The Use of Mobile Satellite Communications in Disaster Mitigation

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The International Decade for Natural Disaster Reduction is committed to providing a strong impetus for disaster mitigation efforts, which include the provision of communications that will not be affected by disasters. UNDHA codified requirements for disaster communications systems at the start of the Decade. Although telecommunications cannot prevent a natural disaster, they can help reduce its impact in many ways. This was recognized by the International Conference on Disaster Communications (Tampere 1991), which called, among other things, for overcoming of all barriers inhibiting deployment of telecoms for disaster prevention and mitigation, and for the maximum utilization of existing networks and systems. Among them are mobile satellite systems such as Inmarsat.

1. Operational Advantages of Mobile Satellite Communications

Satellite communications via mobile terminals – mobile satcoms – are independent of the local telecom infrastructure, and therefore not susceptible to the impact of a natural disaster. Mobile satellite systems are designed to provide telecommunications links between small, light and cost-effective terminals and public switched networks or other satcom terminals. Such terminals can be vehicle mounted, hand portable or transportable, and can, if necessary, also be used in fixed positions. The power supply requirement of these terminals is so small that they can operate from built-in batteries, vehicle batteries, portable generators or solar panels.

Due to the mobility requirement, certain trade-offs are necessary between cost, calling capacity and speed of data transmission to ensure reliable and robust communications in a variety of difficult conditions. In this respect, the mobile satellite systems differ from the fixed satellite systems, which can provide larger communications capacity at greater data transmission rates to stationary terminals with large antennas. All current satellite systems require an unobstructed line of sight from the terminal to the satellite to obtain an error-free connection.

2. The Use of Mobile Satcoms in Disaster Mitigation

Telecommunications systems used in disasters and emergencies must satisfy these key requirements: ready availability, self sufficiency and provision of essential services. Because mobile satcoms satisfy these requirements very well, they are used in all critical paths dealing with natural or technological disasters, namely warning, early intervention measures, emergency operations and ongoing support during rehabilitation and reconstruction.

Mobile satcoms can provide contact between a field team and its base (sometimes half-way around the globe!), communications between different teams within the same disaster area, a means of early warning to even the most remote communities, and can serve in monitoring and prediction systems. Portable terminals have proved their worth in a wide variety of applications, such as sending situation reports by telephone, fax, data, photos or video; ordering supplies, medicines and food; managing of field personnel; contact with the media; inter-agency coordination and others.

Over 150 national and international disaster relief organizations now use Inmarsat, including

UNDHA, UNICEF, WFP, the organizations of the Red Cross and Red Crescent Movement and dozens of non-governmental organizations. UNDP has Inmarsat satcom terminals in 11 African countries for use in drought and other emergency relief operations. With the cost of equipment continually coming down and more services being introduced, further organizations are joining the ranks of Inmarsat users, including national emergency and civil defence agencies.

3. Community Preparedness and other Disaster Mitigation Measures

Contingency planning and disaster preparation measures, including **pre-positioning** of emergency supplies and communications equipment, can reduce the impact of natural disasters. Organizations concerned with national emergency planning, such as civil defence units, police, fire brigades and medical emergency teams, increasingly incorporate satcoms into their disaster relief plans.

For example, the Caribbean Disaster Emergency Response Agency (CDERA), co-ordinating the emergency relief activities of 14 islands, has been successfully using Inmarsat data messaging services in preparedness activities on two islands; eventually most if not all Caribbean islands could have their own pre-positioned mobile satcoms. The Pan American Health Organization (PAHO) has several Inmarsat terminals at selected locations in the Americas. UNDHA in Geneva is establishing a worldwide emergency preparation inventory of material, expertise and communications equipment, including mobile satcoms. Such efforts need to be increased if effective community preparedness is to be achieved.

Telephone, fax or data satcom terminals should be pre-positioned at more strategic locations, so that an uninterruptible source of warning information is always available even if local radio or TV infrastructure has been disabled or has never been established. A network of Inmarsat terminals would be particularly effective if connected to an appropriate regional or global database of relevant disaster information

Warning systems

Small mobile satcom terminals coupled with activated sensors are used for SCADA (Supervisor Control and Data Acquisition), monitoring and early warning functions. Terminals can be powered by solar panels or batteries and can be located even in the most remote areas. For example, SCADA monitoring of seismic events can help identify potential volcanic or earthquake activity. Similarly, mobile satcoms can be used for distribution of GIS (Geographic Information Systems) data.

