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*Technical Report*

**Satellite Earth Stations and Systems (SES);
Overview of present satellite emergency
communications resources**

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***ETSI***

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# Contents

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# Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

# Introduction

Recent major catastrophes have raised awareness of the need for effective emergency telecommunication networks. For instance:

- The Tsunami of Christmas 2004.
- Katrina hurricane.

Satellite has definitely turned out to be a cornerstone in such networks since satellites are not damaged by disasters occurring on the surface of the earth. Beside, satellites have the capability to broadcast their signal which is helpful in mass alert. Based on these considerations, TC SES has created in September 2006 a new working group dedicated to Satellite Emergency Communications, namely SatEC, and requested SatEC to start its work by a survey on satellite emergency communications.

# 1 Scope

The present document is an overview of all the resources, in a broad sense, which could contribute to the design and set up of effective networks for emergency telecommunications, including:

- Review of Spectrum allocation and Spectrum allocation studies, regulatory situation and perspective.
- Overview of access to commercial capacity.
- Overview of present satellite emergency communication systems architectures.
- Overview of available relevant technologies, off-the-shelf technologies or promising standards.
- Standardization bodies, fora and Working groups working on the subject.

As a conclusion, the present document will provide recommendations for future work.

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## 2.1 Normative references

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Not applicable.

## 2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area**.** For non-specific references, the latest version of the referenced document (including any amendments) applies.

[i.1] ETSI TS 102 181: "Emergency Communications (EMTEL); Requirements for communication between authorities/organizations during emergencies".

[i.2] A/CONF.184/BP/2: "Disaster Prediction, Warning and Mitigation".

[i.3] Report ITU-R Recommendation M.2033: "Radiocommunication objectives and requirements for public protection and disaster relief".

[i.4] ETSI EN 300 421: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for 11/12 GHz satellite services".

[i.5] ETSI EN 302 307: "Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications".

[i.6] ETSI TR 102 187: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; Overview of BSM families".

[i.7] ETSI EN 301 790: "Digital Video Broadcasting (DVB); Interaction channel for satellite distribution systems".

[i.8] ETSI TR 102 444: "Emergency Communications (EMTEL); Analysis of the Short Message Service (SMS) and Cell Broadcast Service (CBS) for Emergency Messaging applications; Emergency Messaging; SMS and CBS".

# 3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

| | |
|---|---|
| AAA | Authentication, Authorization, Accounting |
| BGAN | Broadband Global Area Network |
| BSS | Broadband Satellite Services |
| C | Citizens |
| CAP | Common Alerting Protocol |
| CEN | Comité Européen de Normalization |
| CENELEC | Comité Européen de Normalisation Electrotechnique |
| CEPT | Conférence Européenne des Postes et Télécommunications |
| CGC | Complementary Ground Component |
| COLT | Cell On Light Truck |
| DMR | Digital Mobile Radio |
| DVB | Digital Video Broadcasting |
| DVB-H | DVB for Handheld terminals |
| DVB-RCS | Return Channel by Satellite in a DVB-S system |
| DVB-RCS+M | DVB-RCS as adapted to Mobiles |
| DVB-S | DVB by Satellite |
| DVB-SH | DVB for Handheld by Satellite |
| DVB-S2 | DVB-S release 2 |
| DVB-T | DVB for Terrestrial television |
| EGNOS | European Geostationary Navigation Overlay Service |
| EIRP | Equivalent Isotropic Radiated Power |
| EMTEL | EMergency TELecommunications |
| ESA | European Space Agency |
| ETSI | European Telecommunication Standardization Institute |
| EU | European Union |
| FEC | Forward Error Correction |

| | |
|---|---|
| FCC | Federal Commission for Communications |
| FSS | Fixed Satellite Services |
| G/T | Gain over noise Temperature ratio |
| GMES | Global Monitoring of Environment and Security |
| GNSS | Global Navigation Satellite System |
| GPS | Global Positioning System |
| GSM | Global System for Mobiles |
| ICG | International Coordination Group |
| ICT | Information and Communication Technology |
| IOC | International Oceanographic Commission |
| ISI | Integral Satcom Initiative |
| IP | Internet Protocol |
| IT | Intervention Team |
| ITU | International Telecommunication Union |
| ITU-R | International Telecommunication Union Radiocommunication Sector |
| LA | Local Authorities |
| LBS | Location Based Services |
| MBMS | Multimedia Broadcast and Multicast Services |
| MF-TDMA | Multiple Frequency and Time Division Multiple Access |
| MPE | Multi Protocol Encapsulation |
| NGO | Non Governmental Organization |
| NCC | Network Control Centre |
| PMR | Private Mobile Radio |
| PPDR | Public Protection and Disaster Relief |
| PSAP | Public Safety Answering Point |
| PSC | Public Safety Communication |
| PSTN | Public Switched Telephony Network |
| RCST | Return Channel Satellite Terminal |
| RR | Radio Regulations |
| SAR | Search and Rescue |
| SatEC | Satellite Emergency Communications |
| SC | Satellite Component |
| SCPC | Single Channel Per Carrier |
| SG | Study Group |
| TEWS | Tsunami Early Warning System |
| TIA | Telecom Industry Association |
| TSF | Télécom Sans Frontières |
| UDLR | Uni-Directional Link Return |
| UMTS | Universal Mobile Telecommunication System |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UNO | United Nations Organization |
| UNOCHA | United Nations Office for Coordination of Humanitarian Affairs |
| VHF | Very High Frequency |
| WGET | Working Group on Emergency Telecommunications |
| WP | Working Party |

# 4 Position of the problem

## 4.1 Categories of emergency considered

According to ETSI EMTEL working group, emergency is "an urgent need for assistance or relief" (see http://www.emtel.etsi.org). Emergencies are roughly categorized as (a) daily emergencies which are handled by regular emergency services (fire brigades, emergency medical services, …) and (b) disaster emergencies (disasters for short) which are "a serious disruption of the functioning of society, posing a significant, widespread threat to human life, health, property or the environment, whether caused by accident, nature or human activity, and whether developing suddenly or as the result of complex, long-term processes".

The examples cited in the introduction refer to disasters mainly characterized by:

- a wide area is affected;
- human lives are in danger;
- … but daily emergencies infrastructures, if available, are damaged as well and can not ensure their mission: hospitals do not have any more power supply, roads are cut etc.;
- in particular, the terrestrial telecommunication infrastructures are not operational or not available.

Satellite was then used to connect the devastated area with infrastructure for medical care, for backing rescue teams in general, for connecting persons with their relatives.

Satellite turn out to an unrivaled solution in case of disasters and that is why the emphasis will be put on such scenarios in the present document. However there is a tight interlacing between disaster emergencies and daily emergencies. Both situations share a lot of similarities in terms of organization and resources.

There will be no restriction regarding the cause of the disaster.

The present document focuses on the following phases of disaster management:

1) Preparedness should be to some extent envisaged:
    - Satellite networks should be operational when some disaster occurs.
    - To observe the Earth, to detect hazards at an early stage.
2) Crisis is central in the study, from break-out (decision to respond) to immediate disaster aftermath, when lives can still be saved. Emergency response is understood as the reaction of the Society to a disaster; it should be distinguished from the disaster itself.
3) Return to normal situation should be envisaged with provisory networks based on satellite links.

Satellite is useful in general when persons are isolated (e.g. persons living on remote islands).

It can be useful for some specific usages such as Location Based Services (LBS) or remote observation of the disaster area.

## 4.2 Emergency response

Figure 1 represents the successive phases of an emergency response.

