



Technical Report

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

**PREVIEW**  
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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. Satellite communication, observation and navigation are the cornerstones of emergency management because they are resilient to Earth damage and provide a wide coverage of service.

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.

The present document is a revision of the initial document TR 102 641.

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# 1 Scope

The present document presents an overview of concepts, systems and initiatives related to the use of space resources in the context of disaster management, including:

- An introduction to the field of disaster management and the relation with Information and Communication Technology.
- The role of space technology in disaster management.
- The requirements of telecommunication systems deployed for disaster management.
- A list of typical space resources used, covering earth observation, satellite navigation and satellite communications.
- A list of initiatives in the field of emergency communications, including standardization activities.

The present document does not cover extensively any given technology through e.g. project descriptions or equipment characteristics as it is meant as an overview document.

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# 2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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## 2.1 Normative references

The following referenced documents are necessary for the application of the present document.

Not applicable.

## 2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] "Environmental health in emergencies and disasters: a practical guide". Edited by B. Wisner and J. Adams, World Health Organization, 2003.
- [i.2] ETSI TS 102 181: "Emergency Communications (EMTEL); Requirements for communication between authorities/organizations during emergencies".
- [i.3] Recommendation ITU-T X.1303: "Common alerting protocol (CAP 1.1)".
- [i.4] ETSI TR 103 166: "Satellite Earth Stations and Systems (SES); Satellite Emergency Communications (SatEC); Emergency Communication Cell over Satellite (ECCS)".
- [i.5] ISO 22320: "Societal security -- Emergency management -- Requirements for incident response".
- [i.6] OASIS, OASIS Emergency Management TC: "Common Alerting Protocol Version 1.2".

- [i.7] OASIS, OASIS Emergency Management TC: "Emergency Data Exchange Language Resource Messaging (EDXL-RM) 1.0".
- [i.8] "EU Handbook on assistance interventions in the frame of the Community Mechanism for Cooperation in civil protection", European Commission, Environment Directorate-General, May 2003.
- [i.9] ETSI SR 002 777: "Emergency Communications (EMTEL); Test/verification procedure for emergency calls".
- [i.10] ETSI TR 102 180: "Emergency Communications (EMTEL); Basis of requirements for communication of individuals with authorities/organizations in case of distress (Emergency call handling)".
- [i.11] ETSI TR 102 299: "Emergency Communications (EMTEL); Collection of European Regulatory Texts and orientations".
- [i.12] ETSI TR 102 476: "Emergency Communications (EMTEL); Emergency calls and VoIP: possible short and long term solutions and standardization activities".
- [i.13] ETSI TR 102 410: "Emergency Communications (EMTEL); Basis of requirements for communications between individuals and between individuals and authorities whilst emergencies are in progress".
- [i.14] ERC Report 25: "The European table of frequency allocations and applications in the frequency range 9 kHz to 3000 GHz (ECA table)".
- [i.15] ITU Radio Regulations.
- [i.16] UN resolution 61/110: "United Nations Platform for Space-based Information for Disaster Management and Emergency Response".

### 3 Abbreviations

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

BGAN	Broadband Global Area Network
CAP	Common Alerting Protocol
CEPT	Conférence Européenne des Postes et Télécommunications
COP	Common Operational Picture
COSPAS	Cosmicheskaya Sistyema Poiska Avariynich Sudov
DC	Direct Current
ECA	European Common Allocation
ECC	European Communications Committee
EGNOS	European Geostationary Navigation Overlay Service
ELT	Emergency Locator Transmitter
EMTEL	EMergency TELcommunications
EO	Earth Observation
EPIRB	Emergency Position Indicating Radio Beacon
ETSI	European Telecommunications Standards Institute
EXDL	Emergency Data Exchange Language
FSS	Fixed-Satellite Service
GNSS	Global Navigation Satellite System
GOES	Geostationary Operational Environmental Satellite
GPS	Global Positioning System
GSO	Geostationary Orbit
ICT	Information and Communication Technology
IPR	Intellectual Property Right
ISO	International Standardization Organization
ITU	International Telecommunication Union
ITU-R	International Telecommunication Union Radiocommunications Sector
ITU-T	International Telecommunication Union Telecommunications Sector