Emergency Operations

When a natural disaster occurs, access to mobile satcoms allows local authorities and relief teams to communicate with each other and with the outside world immediately. Local field workers can make an initial assessment of the damage and report the facts — including transmissions of photos and video — and request appropriate aid in the crucial first 48 to 72 hours, when the scope for saving lives is at its greatest. Inmarsat has been providing emergency communications since the start of its world-wide mobile satellite service in 1982. With increasing frequency, relief teams arriving in the area affected by the disaster are bringing with them portable Inmarsat satcom terminals. The very extensive use of Inmarsat satcoms in dealing with natural disasters (for example the hurricanes Hugo and Andrew, the floods in the US, China, India, Bangladesh, and the earthquake in Mexico City, Armenia, Iran, Turkey and India) is a testimonial to the effectiveness and versatility of mobile satcoms.

A related type of application is, for example, emergency back-up communications for hospitals based on portable satcoms equipment, which allow the personnel to remain in contact regardless of the severity of the disaster. For this reason, mobile satcoms are being introduced for back-up uninterruptible communications by medical centres, corporations and embassies located in disaster prone areas.

Rehabilitation and Reconstruction

Although telecommunications are high on the list of priorities during the rehabilitation and reconstruction phase following a disaster, it could be weeks or even months before the communications infrastructure returns to normal. During this period, many different systems can provide an interim solution, including VSATs and mobile and transportable satcoms. They support the rehabilitation work, enabling local government and businesses to function, and are used by expatriate and other workers to keep in touch with their HQ and families back home.

Co-ordination of relief and rehabilitation work is often difficult and expensive, particularly in geographically extensive or complex emergencies. However, developments in cellular radio technology and falling costs of cell site management equipment have resulted in some novel applications. A multi-channel satphone can be connected to a cellular radio microcell, or with a Private Branch Exchange (PBX) to multiple fixed users. A number of manufacturers now offer the requisite equipment to connect to Inmarsat satcoms. The average cost of a satellite call in a multi-channel operation can be below US$3.00 per minute.

4. About Inmarsat

Inmarsat is the first — and the only global — mobile satellite telecommunications system. It is an intergovernmental organization, with 73 member countries being Party to the Inmarsat Convention. They nominate national signatories (typically the country's telecommunications provider or the government communications department) to provide Inmarsat services in accordance with the cooperative Inmarsat Operating Agreement. Other service providers and integrators may also be involved.

Inmarsat mobile communications systems are connected to the public switched networks. They enable the mobile user to roam and operate throughout the world, subject only to national licensing requirements. This is an important benefit for the disaster relief user as the same equipment can be used all over the world.

Most countries allow importation of mobile terminals for disaster relief without any limitations, or only with minimum licensing or regulatory requirements. Inmarsat is working closely with the international regulatory bodies and regional telecommunications organizations (e.g. ITU, CTU, PATU, APT, CEPT) towards removing all barriers to free movement of mobile satcoms for these purposes. Following the declaration of the Tampere Conference, work is in progress on the Disaster Communications Convention thanks to the efforts from the ITU, IAF (International Astronautical Federation) and UNDHA. Such a convention can significantly lower the barriers to the free and rapid development of all types of communications equipment for disaster mitigation. PAHO has already been able to persuade the governments of most of its member states to allow unhampered movement of Inmarsat satellite terminals in the Americas for the use in major disasters.

In order to alleviate the cost burden of disaster mitigation, Inmarsat has provided free satellite service in conjunction with one or more of its signatories, in accordance with its own policy on

humanitarian relief in major disasters. A most recent example was during the 1993 earthquake and floods in India. A number of Inmarsat signatories and other commercial entities offer leased terminals and other services at reduced rates to the disaster relief organizations.

5. Other Mobile Satellite Systems

In accordance with the ITU radio frequency allocation, mobile satellite systems can be operated in several frequency bands. Their satellites can be in a variety of orbits. Inmarsat, as well as several regional systems use satellites in geostationary orbits (GEOs): e.g. Qualcomm, (providing low-speed data in the US and Europe), Optus in Australia (voice, fax and data services starting in 1994), AMSC and TMI in the US and Canada (planned to be launched in 1995/96), and the Japan's "N-Star" (voice and data service planned for 1994/95).

Other planned systems propose to use other earth orbits — two examples of which are low earth orbits (LEOs) and intermediate circular orbits (ICOs) — which have their own advantages and disadvantages relative to GEOs, such as trade-off between possibly smaller terminals and reduced voice delay on one hand, and less than continuous availability or increased cost on the other. Several such systems with a regional or global coverage can be mentioned, but all are some years from actual operation: "Orbcom" (data communications by 1996); "Iridium" (with a proposed launched of telephone and data services by 1998); "Globalstar" (1998); "Teledesic" (telephone, data, video service by 2001), and Inmarsat's own Inmarsat-P ("Project 21"), slated for the end of this decade. Other systems are already operational with a regional or a restricted global availability, e.g. VITASAT, which provides a limited store-and-forward data messaging capability.