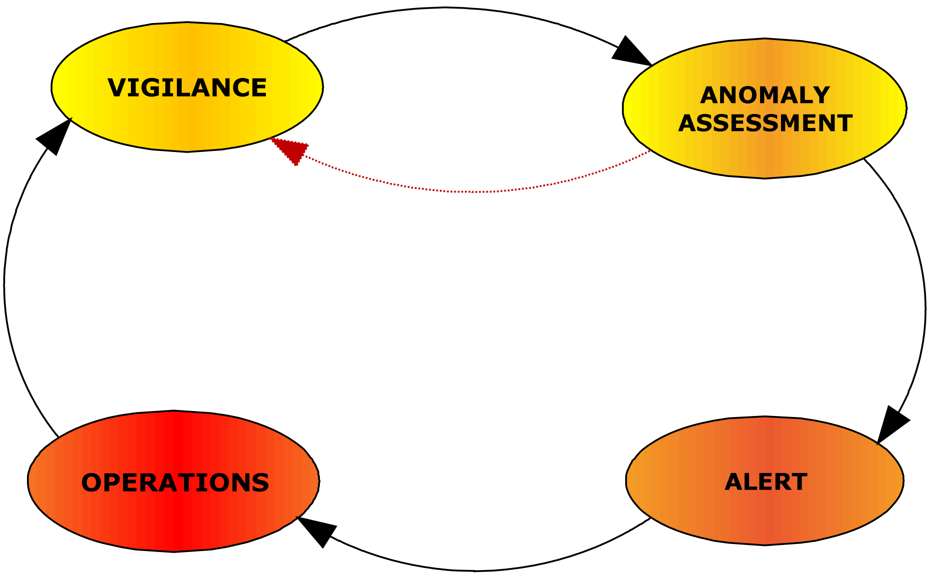


**Figure 1: Emergency response state diagram**

The reasons for the transition from one state to the next one are not in the scope of SatEC's work. This state diagram just intends to highlight the need for telecommunications in the different states of the emergency response.

### 4.2.1 Vigilance and anomaly assessment

The vigilance system has two main functions:

- Detection and location of anomaly and possible disaster threats.
- Communication between and, in case, alert to authorities with a view to assess the situation and take any appropriate decision including the launch of an alert. This communication can be extended to professionals such as the responsible of industrial plants or of big meeting places who have a professional need to be advertised of the threat in advance.

Detection of a hazard may be done by several means:

- Emergency call: this is the case where a Citizen is calling a dedicated Public Safety Answering Point (PSAP) e.g. dialling 112 in Europe to witness of the outbreak of a hazard.
- Systematic watch by professionals e.g. helicopters flying over forests in summertime to detect fires. Satellite can play a role to that respect by means of observation and scientific satellites. A typical case when satellites can detect hazards prior to any other means is meteorological hazards.
- Sensors involved in a complex network with machine-to-machine connections. Sensors are useful in places where human being can not go (nuclear reactor) or actually rarely goes (water level sensor upward a river to detect inundations). Satellite is then a relevant solution to connect the sensors to an expertise centre.

As for location, satellite is nowadays the best means to provide the geographical coordinates of any object thanks to GNSS and GPS/Galileo/Glonass constellations. The idea is to have terrestrial sensors coupled with a GPS/Galileo/Glonass sensor; for example a so-called "tsunameter" which sends its coordinates when it is overwhelmed.

Vigilance is part of a wider phase called "preparedness" which includes:

- Maintenance of the system.

An emergency system should be ready to start at any time. To that end, it should be tested at regular time intervals in quiet times from end to end.

- Training and education of authorities, rescue teams and citizens.

### 4.2.2 Alert

There are basically two kinds of alert: alert to authorities (which can be extended to some professionals) and alert to citizens; the requirements are not the same.

Following the example of the International Oceanographic Commission (IOC), the concept of Early Warning is introduced. Early Warning means that there is an evidence of an abnormal situation but that is has not yet turned to a hazard. IOC suggests to disseminate an Early Warning of a tsunami when the seismographs reveal abnormal activity in critical places; and to disseminate an Alert once and only once a big wave has risen.

Note that when the tsunami begins to rise, far abroad from coasts, there is still time to respond efficiently.

Alert makes sense if and only if there is a delay between the very break out of the hazard and the damages it could cause which leaves time to people to escape.

Alert to citizens is always the authorities' responsibility since they are the only one who can clearly appreciate the danger depending on local circumstances.

Deciding that the situation is critical may be taken at governmental, national level. This is the case for examples for earthquakes in all European countries.

In every stage, satellite could be an efficient way to propagate alert to the citizens. Mass Alert could be a typical mission of a satellite based emergency system.

### 4.2.3 Operations

#### 4.2.3.1 Involved parties

This clause lists the involved parties in an emergency operation as well as the communication flows. In the discussion, the following terms are used:

- Fixed: the telecommunications equipment can be pre-installed at a given place (typically a coordination center).
- Transportable: the telecommunication equipment will be set up in a place not known in advance, still during the time of the crisis it will be fixed or – at least – will not have to be operating while being moved.
- Mobile: the telecommunications equipment will possible be operated while moving.

In a situation of crisis the involved parties can be classified in the following way:

- *The administration authorities* (fixed): the local, regional or national authorities which are responsible for rescue operations.
- *The temporary task force for coordination* (fixed): an ad-hoc task force set up for coordination purposes and featuring representatives of all the disciplines on the field. This task force is usually located far from the field in direct contact with the administration authorities. If necessary, a *field task force* (transportable) may be set up closer to the field which coordinates with the (back) coordination task force.
- *The emergency control centre* (fixed)*:* each center coordinates the rescue means of a given discipline during daily operations. As soon as the emergency – daily or not – reaches a critical mass in terms of engaged resources, *field emergency control centres* (transportable) are deployed close to the field.
- *The rescue teams* (mobile)*:* teams in charge of rescuing Citizen in danger, preventing hazard extension or any time critical mission just after the break out of the crisis; in charge of caring injured people once the crisis is over.
- *The citizens* (fixed and mobile): the citizens are directly or indirectly affected by the disaster. They rely on telecommunications means in order to be informed of situation, get in touch with their (injured) relatives etc.
- Additional infrastructure specific to the emergency situation (fixed hospitals, energy and telecommunication operators etc.)

Figure 2 shows the communication flows that are likely to take place among the parties. This graph is inspired from TS 102 181 [i.1] but tries in addition to highlight the difference between operational authority and employer authority. For example a fireman could have to report to the Field Temporary Task Force for Coordination and to its ordinary Control Centre. By the way, it shows the need for connections.