LEO	Low Earth Orbit
MSS	Mobile Satellite Service
NOAA	National Oceanic and Atmospheric Administration
NRBC	Nuclear, Radiological, Bacteriological, Chemical
OASIS	Organization for the Advancement of Structured Information Standards
PAMR	Public Access Mobile Radio
PCP	Partnership Co-operation Panel
PLB	Personal Locator Beacon
PLMN	Public Land Mobile Network
PMR	Private Mobile Radio
POES	Polar Operational Environmental Satellite
PPDR	Public Protection and Disaster Relief
PSTN	Public Switched Telephony Network
RDSS	Radio Determination Satellite Service
SARSAT	Search And Rescue Satellite-Aided Tracking
SatEC	Satellite Emergency Communications Working Group
SCN	Satellite Communications and Navigation Working Group
SG	Study Group
SLA	Service Level Agreement
TC SES	Technical Committee Satellite Earth Station and Systems
TC	Technical Committee
TETRA	Terrestrial Trunked Radio
TR	Technical Report
TS	Technical Specification
VPN	Virtual Private Network
VSAT	Very Small Aperture Terminal
WGFM	Working Group Frequency Management
XML	Extensible Markup Language

## 4 Positioning of the problem

According to ETSI EMTEL Special Committee, emergency is *an urgent need for assistance or relief*.

Emergencies are roughly categorized as (1) daily emergencies which are handled by regular emergency services (fire brigades, emergency medical services, etc.) and (2) disaster emergencies (disasters for short) which are - according to the definition of the World Health Organization, *a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses that exceed the ability of the affected community or society to cope using its own resources* [i.1]. Disasters result from natural or man-made hazards.

The outcome of a major disaster is mainly characterized by:

- A wide area is affected.
- Environmental damages are occurring.
- Human lives are in danger.
- Water, electricity and transportation infrastructures are impaired.
- Daily emergency organizations and infrastructures are deeply affected and overwhelmed so they cannot ensure their missions.
- The economical situation of the affected country may be impaired on a long-term basis (several years).
- Terrestrial telecommunications infrastructures are destroyed, saturated or simply not available.

The present document focuses on the use of satellite telecommunications systems in order to optimize disaster management hence mitigate the negative impacts of a disaster on these occasions. Because of the scope of SES/SatEC the present document will focus on emergency telecommunications.

While not within the major focus of the present document, the following topics are also related:

- a) the use of satellite-based navigation and Earth observation services for disaster management; and
- b) the management of daily i.e. regular emergencies such as day-to-day fire fighting missions and the emergency medical service.

## 4.1 Disaster management and response

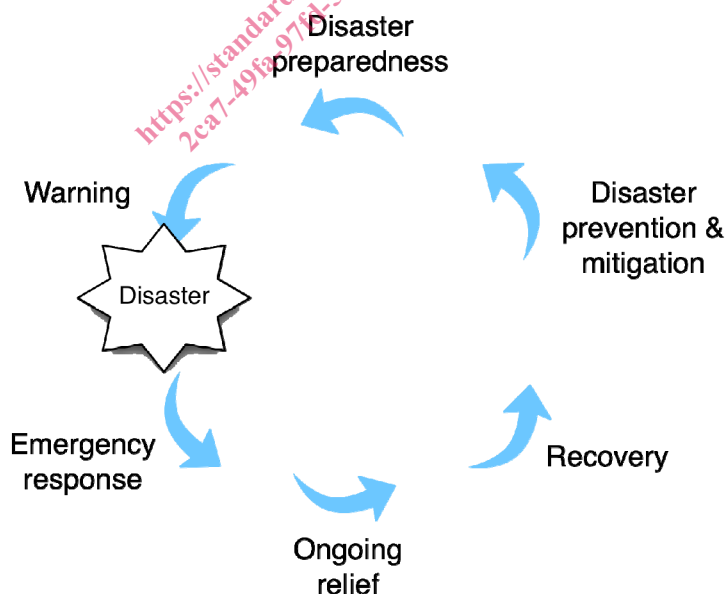
### 4.1.1 Disaster management cycle

The United Nations Department of Humanitarian Affairs defines disaster management as *a comprehensive approach and activities to reduce the adverse impacts of disasters*. It is important to note that disaster management is not limited to the response upon the occurrence of a disaster.

