESS project due to their extensive experience of European navigation systems.

The HARMLESS programme's objective is to research and promote the use of European navigation satellite systems in the area of emergency management, humanitarian aid and law enforcement. The projects runs for 20 months and during this time, products go through research and development in order to be introduced onto the market. GMV's product development samples include:

- Emergency resource management centres;
- Mission planning systems;
- Earth observation processing systems;
- Intelligent transportation systems;
- Web accessible location-based service platforms; and
- Environmental and asset monitoring systems.

Over the course of HARMLESS, GMV have developed a particularly innovative solution for search and rescue dogs. Entitled the Osmographer, this K9 search and rescue support system is used where humans are buried alive in collapsed buildings, snow avalanches and landslides, for example. In the aftermath of natural or manmade disasters, dogs are often used to locate humans in ruins and quick and thorough cover of the affected area is of vital importance. The Osmographer gives crucial details such as the position of the dog, the wind direction and speed, the sensitivity of the dog's nose when picking up a scent and the region that has been covered by the dog. This means that no time is wasted going back over ground already covered and means that resources may be quickly relocated to another area once one area has been searched.

The system itself comprises a GPS positioning device and GPS reference station, a wind sensor, R/F communications device, a central unit and a central processing application. There is no other current technology available that can estimate the searched coverage of an area. In addition, once the search operation is over, the search may be replayed to enable analysis of the operation for purposes of improvement.

The feasibility of the Osmographer has been confirmed, as have the user requirements. The architecture has also been selected. The first units are expected for delivery by the second quarter of 2008.

that the choices they make regarding satellite communications are the right ones and that they decide upon the correct type of satellite terminal for the job the are carrying out. There are various options available on the market at present. Let's look at the choices a humanitarian or governmental organisation has.

Mobile Satellite Services

Mobile Satellite Services or MSS are available in the form of telephone handsets and also terminals that may be transported on vehicles, vessels and aircraft such as helicopters.

Applications supported by MSS services:

- Mobile telephony;
- Push to talk radio;
- Emergency Response Co-ordination;
- Communications-on-the-Move;
- Asset tracking;
- Data transfer;
- Lone worker protection;
- Environmental monitoring;
- Event reporting; and
- Messaging.

Handheld mobile satellite phones are a versatile and reliable way of keeping in touch whilst moving around.

ACeS of the Philippines has introduced the R190. This is the world's smallest mobile satellite phone. It weighs less than 200 grams, measures similar to contemporary GSM phones and is a dual mode phone : ACeS Satellite and GSM 900.

The ACeS system also includes several high-quality personal mobile satellite communication capabilities that makes it user-friendly and extremely flexible. For example, digital voice, alerting and paging services, data transmission, call transfer, call forwarding, call waiting, call holding, conference calls, three-party service, call barring, operator intervention, assistance, call trace. The ACeS handset provides a voice quality similar to digital cellular systems.

Features:

- Full regional coverage;
- Dual mode ACeS/ GSM 900;
- Seamless roaming capability in ACeS and GSM900 networks;
- Pocket size;
- New icon-driven menu;
- Smart dialling;
- Flexible phone book features; and

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- Full range of accessories

It supports supplementary services (network operator dependent) such as:

- Short message (SMS) in GSM mode;
- SMS, cell broadcast in GSM mode;
- CLI (CLIP/CLIR) in GSM mode;
- AoC/I (advice of charge/information) in GSM mode;
- AoC/C (advice of charge/charging) in GSM mode;
- Call hold/ wait in ACeS and GSM mode;
- Multiparty in ACeS and GSM mode;
- Call divert in ACeS and GSM mode;
- Call barring in ACeS and GSM mode;
- Call transfer in ACeS and GSM mode; and
- Fixed dialling numbers.

Inmarsat have also joined the handheld satellite market with the introduction of the iSatPhone in June 2007 which is a lightweight and pocket sized handset with a rugged design to cope with demanding environments. It is the first handheld satellite phone in the Inmarsat portfolio and is a dual mode satellite/GSM phone targeted at business and personal users who travel and work in areas where local telephone networks are unreliable or non-existent. The service comes with additional features such as call hold and call waiting, conference calls for up to five participants and, in GSM mode, SMS. The handsets retail at around $500 with voice call charges at less than $1 per minute.

BGAN is Inmarsat's mobile satellite service that offers broadband data and simultaneous voice through a single, truly portable device. It also offers guaranteed data rates on demand – up to 256kbps – for live feeds and video conferencing. Ideal for first responders, it provides a mobile 'command post' helping to maintain situational awareness. It is easy to transport and quick to set up and use. BGAN is also very reliable due to the fact that network capacity may be dynamically re-directed to areas of high usage and can maintain bandwidth availability even as other agencies arrive at the disaster zone. BGAN is accessible all over the world in Asia, Europe, Africa, the Middle East and North and South America.

Fixed Satellite Services

Fixed Satellite Services or FSS are suitable where humanitarian or governmental organisations require a more permanent means of communications and know they will be situated in a certain location for a certain period of time. FSS uses terrestrial terminals to communicate with satellites.

Applications for FSS include:

- Cellular restoration;
- Wi-Fi restoration;
- Emergency phone;
- Communications-on-the-move;
- PSTN backhaul;
- VoIP;
- Broadband Internet;
- Live video;
- Telemedicine; and
- Video conferencing.