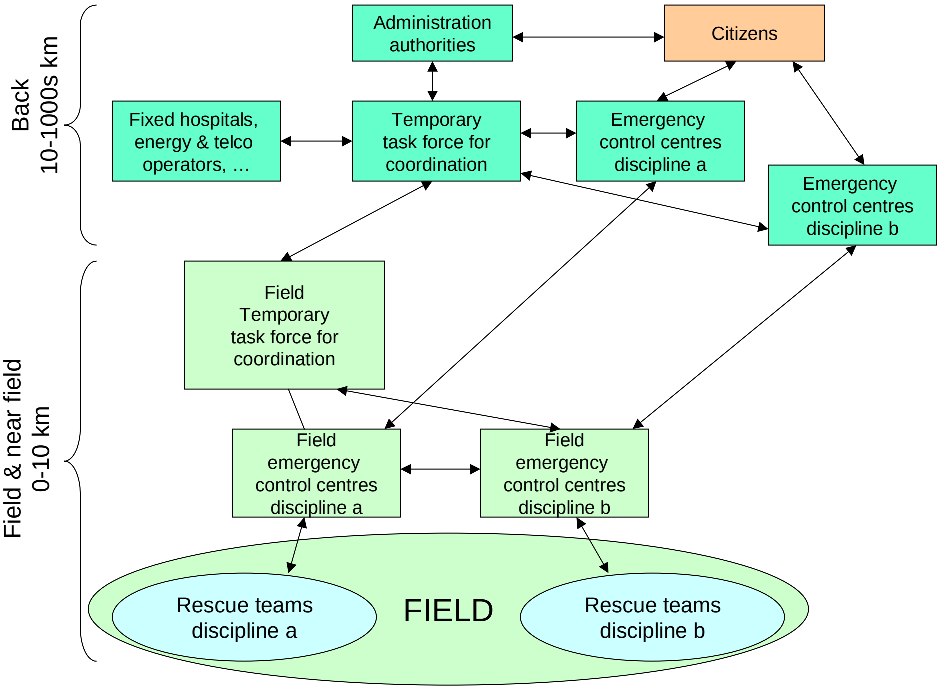


**Figure 2: Communication flow among involved parties in case of disaster emergency**

An example of the types of messages that could be exchanged within this flow is given in annex A.

### 4.2.3.2 Coordination and support of rescue Teams

Coordination of rescue teams begins when the crisis breaks out. The authorities alert them just before the population and then hand over supervision to task forces for coordination and emergency control centres.

Later on, field structures (task force for coordination, emergency control centres) still receive instructions from their back structures. In general, instructions are transmitted through a back-up network made up by a satellite terminal which links the disaster field to terrestrial backbones.

It is worth to create a "cell" surrounding the field within which rescue teams communicate by terrestrial mobile radio means. It is a very flexible solution based on a lot of radio mobile communication devices that could be packed in a container and transported to the field of operations by helicopter or any other means. In such a communication cell, one could for example recreate a GSM communication cell by means of a mini Base Transceiver Station linked to a Mobile Switch Centre of any operator. Other technologies are possible too (e.g. Wi-Fi, WiMAX, TETRA, UMTS, analog PMR, DMR).

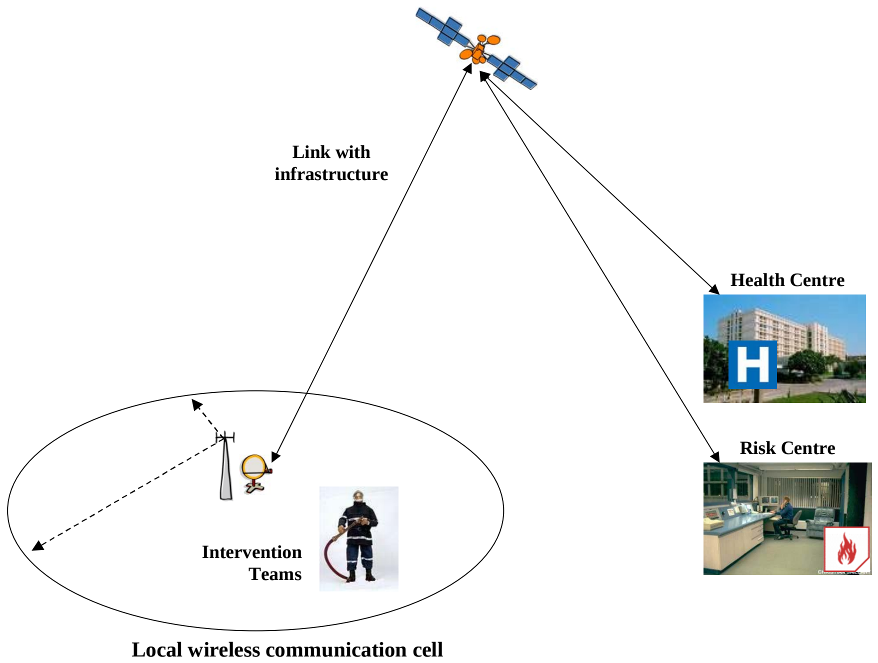


**Figure 3: Communication between Intervention Teams and backing infrastructures**

#### 4.2.3.3 Information feedback from the field of operations

Intervention Teams return information to Local authorities, to the on-the-Field Risk Management Centre, to any additional infrastructure about the situation and request for help. They use one and the same network for receiving instructions and returning feedback.

Note that this is the general case with an outpost on the field. But in the case there is no outpost, direct communication with backing infrastructure should be possible (e.g. scouting operations).

### 4.2.4 Return to normal situation

At that point, the crisis is over and the situation has come back to a stable and livable point. The ordinary networks are down and it is necessary to set up a network able to work on a regular basis.

The main functions of the network are as follows:

- to coordinate rescue teams and to return feedback from the field which is still necessary at that point;
- as far as possible to enable the same services as before the crisis and to offer public access.

The architecture may be the same as the one outlined above with a satellite link but the network should be more stable and powerful.

## 4.3 Method of distribution

### 4.3.1 Unicast

Support, Requests, Reports are unicast messages.

Instructions may be unicast messages.

### 4.3.2 Multicast

Multicast is in essence dissemination of a message to a selected group of users.

Targeted Alerts, Instructions are multicast messages.

### 4.3.3 Broadcast

Alert to the citizens is a broadcast message i.e. this message targets everyone.

## 4.4 Nature of the content (operations)

There may be different types of contents justifying the use of different communication technologies. The goal of this clause is to refine this analysis.

### 4.4.1 Basic signals

The use of very basic signals has proven effective in Emergency Calls (SOS) or Broadcast Alert (stressing sounds, flashing lights).

### 4.4.2 Speech

Speech is the minimum that all involved parties demand. It is the most common medium of interaction.

### 4.4.3 Video teleconferencing

It is useful:

- to provide Support to Intervention teams for example by demonstrating how to practice emergency surgery or handling of dangerous substances;
- for intervention teams to report on what is going on around them.

### 4.4.4 Images

Images e.g. maps are an important type of content.

### 4.4.5 Data

Data covers all the remaining cases of digital communications: short text messages, location data, triage data etc.

Data communication is useful when very specific information is required e.g. blood typing. It seems relevant for communicating the output of sensors (which can be analysed as a Report message).

# 5 Review of resource to cope with the need

## 5.1 Operational emergency networks using satellite

### 5.1.1 Experience of Katrina Hurricane

Though this experience was extreme, it has highlighted the importance of satellite telecommunication during the relief of a disaster. This clause gathers return of experience about it.

As one could have predicted, satellite cell phones (from Globalstar) were the telecom device that kept the best service.

Sprint operator deployed so-called COLTs (Cells On Light Trucks), a concept very similar to that described in clause 4.2.3.2.

An interesting initiative consisted for Bell South to redirect incoming phone calls to a voice mail system giving the ability to people to consult them at a later time, once they could do it. This gave a contact point to relatives and insurance companies.

Old-fashioned walkies-talkies remain a must for communications on the field with more pros than cons: easiness to use, no third party (operator) involved, no need for license; as for cons, poor services (only analog voice) and possible interference with other users.

Wi-Fi and WiMAX were being deployed initially to support relief efforts but served then to enable basic services and make a link between people struck by the disaster and their relatives. WiMAX has been used to feed Wi-Fi hot spots. The FCC has been instrumental in coordinating and easing the work of Wireless Internet Services Providers.

The first point was not to restore the networks as they were; people were gathered in provisory shelters and the priority is to supply them with telecommunication services.

It turned out that the biggest problem for telecommunication within the area hit by the hurricane or between this area and the rest of the world was electrical power. To cope with that, operators had delivered fuel provisions in advance.

