

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

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## Foreword

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

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## 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.

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# 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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The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

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".

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## 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 TELcommunications
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:

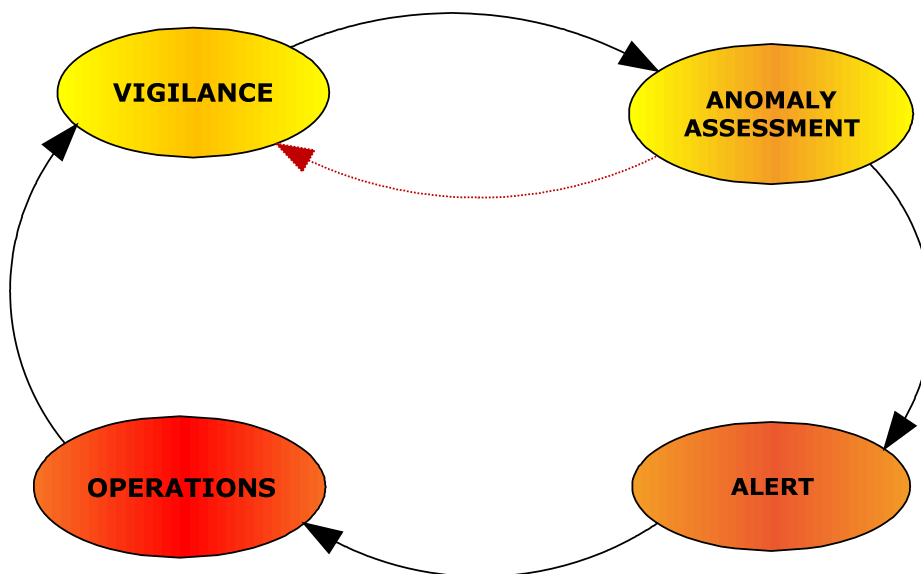
- 1) Preparedness should be to some extent envisaged:
  - Satellite networks should be operational when some disaster occurs.
  - To observe the Earth, to detect hazards at an early stage.
- 2) Crisis is central in the study, from break-out (decision to respond) to immediate disaster aftermath, when 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 it 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.)