In order to better grasp all activities related to disaster management; it is often split in four broad phases:

- Disaster mitigation and prevention: a set of measures to reduce or neutralize the impact of natural hazards by reducing social, functional, or physical vulnerability.
- Disaster preparedness: the organization, education, and training of the population and all relevant institutions to facilitate effective control, early warning, evacuation, rescue, relief and assistance operations in the event of a disaster or emergency.
- Emergency warning and response: a sum of decisions and actions taken during and after disaster, including alerting, immediate relief, rehabilitation, and reconstruction.
- On-going recovery and relief: a set of measures aiming to restore the affected place to its prior state (i.e. before the disaster).

The disaster recovery phase is likely to trigger a new iteration of disaster management starting with disaster mitigation and prevention. For this reason, disaster management is often represented as a never-ending cycle of mitigation, preparedness, response and recovery as shown in Figure 1.



**Figure 1: The disaster management cycle**

Efficient and effective disaster management relies on proper coordination. Coordination calls for communication among the involved parties. Communication relies on the availability of adequate telecommunications systems fitting the specifics of the environment (distance among the parties, mobility, topology), the context of information exchanges (nature and amount of the information, frequency of the exchanges).



The next paragraph describes more in details the response phase. Indeed, upon a disaster, existing telecommunication infrastructures are often destroyed, severely impaired or saturated (if present at all).

### 4.1.2 Disaster response

Disaster response is the most acute phase of disaster management. It encompasses several types of missions:

- Alerting: citizens are alerted (e.g. about sheltering procedures). Emergency responders and authorities are alerted.
- Scouting and evaluation assessment: the situation is assessed in order to identify existing threats, define the proper answer and estimate the resources to deploy.
- Emergency response: immediate and urgent actions are taken so to:
  - a) minimize the number of casualties;
  - b) mitigate the impact of immediate and significant threats (e.g. distributing iodine pills in case of nuclear contamination, first aid/medical care, emergency sheltering/lodging, fire fighting).
- Disaster relief: actions are taken so to cope with situations where life is not immediately threaten (e.g. installing water sanitization plants and power generators, decontamination against NRBC agents, psychological assistance, food and medics supply) but endangered on the medium term.

In order to ensure effective response and an efficient use of resources, several measures are taken in the organization of the response:

- The operation area (i.e. the area suffering the consequences of a disaster) is partitioned into zones so to ease management and cope with the escalation of the operation.
- Responders are scheduled and dispatched according to their disciplines with the objective to compartment as much as possible the activities on the operation area in order to ease global management and relax constraints on communication.
- Command and reporting follows a hierarchical scheme in order to ease coordination and make sure that relevant information is available at the right decision level.

Figure 3 shows the communication relations that are likely to take place among the participating entities. This diagram is inspired from TS 102 181 [i.2] and focuses on satellite communication aspects. Other satellite services like Earth observation are not explicitly depicted.

The entities are dispatched on two areas: the disaster area [i.8] including the operation area and the off-site area. The distance from the disaster area and off-site area can range from tens of kilometres (for a small-scale disaster) to thousands of kilometres (e.g. responders sent abroad in case of a large-scale disaster).

Several coordination task forces exist whose roles are to realize an effective and efficient integration of all disciplines active on the operation area. While the present document mostly focuses on emergency telecommunications for responders, it is worth noting that the affected persons (directly such as victims or indirectly such as their relatives) are in need of communication capabilities so to call for help, communicate with their family, etc.

The means of communication links among entities display a wide scope of requirements pertaining to:

- The range: close range (i.e. hundreds of meters) from the operation area to the field control center and long range (hundreds to thousands of kilometres) from the field temporary task force to the off-site coordination task force.
- The motion of the communicating entities: mobile for rescue teams, semi-mobile for field control centers and fixed for the temporary coordination task forces.
- The number of communication terminals and bandwidth needs.
- The nature of the communication: mostly voice in a group-call mode for the operation area and point-to-point broadband data upward.