The challenge of restoring communications is easily met with VSAT technology. The VSAT may be deployed in a timely and efficient manner. The nature of the technology means that it is able to integrate into an existing system but also has the ability, using a mesh topology, to communicate with any site without the use of a central hub. A star topology will enable two-way communications between any site and a central hub and can provide access to voice, data, Internet and video. Above all, VSATs are cost effective and are now easy to use. A small antenna of only 1m in diameter can provide all the communication required in a disaster situation and may be transported easily to the site due to the fact that the dish will, in many instances, break down into smaller, more manageable and more transportable pieces. The VSAT is also suitable for longer periods of deployment and is perfect for establishing a hub for connectivity in affected areas for use by NGOs and also inhabitants of affected locations.

Regulation

Satellite services cannot be deployed in a disaster situation without the relevant clearance and licensing from the authorities of any country. It is vital that all paperwork is pre-arranged and licences obtained before deployment. The Tampere Convention on the Provision of Telecommunications Resources for Disaster Mitigation and Relief operations was unanimously adopted by the delegation of 60 states participating in the Intergovernmental Conference on Emergency Telecommunications in 1998.

The Convention is an international tool for ensuring the prompt delivery of communications in the event of a disaster. The Convention came into force just two weeks after the devastating Asian tsunami when it was ratified by the necessary 30th country. There have been several moves to encourage more countries to adopt this incredibly important Convention that ultimately saves lives.

The Tampere Convention calls on States to facilitate the provision of prompt telecommunication assistance to mitigate the impact of a disaster, and covers both the installation and operation of reliable, flexible telecommunication services. Regulatory barriers that impede the use of telecommunication resources for disasters are waived. These barriers include the licensing requirements to use allocated frequencies, restrictions on the import of telecommunication equipment as well as limitations on the movement of humanitarian teams.

The Convention also safeguards the privileges, immunities and facilities granted to persons providing disaster assistance by grant-

Cyclone Sidr – Telecom Sans Frontieres Mission Report

On November 15th, Cyclone Sidr hit the Southern coast of Bangladesh killing almost 4,000 people and affecting 8.7 million. Over half a million houses and hundreds of kilometres of roads were destroyed. Electricity was cut off notably leading to telecommunication problems.

Bangladesh hasn't signed the Tampere Convention, an international agreement which facilitates the temporary import of satellite communications equipment in emergencies.

In collaboration with the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), TSF immediately deployed as soon as the country requested international assistance. On November 20th, TSF sent a first crew carrying mobile satellite communications equipment in order to strengthen Unicef's team already on the ground.

Within the Cluster Approach, Unicef was appointed Telecommunication Coordinating Agency in order to provide an inter agencies emergency telecommunications service to cover the needs of the entire humanitarian community during the emergency phase of the disaster response.

Following the floods which affected Bangladesh last summer, Unicef had pre-positioned satellite communications equipment in the country. Within the framework of its partnership with Unicef, TSF was first requested to assess the telecommunication infrastructure and the needs of the UN and of the NGOs operating in the affected zones.

Out of the 64 districts of the country, more than half have been affected. All affected districts are located in the South near the Gulf of Bengal. TSF's assessment confirmed that mobile networks were operational in most affected zones and that fixed phone lines were also available.

However, TSF identified needs for data connectivity for the United Nations and a second team with volunteers from the Asian Institute of Technology was therefore sent from Bangkok.

The TSF team included:

- 3 x Emergency telecoms specialists
- 2 x Satellite data transmitters
- 3 x Satellites phone lines
- 3 x Laptops
- 1 x printer

Bangladesh, one of the world's poorest countries, is often confronted by natural disasters since a big part of its territory is situated at sea level. In 190, a cyclone killed half a million people and a tidal wave killed 138,000 in 1991.

More than two months after Cyclone Sidr, the United Nations announced that two million people still needed immediate food and medical assistance, most survivors being homeless. Cyclone Sidr is the worst disaster to hit Bangladesh in ten years.

On December 14th, the Government of Bangladesh appealed for over two billion dollars to the international community to help rebuild the country. TSF's 3 week-mission ended on December 11th. This was funded by the Vodafone Group Foundation, the United Nations Foundation, Inmarsat, Eutelsat, Vizada, France Telecom, AT&T, Cable and Wireless and the Region of Aquitaine.

ing them immunity from arrest and detention and exempting them from taxation and duties. As the first treaty of its kind, the Convention also defines the non-governmental organisations and non-State entities whose personnel would be granted these privileges and immunities when engaged in supporting the work of UN humanitarian and rescue organisations such as the United Nations High Commission for Refugees (UNHCR), OCHA and the International Federation of Red Cross and Red Crescent societies (IFRC).

The Convention defines the overall framework for the cooperation among States parties and all other partners in international humanitarian assistance. It describes the procedures for request and provision of telecommunication assistance, recognising the right of a State party to direct, control and coordinate assistance provided under the Convention within its territory. It defines specific elements and aspects of the provision of telecommunication assistance, such as termination of assistance and settlement of disputes. It requires States to make an inventory of the resources — both human and material — available for disaster mitigation and relief, and to develop a telecommunication action plan that identifies the steps necessary to deploy those resources.

The right decision

The decision to use satellite-based solutions in order to restore communications to disaster-hit areas is not just the right one but it is more often than not the only one. Versatile, robust, flexible, accessible, easy to deploy – it addresses all the principal areas of concern and plays a part from the immediate aftermath of a disaster right to the end, where communications are re-established and months have passed. It can even help introduce new business and prosperity to an affected area. The importance of communication cannot be underestimated and the fact that an agency can simply ship and move in an entire communications system that is independent of any terrestrial infrastructure is surely a gift in a box. If the correct decisions are made at each stage of the recovery, all communications including voice, video, data, email, Internet access can be made available and those dealing with the disaster on the ground, no matter where they are can have direct contact with those back at a base or at headquarters. The lifeline that satellite communication provides is invaluable not just to those working in an affected area but even more so to those who have lived through the devastation. ■

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