### 5.1.2 Cospas/Sarsat system

Cospas-Sarsat is a satellite system designed to provide distress alert and location data to assist search and rescue (SAR) operations, whether at sea, in the air or on land, using spacecraft and ground facilities to detect and locate the signals of distress beacons.

This satellite system was initially developed under a Memorandum of Understanding among Agencies of the former USSR, USA, Canada and France, signed in 1979.

The System was then declared operational in 1985 following the successful completion of the demonstration and evaluation phase. On 1 July 1988, the four States providing the space segment signed the International Cospas-Sarsat Programme Agreement which ensures the continuity of the System and its availability to all States on a non-discriminatory basis. In January 1992, the government of Russia assumed responsibility for the obligations of the former Soviet Union. A number of States, Non-Parties to the Agreement, have also associated themselves with the Programme and participate in the operation and the management of the System.

Crafts or persons in distress emit a beacon either at the 121,5 MHz frequency (first frequency available historically for this purpose) or at 406 MHz frequency (offering better performances). This signal is captured by near polar orbit satellites (geostationary satellites have proven to be capable to provide the service as well) then forwarded to the appropriate Search and Rescue Point of Contact through the Cospas-Sarsat Mission Control Centres network.

Since 1982, the System has been used for thousands of SAR events and has been instrumental in the rescue of over 20 000 lives worldwide.

## 5.2 Relevant Regulations

### 5.2.1 ITU-R and other regulation bodies

Radio spectrum, either dedicated to satellite or not, is managed all over the world according to a set of rules called the Radio Regulations (RR). These RR have the value of an international treaty and are compelling for the signatories. Administrations negotiate and establish the RR within the Radiocommunication sector of the International Telecommunication Union (ITU-R), an international body attached to UNO and based in Geneva.

Within ITU-R, the work is organized by Study Groups. Let us quote the definition of Study Groups as it is stated by ITU-R itself:

"ITU-R Study Groups are established and assigned study Questions by a Radiocommunication Assembly to prepare draft Recommendations for approval by ITU Member States."

There are study groups specializing in the following areas:

- SG 1 Spectrum management;
- SG 3 Radiowave propagation;
- SG 4 Satellite Services;
- SG 5 Terrestrial Services;
- SG 6 Broadcasting Service;
- SG 7 Science Services.

"Subgroups, such as Working Parties (WP) and Task Groups (TG) are established to study the Questions assigned to the different Study Groups. This structure allows smaller entities to select the areas of competence to which they wish to contribute."

The reader is referred to ITU-R literature for further details.

Study groups whose work is relevant for emergency satellite communications are SGs 1, 4, 6 and 7.

Among the different services, satellite services have a special status since space is a no man's land: they are not submitted to control by any national authority (see below). They are only subject to agreements between satellite operators (or specifically Administrations acting on behalf of them). An other essential duty of ITU-R is to organize the agreeing procedure, called frequency coordination, by fixing the rules for it, by recording requests for frequencies and eventually recording the agreements between operators.

National Administrations through their National Regulatory Authority control terrestrial radiocommunications in their territory in the sense that they allow or forbid emissions. They are concerned with space communications as far as these may interfere with (or be subject to interference from) terrestrial communications; in particular, they control Earth stations.

CEPT countries have felt the need to coordinate frequency usage between them. They have created the European Radiocommunication Office (ERO) which works on harmonization measures; it edicts decisions and recommendations consistent with ITU-R rules but restricted to the European continent.

This regulatory issue is critical for example when several countries are affected by one disaster.

## 5.2.2 Regions of concern

This survey is valid for the whole world unless otherwise specified.

## 5.2.3 Services of concern

### 5.2.3.1 The concept of service in ITU-R

The ITU-R regulation rules define a service as follows:

"*radiocommunication service:* A service (…) involving the transmission, *emission* and/or reception of *radio waves* for specific *telecommunication* purposes."

When there is no ambiguity, we will speak of *service* in place of *radiocommunication service*.

Formally, a service is fully defined by:

- a set of frequency bands;
- a certain power flux distribution (an antenna diagram) which constrains emission in certain directions and prevents interference in certain other ones in these bandwidths.

A service is associated a number of tasks that all devices declared as operating in this service should carry on. In common sense, the word service refers to such a set of tasks.

#### 5.2.3.2 Relevant services

A number of services are relevant in emergency communications (based on satellite or not). They are listed on ITU-R web site (http://www.itu.int/ITU-R/) and can be found out by launching a search on the word *emergency*. The list is reproduced here below.

| Disaster phases | Major radiocommunication services involved | Major tasks of radiocommunication services |
|---|---|---|
| **Prediction and Detection** | • Meteorological services (meteorological aids and meteorological-satellite service)<br>• Earth exploration-satellite service | Weather and climate prediction. Detection and tracking of earthquakes, tsunamis hurricanes, typhoons, forest fires, oil leaks etc. Providing warning information |
| **Alerting** | Amateur services | Receiving and distributing alert messages |
| | Broadcasting services terrestrial and satellite (radio, television, etc.) | Disseminating alert messages and advice to large sections of the public |
| | Fixed services terrestrial and satellite | Delivering alert messages and instructions to telecommunication centres for further dissemination to public |
| | Mobile services (land, satellite, maritime services, etc.) | Distributing alert messages and advice to individuals |
| **Relief** | Amateur services | Assisting in organizing relief operations in areas (especially when other services are still not operational) |
| | Broadcasting services terrestrial and satellite (radio, television, etc.) | Coordination of relief activities by disseminating information from relief planning teams to population |
| | Earth exploration-satellite service | Assessment of damage and providing information for planning relief activities |
| | Fixed services terrestrial and satellite | Exchange of information between different teams/groups for planning and coordination relief activities |
| | Mobile services (land, satellite, maritime services, etc.) | Exchange of information between individuals and/or groups of people involved in relief activities |

## 5.3 Available technology and commercial access

This clause discusses the actual means to provide the services of interest, their relevance and their weaknesses.

NOTE: UNO report A/CONF.184/BP/2 [i.2] presents a good synthesis on the use of space technology in natural disasters management. It goes back to 1998 but most of the material is still up-to-date.

### 5.3.1 Available technology

Available technology means off-the-shelf technologies, including proprietary technologies which have encountered some success but includes also standards not yet marketed.

#### 5.3.1.1 Types of satellites and payloads

Satellites in orbit around the Earth essentially accomplish four types of missions each of which is relevant for an emergency network.

1) Observation satellites with optical, radar or thermal imagery instruments, space probes or radar altimetry instruments

   - for topography measurements and for mapping hazardous zones (concept of "vulnerability assessment");
   - for detecting and monitoring meteorological hazards, such as hurricanes;
   - for monitoring a variety of geological hazards (earthquakes, volcanoes etc.);

- for monitoring sea surface temperature to forecast events like El Niño;
- for measuring sea level height to detect tsunamis;
- for measuring motion of toxic clouds, oil slicks or fires when they are moving slowly;
- etc.

2) Global Positioning System (GPS)/Galileo/Glonass satellites
   - for emergency location and navigation purposes, especially within the context of search and rescue operations;
   - in combination with satellite imagery for monitoring potential disasters.

3) Telecommunications satellites
   - for broadcasting warnings either to fixed or mobile terminals;
   - for linking disaster areas with backbones or more generally backing infrastructures;
   - for sending distress signals, especially from ships and aircrafts.

4) Satellite-based mobile telephone systems in emergency instances where the terrestrial networks have been damaged or destroyed.