6. Inmarsat System and Services

The Inmarsat System

Providing a full global coverage, Inmarsat operates its own four main geostationary satellites and leases additional capacity on seven other satellites which act as spares. Starting in 1995, the next generation of Inmarsat satellites will provide eight times as much capacity and further services.

Over 80 Land Earth Stations (LESs) provide an interface between the space segment and the national and international telecommunications networks. Many LESs offer a range of value-added services to their users, e.g. electronic mailboxes, access to e-mail networks, multipoint-to-point and point-to-multipoint data distribution.

There are over 35,000 Inmarsat terminals of all types in operation today. They are purchased, leased or rented from manufacturers, their agents, system integrators or rental agencies. Special rental or leasing arrangements for disaster relief teams are offered by several Signatories. All terminals can operate from a variety of power sources and can communicate with one another.

Inmarsat-A

There are now over 6,700 land-based Inmarsat-A terminals registered in some 140 countries. Inmarsat-A terminals offer high quality telephone/fax/data, telex or High Speed Data (56/64 kbits/s), which also allows photo and video transmission. The system provides direct dialling to any telephone, fax or telex machine throughout the world. In the other direction, terrestrial subscribers can call Inmarsat transportable terminal as easily as calling any other international number.

Inmarsat-M

In response to demand for smaller, lighter and cheaper mobile satellite telephones, Inmarsat introduced in late 1993 a fully digital Inmarsat-M terminal to provide cellular quality voice as well as fax and data transmission at 2.4 kbits/s. An Inmarsat-M briefcase terminal is easily portable (8-14 kg including battery), and at a cost typically below US$5.00/minute is considerably cheaper to operate than Inmarsat-A. Over a thousand terminals are in use around the world already.

Inmarsat-B

Inmarsat-B, introduced in 1994, is the digital successor to Inmarsat-A. It offers increased functionality at lower charges, as well as a range new services based on its higher data rates. A very high quality voice service is provided, along with fax, telex and data up to 64kbits/s, with higher rates planned in the future.

Inmarsat-C

When written messages are preferred to voice communications, Inmarsat-C is a low cost communications solution. There are over 4,000 land based inmarsat-C users today. A small Inmarsat-C terminal (starting at about 4 kg), battery powered and combined with a small PC (even a palm-sized data organizer can be used!) can immediately provide every field team with a means of reaching headquarters with an accurate assessment of the disaster situation and requirements. Received messages can be displayed, stored in memory or printed at a later time. Mobile versions in vehicles allow GPS-based position determination and reporting, and 2-way messaging while on the move. Inmarsat-C terminals connected to sensors or control devices offer SCADA.

7. Conclusions

Two years ago, Inmarsat entered the second decade of its operation. It now provides backbone communications to and from disaster areas. The system has over 35,000 users, and is growing rapidly, with a significant proportion going to more and more disaster and emergency organizations. Continuous engineering and commercial efforts guarantee further improvements in the size, cost and performance of mobile terminals. A new service, satellite paging will be introduced for one-way messaging to workers in the field and even in urbanized areas. By the end of this decade, Inmarsat's "Project 21" and other planned systems could provide the hand-held mobile satellite phone service. This continued evolution and expansion, as well as the entry of other mobile satellite systems onto the communications scene attest to the growing utility and effectiveness of mobile satcoms in helping to mitigate the effects of natural disasters and other emergencies.

For more information, please contact your national telecommunications company or Inmarsat, International Mobile Satellite Organization, 99 City Road, London EC1Y, UK. Fax 44-71-528-0020.