### 5.3.1.2 Multimedia by satellite

The present document distinguishes between narrowband and broadband. Although the border is actually not so clear, it has been considered that broadband begins at 1 Mbps according to reference [i.3].

#### 5.3.1.2.1 Narrowband

##### 5.3.1.2.1.1 Inmarsat

Inmarsat is at the origin an international organization aimed at the safety of people at sea. It turns to a private company in 1999. Inmarsat owns and operates a fleet of 10 geostationary satellites, divided in four generations, with worldwide coverage.

Inmarsat provides data and (digital) voice services for people on the move (though inmarsat terminals are not *mobile* in the sense now given to this word in telecommunications) where networks are in outage or simply not available. The bit rate can reach 256 kbps guaranteed and up to 512 kbps best effort. It is intended for the land mobile market (BGAN, Broadband Global Area Network), the maritime market (FleetBroadband service, to come) and the aeronautical market (SwiftBroadband service, to come).

Inmarsat has developed a specific technology to support its services. They have developed a terminal which serves as an interface between a satellite link and any type of terrestrial network (GSM, PSTN, ethernet etc.). Though it is proprietary, it has encountered such a success that it can not be ignored in a survey on emergency telecommunications by satellite.

##### 5.3.1.2.1.2 DVB-SH

DVB-SH belongs to the large DVB standard family. At the origin, DVB standards have been designed with a view to transport digital TV. But the so-called MPEG2 container was also suitable for carrying IP datagrams by means of Multi Protocol Encapsulation Mechanism (MPE) of IP datagrams into a payload of the DSMCC_section format.

The DVB-SH is an adaptation of DVB-H to transmissions by satellite. DVB-H is basically an adaptation of DVB-T to small "handheld" terminals similar as for size, aspect and user interface to UMTS terminals. DVB-H introduces only minor changes in DVB-T waveform (so-called 4K mode) and at the link layer (FEC coding of the MPE container) but represents a breakthrough as it introduces a "service layer", IP datacast, for IP multicast. Note that IP datacast is copied from MBMS, UMTS service layer. Beside, DVB-H may be combined with a return channel for interaction (selection of programs).

The new standard DVB-SH, instead, provides multimedia services over hybrid satellite and terrestrial networks at frequencies below 3 GHz to a variety of mobile and fixed terminals having compact antennas with very limited directivity. Target terminals include handheld (PDAs, mobile phones etc.), vehicle mounted, nomadic (laptops, palmtops etc.) and stationary terminals. The present document allows to achieve a universal coverage by combining a Satellite Component (SC) and a Complementary Ground Component (CGC): in a cooperative mode, the SC ensures geographical global coverage while the CGC provides cellular-type coverage.

#### 5.3.1.2.2 Broadband

##### 5.3.1.2.2.1 DVB-S

DVB-S is a waveform originally designed for digital TV but which could easily adapted to the transport of IP datagrams (see paragraph above). Thus DVB-S has become the first true standard for multimedia over satellite.
See EN 300 421 [i.4].

DVB-S is basically a broadcasting technology for passive receivers hence a waste of bandwidth in IP unicast or even multicast. A reverse link was needed not only because it was users' demand but for a more efficient management of the bandwidth.

##### 5.3.1.2.2.2 DVB-S2

DVB-S2 is an evolution of DVB-S designed with a view to save bandwidth. DVB-S2 introduces new coding and modulation techniques, Variable Coding and Modulation and when a return channel is available this turns to Adaptive Coding and Modulation which means that coding and modulation are chosen so as to reduce the bandwidth while maintaining a good signal-to-(noise plus interference) ratio. See EN 302 307 [i.5].

##### 5.3.1.2.2.3 BSM Air Interfaces families

Broadband Satellite Multimedia ETSI working group is standardizing a set of technologies enabling multimedia by satellite with a return channel.

Return channel is defined with respect to a central node, the Network Control Centre (NCC) which is responsible for establishing connections of satellite terminals to the satellite subnetwork. The NCC may be coupled with a hub which is an intermediate node for the traffic between two satellite terminals. The forward link or channel goes from the hub to satellite terminals while the return link goes from satellite terminals to the hub. The wording of return channel does not make any more sense when a direct connection is established between two satellite terminals.

The technologies available on the market are classified according to their Air Interface (see TR 102 187 [i.6]). There are four ones.

| FAMILY CODES | DEFINITION |
|---|---|
| THS-x | Transparent satellite<br>Hybrid (1-way satellite channel)<br>Optional terrestrial return path<br>Star connectivity |
| TSS-x | Transparent satellite<br>Satellite Return channel<br>Star connectivity |
| TSM-x | Transparent satellite<br>Satellite Return channel<br>Mesh connectivity |
| RSM-x | Regenerative Satellite<br>Satellite Return channel<br>Mesh connectivity |
| NOTE: The suffix "x" is a letter from A to Z. | |

Let us give examples of commercial technologies corresponding to each family:

- THS: solutions based on UDLR protocol such as the ones developed by Hitachi or by UDcast.
- TSS: DVB-RCS protocol with star topology; Hughes IPOS (or Direcway) technology.

- TSM: SCPC technologies; or MF-TDMA technologies such as Viasat Linkway.
- RSM: DVB-RCS protocol with mesh topology (for example Amerhis or Skyplex); Hughes Spaceway technology.

##### 5.3.1.2.2.4 DVB-RCS

DVB-RCS provides the interaction channel for geostationary satellite interactive networks with fixed Return Channel Satellite Terminals (RCST) (see EN 301 790 [i.7]). In such a system the RCSTs receive a Forward Link signal based on the DVB-S or DVB-S2 specifications. In a non-regenerative system, the Return Link signal transmitted from the RCST is received by one or more Gateways, which also interact with the NCC. In regenerative systems, instead, it may also be possible to have direct RCST-to-RCST communications. The system may be used in all frequency bands allocated to FSS or BSS services. A standardization process for the extension of DVB-RCS to mobile environment is currently going on and the first draft of the new standard DVB-RCS+M is to be published at the beginning of 2008.

## 5.3.2 Commercial access

### 5.3.2.1 Observation satellites

The satellites are operated by governmental agencies which ease access to image data bases for public services purposes. The countries which own and operate observation satellites in the world are China, India, Japan, Russian Federation and United States; in Europe, the European Organization for the Exploration of Meteorological Satellites (EUMETSAT; see http://www.eumetsat.int).

The abilities of geostationary satellites to provide a continuous view of weather systems make them invaluable in following the motion, development and decay of some phenomena.

Even such short-term events as severe thunderstorms, with a life time of only a few hours, can be successfully recognized in their early stages, and appropriate warnings of the time and area of their likely maximum impact can be expeditiously provided to the general public.

Polar-orbiting satellite systems provide data needed to compensate for many of the deficiencies in conventional surface-based observing networks, especially over marine regions and sparsely inhabited land areas. In their near-polar orbit, such satellites acquire data from all parts of the globe in successive revolutions, each of which takes just over an hour and a half. From a relatively low altitude (approximately 800 km), the satellite's sensors can acquire data at high resolution, both spatially and spectrally.

At the date, satellites can acquire two successive images of a given region at about eight hours interval. If we consider a more elaborated service than simple image delivery, for example processing of images or combination of processed images and GIS data, the time interval at which decision makers receive two successive inputs could be reduced. This implies a complete Information and Communication Technology (ICT) architecture. Also it is possible to augment the capability of Earth Observation satellites thanks to Advanced Wide Field Sensors embedded on geostationary satellites (the same strategy as for GNSS and EGNOS).

### 5.3.2.2 Telecommunication satellites

The purpose of this clause is to list the requirements for a commercial satellite offer enabling to link the disaster area with backing infrastructure. It should help a satellite terminal user to choose quickly a relevant satellite offer.

The satellite terminal user should specify its need in terms of:

- Geostationary vs non geostationary satellites.
- Frequency bands. Satellite terminals on the field should use transportable antenna, as light and small as possible; hence the satellite should offer Ku or Ka-band links.
- Waveform and coding. The payload and the teleport at the other end of the link should comply with the waveform and coding of the satellite terminal technology. This includes the following options:
  - digital versus analog transmission;
  - multiple access technology versus SCPC;

  - transparent versus regenerative payload;
  - etc.

- Source bit rate. Types of contents as listed in clause 4.4 or applications output require a minimum bit rate to function satisfactorily. The bit rate combined with the coding rate and the spectral efficiency of the waveform yields a certain amount of bandwidth that should be available to the satellite terminal user.
- Coverage: The coverage of the satellite should encompass the satellite terminal. The EIRP and G/T should result in a good link budget (given the coding, the waveform and the bandwidth).
- Added value services: There are a lot of possibilities here: the satellite terminal user may want to use client-server or end-to-end applications (e.g. videoconferencing); it may want to connect to the MSC of any mobile operator (GSM backhauling); it may want to use "poor" phone systems etc.

Each region should have a priority list of satellites to cover the region and the services of concern.

#### 5.3.2.3 Positioning systems by satellite

There are three satellite constellations orbiting around the Earth and dedicated to positioning: GPS, Glonass and soon Galileo; these systems are so called Global Navigation Satellite System (GNSS). In addition, there are three Satellite Based Augmentation Systems: EGNOS to cover Europe, WAAS to cover North America and MSAS to cover Japan.

The three GNSS consist of constellations of Middle Earth Orbit satellites on three planes. Terminals compute their distance to four different satellites by measuring the time for a signal to come from the satellites; then they derive the position and time (x, y, z, t) by trilateration techniques. The three GNSS have coordinated their frequencies so as to permit functioning without interference.

Global Positioning System (GPS) is the USA system and the first deployed historically. It is made up of 32 satellites but only 24 are required for the system to be fully operational.

Glonass is an equivalent system developed and operated by the former Soviet Union (today Russia). Legal constraints on the use of the signal have been relaxed since the $1^{st}$ of January 2007 (it was until then forbidden to use distance evaluation with an uncertainty below 30 m).

GPS and Glonass have a typical accuracy of 20 m.

Galileo is the forthcoming European system. But the set of stakeholders goes beyond Europe. So far only one satellite has been launched and a 2nd one is planned to be launched end of 2007. The system is due to be operational by 2013.

EGNOS (European Geostationary Navigation Overlay Service) is a system dedicated to navigation applications and positioning; it is made up of three geostationary satellites and a ground network and is operational since 2005. It is an ESA program. EGNOS works in connection with GPS and Glonass constellations. It essentially provides enhanced positioning based on native GPS/Glonass signals with a specified accuracy of 5 m and integrity of the position (dynamic estimation of a bound of the position error and alarm in case the system detects a failure).

EGNOS and Galileo are parts of a wider system: the Global Navigation Satellite System designed by Europe for positioning purposes.

In the future, EGNOS will to provide signals to augment both Galileo on the one side and the GPS/Glonass pair on the other side.

## 5.4 Standardization effort

Here other technologies than satellite are envisaged as far as they interconnect with a satellite network.

### 5.4.1 EMTEL

http://www.emtel.etsi.org

EMTEL is short for Emergency Telecommunications.

EMTEL was created in 2002. At the beginning, it was ad-hoc group of the Operational Coordination Group, that meaning that its mission consisted in ensuring that the need for emergency telecommunications was taken into account by all Technical Committees. EMTEL became a Special Committee in February 2005. As such it produces deliverables containing users' requirements.

EMTEL gathers all stakeholders which have to intervene in emergency situations and could need telecommunication means including National Civil Securities, Non Governmental Organizations, International Organizations etc. a few of which are listed below in the present document. EMTEL seeks to develop a consensus among these stakeholders about common description of the needs and of the processes. It takes the lead to interface between ETSI and International and Standardization bodies on the topic of emergency communications.

EMTEL is also the interface for emergency communications issues between ETSI and:

- Commission for Environmental Cooperation;
- European Free Trade Association;
- North Atlantic Treaty Organization;
- ITU groups;
- CEPT ERO;
- relevant CEN and CENELEC committees.

EMTEL covers all possible technologies.

It belongs to SatEC missions to liaise with EMTEL and to take into account EMTEL deliverables in its own deliverables.

### 5.4.2 MESA

http://www.projectmesa.org/

MESA is joint project between ETSI and TIA about the use of broadband wireless mobile technologies for Public Protection and Disaster Relief (PPDR). Mesa is a nickname for Public Safety Partnership Project. It refers to the name of the town where the partnership agreement was signed, in Arizona.

Mesa seeks interoperability and interworking of wireless mobile networks; its vision is to reach a "system of systems". Mesa is producing specifications to enable this system-of-systems with a truly global scope.

MESA involves users and organizations from the PPDR and Peacekeeping sectors as well as the industry.

"Interconnection to one or more of the planned **broadband satellite constellations** is also being considered by MESA in order to ensure a **stable communication path from remote areas** where terrestrial infrastructures may be seized during natural disasters." (Quoted from Mesa web site).

It belongs to SatEC missions to liaise with Mesa and each "project" should take into account deliverables of the other one.

## 5.5 Initiatives related to SatEC all over the world

This clause introduces a few international organizations whose mission is closely linked to SatEC work. Many other organizations could be cited. For a more complete list, see http://globalcrisis.info/emergencytelecommunications.htm.

### 5.5.1 PSC forum

http://www.psc-europe.eu/

The "Forum for Public Safety Communication Europe" (PSC Forum) has been established, with the support of the European Commission, in order to facilitate consensus building in the area of public safety communication and information management systems. The Forum was launched on 1st June 2006 for an initial duration of 3 years and fosters the development and the use of public safety communications and information management systems to improve the provision of public safety services and the safety of the citizens of Europe and the rest of the world. This Forum invites users and policy makers, industrials (technology and service providers), research organizations and standard making authorities to reach consensus on:

- consolidated user requirements;
- solutions for inter-operability of communication systems among users;
- a R&D road map for future activities;
- guidelines for policy makers and regulators, indicating ways for the improvement of global, European or national inter-operability through implementation of harmonized technologies and/or approximation of legal environments.

The idea is that Forum's conclusions and recommendations will be put together in Memoranda of Understanding to be submitted to relevant authorities and representative bodies.

In particular, the SHARPS Working Group (Satellite and High Altitude platforms for emeRgency and Public Safety communications) in the PSC Forum, is writing a white paper that will include an overview of state of the art and of the upcoming evolution of the satellite and HAP technologies relevant for emergency and public safety, including terminals, interoperability issues with terrestrial systems, technology limitations and advantages.

### 5.5.2 ISI

http://www.isi-initiative.eu.org/

"The Integral Satcom Initiative (ISI) is an industry-led action forum designed to bring together all aspects related to satellite communications. ISI addresses broadcasting, broadband, and mobile satellite communications, as well as their convergence, in integration within the global telecommunication network infrastructure. ISI supports all forms of space communication and space exploitation. ISI is a Technology Platform included in the seventh Framework Programme (FP7) of the European Commission.

ISI is an open platform, whose membership embraces all relevant and interested private and public stakeholders. ISI intends to collaborate and cooperate with the European Commission, the European Space Agency (ESA), the EU and ESA Member States and Associated States, the National Space Agencies, International Organizations, User fora, and other European Technology Platforms. ISI fosters international cooperation under a global perspective.