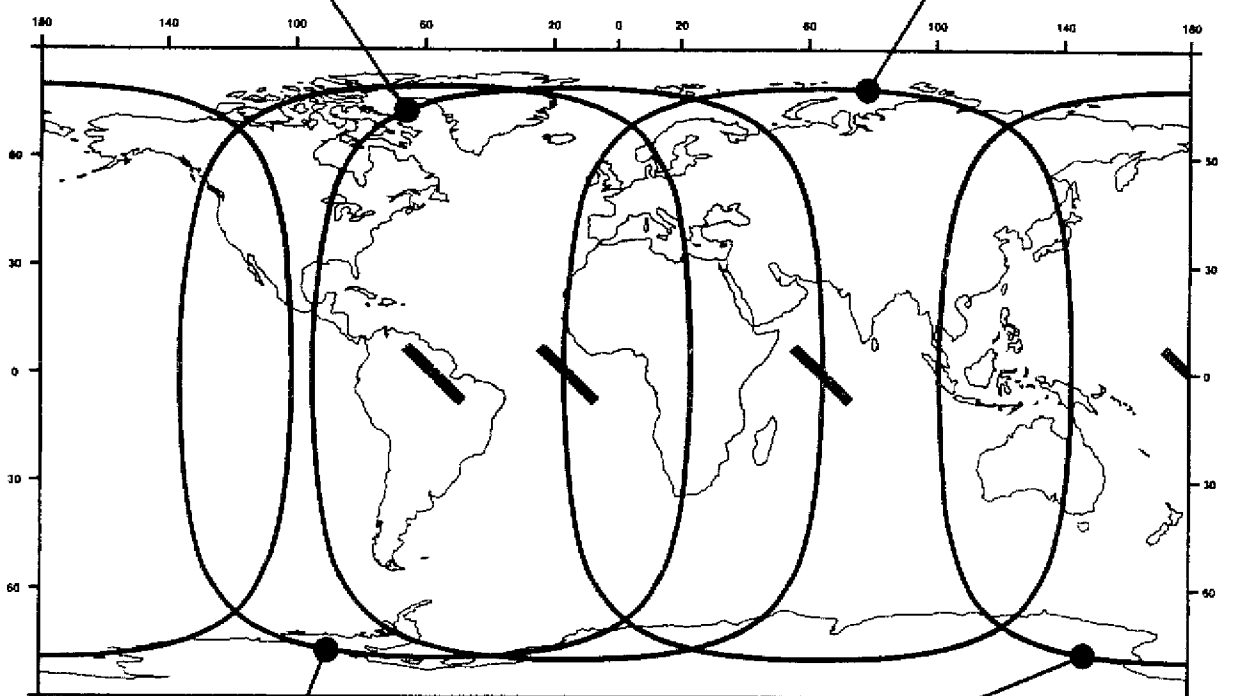
Inmarsat System Coverage and Service Providers

Atlantic Ocean Region (East)

Service Provider	Station	Systems
Embratel Brazil	Tangua	A,C
Telecom Denmark	Blaavand	C
National Telecom Egypt	Maadi	A
France Telecom	Pleumeur Bodou	A,C
	Assaguel	M
DBP Telekom Germany	Raisting	A,C
Station 12 Holland	Burum	A,C,M
Telespazio SPA Italy	Fucino	A,
Norwegian Telecom	Eik	A
Polish Telecom	Psary	A
CP Radio Marconi Portugal	Sintra	C
PTT Genel Mudurlugu Turkey	Ata	A,C
British Telecom	Goonhilly	A,C,M
Black Sea Shipping Co Ukraine	Odessa	A
Comsat Mobile Communications US	Southbury	A,B,C,M
IDB Mobile Communications US	Staten Island	A

Indian Ocean Region

Service Provider	Station	Systems
Telstra Australia	Perth	A,C,M
Beijing Marine China	Beijing	A,C
France Telecom	Aussaguel	M
OTE SA Greece	Thermopylae	A,C
Station 12 Holland	Burum	A,C,M
Videsh Sanchar Nigam India	Arvi	A,C
Telecom Co of Iran	Boumehen	A
KDD Japan	Yamaguchi	A,B,M
KTA Korea	Kumsan	A,C
Norwegian Telecom	Eik	A,C,M
Polish Telecom	Psary	A
Ministry of PTT Saudi Arabia	Jeddah	A
Singapore Telecom	Sentosa	C
PTT Genel Mudurlugu Turkey	Ata	A,C
Black Sea Shipping Co. Ukraine	Odessa	A
Comsat Mobile Eurasia US	Anatolia	A
IDB Mobile Communications US	Gnangara	A



Atlantic Ocean Region (West)

Service Provider	Station	Systems
British Telecom	Goonhilly	A,C,M
France Telecom	Pleumeur Bodou	A,C
Norwegian Telecom	Eik	A,
Comsat Mobile Communications US	Southbury	A,B,C,M
IDB Mobile Communications US	Niles Canyon	A

Pacific Ocean Region

Service Provider	Station	Systems
Telstra Australia	Perth	A,C,M
Bijing Marine China	Beijing	A,C
KDD Japan	Yamaguchi	A,B,M
KTA Korea	Kumsan	A,C
Far East Shipping Co Russia	Nakhodka	A
Singapore Telecom	Sentosa	A,C
Comsat Mobile Communications US	Santa Paula	A,B,C,M
IDB Mobile Communications US	Niles Canyon	A