ISI is determined to contribute significantly to several EU and ESA policies, in order to promote European industrial competitiveness, growth and employment in a sustainable way, in synergy with National priorities. Representative sectors of interest include ICT, Space, Security, Transport, Development, and Environment. Specific policy initiatives of interest include i2010, the European Space Policy, and in general all those initiatives which can benefit from the existence of an efficient satellite communications infrastructure, or which are aimed at the development of innovative satellite services and technologies.

(…)

ISI works towards the convergence and integration of satellite and terrestrial networks, both fixed and mobile, considering all interworking and interoperability aspects. ISI supports the development of applications and services according to a user-centric approach, to enable all citizens to become full members of the knowledge-based society. ISI addresses the integration of satellite communications with navigation, Earth observation, and Air Traffic Management systems. Specific attention is devoted to Galileo and GMES. Data relay systems and the use of Unmanned Aerial Vehicles are in the scope of ISI, as well. ISI will be instrumental in achieving and maintaining European leadership and competitiveness in all of the above fields, fostering the entire industrial sector, and maximizing the value of related research and technology development. ISI embodies the critical mass required to pursue the above objectives considering short-term priorities, medium-term evolutions, and long-term strategic directions.

ISI contributes to the harmonization of the European and International regulatory framework for satellite communications, helping in the removal of barriers. ISI works for the allocation of sufficient spectrum for all satellite communication applications and services. ISI favours the consideration of a regulatory framework for complementary ground components (CGC). ISI promotes open standards and international standardization approaches. ISI fosters wide adoption of common standards (…)."

(Quoted from ISI terms of reference).

### 5.5.3 Télécom sans frontières

Télécom Sans Frontières (TSF) is a non-governmental organization which aims at providing telecom services to population and rescue teams after a disaster.

Though created in France, it is now present on a permanent basis in two other countries: Nicaragua and Thailand which enables quick intervention worldwide. TSF provides direct assistance to the population but supports other non governmental organizations too. In their presentation, TSF underlines that is of key importance in humanitarian interventions that people isolated in disaster areas can send news to their relatives outside.

Actually TSF teams bring different telecommunication terminals on the field of the disaster and establish local communications as well as connections to backbones. Then they establish a network by connecting all the devices together. The services provided include phone, fax, data, videoconferencing, connection to the Internet.

Satellite communications are essential in the technologies that TSF uses: Inmarsat fleet with B-Gan and Thuraya satellites with the corresponding terminals (phones).

### 5.5.4 International Charter "Space and Major Disasters"

Following the UNISPACE III conference held in Vienna, Austria in July 1999, the European and French space agencies initiated the International Charter "Space and Major Disasters". Since many other space agencies from all over the world have joined.

The Charter aims at providing a unified system for space data acquisition and delivery to those affected by disasters thus mitigating the effects on human life and property. Each member agency has committed resources to support the provisions of the Charter. Space data means here outputs of observation satellites or probes.

Actually the systems functions as follows: an on –duty operator receives the call, checks the identity of the requestor and verifies that the request form is properly filled up. The operator passes the call to an Emergency On-call Officer who analyses the request and the scope of the disaster with the user and prepare an archive acquisition plan using available space resources taking into account the level of emergency.

### 5.5.5 UNO

#### 5.5.5.1 The Working Group on Emergency Telecommunications and Tampere convention

The Working Group on Emergency Telecommunications (WGET), created by the United Nations Office for Coordination of Humanitarian Affairs (UNOCHA), is an open forum to facilitate the use of telecommunications in the service of humanitarian assistance. More specifically:

"Its objectives include:

a. facilitating the promotion and implementation of The Tampere Convention on the Provision of Telecommunication Resources for Disaster Mitigation and Relief Operations;

b. encouraging measures applying the ITU resolutions and recommendations relative to telecommunications for disaster relief;

c. exchanging and disseminating information concerning emergency telecommunications;

d. promoting cooperation and interoperability of telecommunications with and in the field.

3. Institutional participants in the WGET include international, governmental and non-governmental humanitarian organizations with an interest in emergency telecommunications. Individuals with an interest in emergency telecommunications may be invited to participate in the work of the WGET."

(Quoted from WGET terms of reference).

The WGET holds plenary conferences on a regular basis (twice a year).

The main outcome of this Working Group so far is the *Tampere Convention on the provision of telecommunication resources for disaster mitigation and relief operations*.

The UNOCHA convened in June 1998 in Tampere, Finland, an intergovernmental conference to sign the convention; the WGET was instrumental in issuing the text of the convention and preparing the conference.

Provision of Telecommunication Resources means transport of telecom equipment across borders; the aim is to set a legal framework for that, allowing rescue teams to bring their equipment with them on the field of operations.

#### 5.5.5.2 UNESCO/IOC/TEWS

The giant tsunami of December 2004 and its devastating consequences have raised awareness and sensitivity to this particular hazard. Hence a number of initiatives which we will describe roughly here. In this clause, TEWS stands for Tsunami Early Warning System. As explained in clause 4.2.2, the IOC makes a distinction between "Early Warning" and simple "Warning" and the systems all present Early Warning capabilities. However the words Tsunami or Early are sometimes omitted in the acronyms.

There exist four regions in the world where this hazard is critical:

- The North East Atlantic and Mediterranean which has given rise to the NEAMTWS.
- The Indian Ocean which has given rise to the IOTWS.
- The Caribbean which have given rise to the CARIBE-EWS.
- The Pacific which has given rise to the PTWS.

Unesco and more specifically the International Oceanographic Commission (IOC) is organizing the work at international level by gathering International Coordination Groups (ICG); thus there are four ICG. They are constituted by representatives of the different administrations having an interest of any kind in the subject (mainly administrations of countries having coasts exposed to the hazard but also countries having industrial solutions to sell such as Germany).

It is fair to say that PTWS is the only TEWS truly operational on a wide scale; as for the others, there exist only start up networks. IOC has assigned ICGs the mission of launching operational networks at the end of 2007.

The general architecture of a TEWS is constituted by an uplink and a downlink.

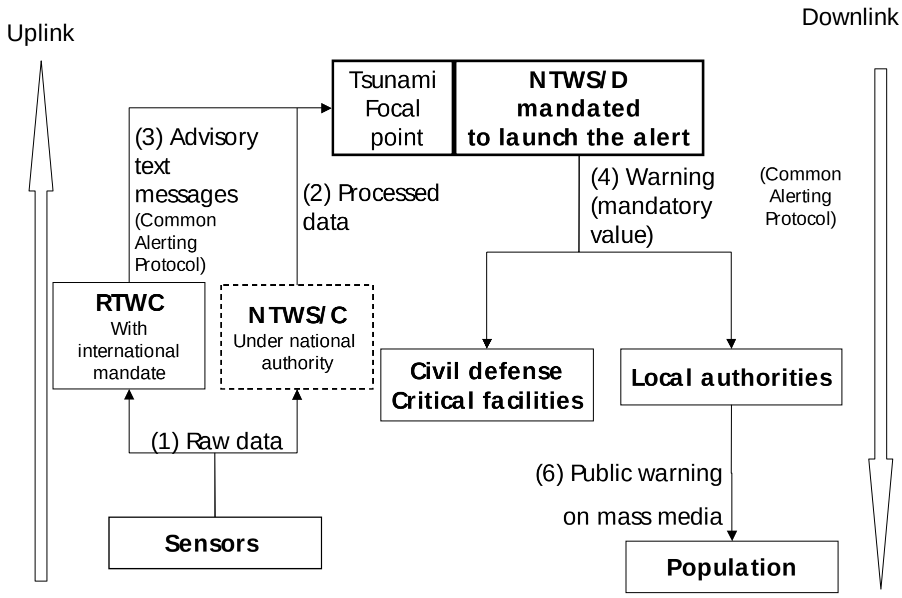


**Figure 4: General Early Warning Systems architecture**

The uplink's main functions are to collect data from many sensors, to process and consolidate it, to compute an evaluation of the criticity of the situation which may result in an alert. Satellite could play a role in the uplink:

- telecommunication satellites could collect data from marine sensors;
- observation satellites could provide data (for example, interferometry enables to day to measure variations of the height at the surface of the Earth of a few centimeters).

The alert is taken at national level for nations consider it to be a matter of national sovereignty although geography and physics commend to take it at supra-national level.

The downlink's main functions are to disseminate the alert first to local authorities in the regions concerned and then to the local population; it is up to the local authorities to decide if the alert is to be spread to the population. As for the first step, national authorities issue situation bulletins on a regular basis that local authorities can consult in pull mode in ordinary times and that are pushed to them in case of emergency. These bulletins could comply with the Common Alerting Protocol (CAP).

Satellite could play a role for dissemination of alert bulletins to local authorities in case of emergency; it could clearly play a role in broadcasting the alert to the population by means of TV or radio channels.

These principles could clearly serve as a basis for the forthcoming specification of an architecture of a satellite based emergency communication system.

# 6 Recommendations for future work

## 6.1 On SatEC positioning

Here it is discussed SatEC positioning with respect to the other standardization bodies, what is new in SatEC, what gap it fills as for technical solutions and the need for standards.

Along the present document, the concept of *emergency network* is underlying. Clause 4.2 Emergency response explains the main missions of an organization in charge of managing emergency situations. From these, the main requirements of emergency satellite networks can be derived. There are three types of networks dedicated to the management of emergency situations according to the three phases of disaster management:

- A network dedicated to *preparedness* can be seen as an infrastructure operated by authorities, available on a permanent basis, enabling authorities to collect and forward information (including emergency calls) about possible hazards and offering various services (access to data bases etc.).

- A network dedicated to *return to normal situation*. This is by definition a network set up on a provisory basis until ordinary networks are operational again. Its main mission is to restore connection of people in the disaster area with the rest of the world. This network can share its resource with the network dedicated to crisis (see below), the Quality of Service policy giving priority to the needs of the later one. It can in general not offer the same level of service than in ordinary times.

- A network dedicated to operations in emergency situations. The emphasis is put on this since they are central in the study.

SatEC vision is that an emergency network dedicated to crisis should gather and, in technical words, integrate all types of resources either public or private, amateur or professional, information or telecommunication etc. In case of emergency situation, a broad participation of professional teams is advisable an emergency network should provide them with the means to connect and to participate, as quickly as possible.

There are a few essential requirements that such a network should meet:

- The infrastructure necessary to operate the network should exist and have been successfully tested at the starting time of the crisis; this requirement may be relaxed for terminals or subnetworks at the edge of the infrastructure which participate on a good will basis to emergency operations (e.g. radio amateur networks). We call that pre-deployment.

- The infrastructure should be interoperable as far as possible with networks or technologies which are nowadays instrumental in managing crisis (e.g. VHF).

- The authorities play an essential role in defining and managing the network. Acting under legal provisions, they mobilize or pre-empt resource in commercial networks, they decide "who" may connect or not to the infrastructure.

- To have a network fully dedicated to emergency communication is not a viable solution. On the one side, it is costly to implement and manage; on the other side, there are many advantages to use commercial networks since they are a good means to launch mass alert and that they are very reliable. However, it makes sense to leave critical pieces of network under total control of authorities. There is room here for specifying architectures with a sensitive approach of resource sharing.

Thus SatEC work would consist essentially in specifying such networks as far as they encompass a satellite link.

What are the implications of these requirements as for standardization?

## 6.2 Redeployment

How could SatEC help in preparing the network? The contribution of SatEC to pre-deployment could be:

- to specify architectures and interfaces between network components. For example, an architecture for GSM backhauling by satellite between a given GSM backbone and a disaster area;
- to specify management of remote devices (monitoring, configuration);
- to publish validation plans.

Also ETSI plug-test facility could be a good means for subnetworks operators (e.g. a NGO) to test connectivity to backbones.

Beside architecture, SatEC should define the respective roles of the operators involved and how they interact (which services they propose to one another). For example, one could imagine a role of chief operator, meaning by that the operator to which authorities, who possess ultimately the control of the emergency network, could delegate their technical responsibility. Inmarsat can be interpreted as an example of this model.

## 6.3 Interoperability

How to make sure that pieces of networks, devices, terminals to be integrated can interconnect and work out? there is a clear need for standards here.

There is an explicit demand (from Mesa, for example or as for the concept described in clause 4.2.3.2) for an integrated emergency network with both mobile (terrestrial) and satellite links. SatEC should address this demand focusing on the satellite link. It should highlight the place of the satellite links within the architecture and specify interfaces with other network components. In its liaison with Mesa, SatEC should be proactive.

(By the way, SatEC statement of work indicates that the working group should focus on "broadband" solutions which often refer to multimedia and IP. This is misleading: the networks considered are not necessarily based on IP and not necessarily multimedia).

It is definitely an objective of SatEC to define a standard set of interfaces (Services Access Points).

Operators and manufacturers can expect from SatEC guidelines to adapt their standards in a way which is convenient to emergency as EMTEL does, for example, with TR 102 444 [i.8] regarding the Cell Broadcasting Service for alert.

## 6.4 Resource sharing

How to share the resource between emergency and ordinary services? this is a problem of Quality of Service. It is clear that traffic relating to the management of the crisis should have priority and be warranted to reach its destination within a delay compatible with action. However it should not interrupt normal functioning. Note that the concept of Quality of Service offers much flexibility, enabling (technically speaking) complete control of the network by authorities (mobilization).

Whichever the level of mobilization, authorities should be identified and authorized as potential users of the resource with extended rights and that, throughout the whole integrated network, which could imply functions such as profile replication or translation in different places.

How to compensate for the resource mobilized? Authorities would likely give a compensation for the resource consumed but this has to be accounted for accurately.

SatEC will study issues related to resource sharing such as AAA functions and Quality of Service.

# Annex A: Types of messages

Here it is given an example of the messages exchanged during operations on the communication network. The classification of messages is presented under the form of a matrix with the Involved Parties as both horizontal and vertical inputs. In each cell, the message from one involved party to the other(s) is indicated. The sources of the messages are on the vertical axis, the destinations on the horizontal axis.

Six types of messages are identified:

1) Advertising of a hazard.

2) Warning (either Targeted Warning or Broadcast Warning).

3) Instructions.

4) Support (typically expertise).

5) Request (either for Instructions or Support).

6) Report.

| Destination Source | Field Task Force for coordination | Authorities | Health Centre | Rescue teams | Citizens |
|---|---|---|---|---|---|
| **Field Task Force for coordination** | | Request for Support ; Reporting e.g. description of damages | Request for Support e.g. identification of a toxic chemical substance | Instructions and Support | Instructions |
| **Authorities** | Support | | Support | Targeted Warning; Instructions ; Support | BroadcastWarning; Instructions |
| **Health Centre** | Support | Instructions | | Support | |
| **Rescue teams** | Request for Instructions and Support ; Reporting | Request for Instructions and Support ; Reporting | Request for Instructions and Support ; Reporting | | |
| **Citizens** | | | | | |

# History

| Document history | | |
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