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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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Foreword

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

The present document is intended to be used as a report on the current status quo.

1 Scope

The present document is intended to outline the concept of Emergency Communication Cells over Satellite (ECCS). An ECCS is understood as a temporary emergency communication cell supporting terrestrial wireless and wired standard(s) (e.g. based on IEEE 802.11 [i.4], VHF/UHF, IEEE 802.16 [i.5], GSM, or TETRA), which are linked/backhauled to a permanent infrastructure by means of bi-directional satellite links. The present document covers the involved roles for operating an ECCS and describes ECCS architectures based on existing products and introduces the challenges for providing interoperable services. An annex with existing ECCS solutions concludes the present document.

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

[i.2] ETSI TS 102 181: "Emergency Communications (EMTEL); Requirements for communication between authorities/organizations during emergencies".

[i.3] ETSI TR 102 641: "Satellite Earth Stations and Systems (SES); Overview of present satellite emergency communications resources".

[i.4] IEEE 802.11: " IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks-Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".

[i.5] IEEE 802.16: "IEEE Standard for Local and metropolitan area networks - Part 16: Air Interface for Broadband Wireless Access Systems".

3 Abbreviations

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

AAA	Authentication, Authorization and Accounting
ATA Spec 300	Air Transport Association

NOTE: See https://publications.airlines.org/CommerceProductDetail.aspx?Product=68.

BGAN	Broadband Global Area Network
BSC	Base Station Controller
BSS	Base Station Subsystem
BTS	Base Transceiver Station
CNES	Centre National d'Etudes Spatiales
DECT	Digital Enhanced Cordless Telecommunications
DNS	Domain Name System
DVB-RCS	Digital Video Broadcasting Return Satellite Channel
ECCS	Emergency Communication Cell over Satellite
EMTEL	Emergency Telecommunications
ETSI	European Telecommunications Standards Institute
GEO	Geostationary Earth Orbit
GIS	Geo Information Service
GSM	Global System for Mobile Communications
HLR	Home Location Register
HPA	High Power Amplifier
IP	Internet Protocol
ISI	Inter-System Interface
ITU-R	International Telecommunication Union Radiocommunication Sector
LAN	Local Area Network
LBS	Location Based Service
LSC	Local Switching Centre
MNO	Mobile Network Operator
MSC	Main Switching Centre
MTA	Multi-national Telecom Adapter
NAT	Network Address Translation
NGO	Non-Governmental Organization
PABX	Private Automatic Branch Exchange
PEA	Pan-European Satellite Telecom Adaptor
PEP	Performance Enhancing Proxy
PKC	(please remove the bullet point with this acronym)
PLMN	Public Land Mobile Network
PMR	Professional (or Private) Mobile Radio
PPDR	Public Protection and Disaster Relief
PSTN	Public Switched Telephone Network
QoS	Quality of Service
SatEC	Satellite Emergency Communications
SCPC	Single Channel Per Carrier
SES	Satellite Earth Stations and Systems
SIM	Subscriber Identity Module
SMS	Short Message Service
SwMI	Switching and Management Infrastructure
TCP	Transmission Control Protocol
TETRA	Terrestrial Trunked Radio
UHF	Ultra High Frequency
UMTS	Universal Mobile Telecommunications System
VHF	Very High Frequency
VLR	Visitor Location Register
VoIP	Voice over IP
VPN	Virtual Private Network
VSAT	Very Small Aperture Terminal

WiMAX	Worldwide Interoperability for Microwave Access
WISECOM	Wireless Infrastructure over Satellite for Emergency Communications
WLAN	Wireless Local Area Network

4 Emergency Communication Cells over Satellite (ECCS)

4.1 Introduction

Recent major disasters like the tsunami in 2004, earthquakes in Turkey (1999 and earlier/later years), a hurricane in the USA (2005), or the earthquake on Haiti (2010), have shown that terrestrial telecommunication infrastructures in the affected areas are either damaged or overloaded - or not existing at all. Consequently, international rescue teams may not rely on local services and they have to take their own communication equipment to the operation area.

Emergency Communication Cells over Satellite (ECCS) are intended as instant means to address this problem by setting up quasi-autonomous communication infrastructure in the field (i.e. incident area) supporting one or more terrestrial wireless standards. Connectivity with remote emergency control centres is enabled by backhauling these terrestrial standards via a non-ground based satellite network.

Report ITU-R Recommendation M.2033 [i.1] lists general radiocommunication objectives of Public Protection and Disaster Relief (PPDR) agencies and organizations. Among other requirements, like interoperability and interworking between networks, services have to be provided for "wide range of geographic coverage areas, including urban, suburban, rural and remote environments".

The EMTEL specification TS 102 181 [i.2] clearly states that "access to permanent bidirectional links between emergency control centres and their mobile teams is crucial in the handling of emergencies and need to be available for the duration of the emergency/disaster".

There is a variety of communication systems in use by governmental and non-governmental rescue and relief organizations from different countries and the most common systems in use are briefly described in the following clauses.

4.1.1 Analogue radio

Analogue Professional Mobile Radio (PMR) systems are simple, robust, still widely deployed and actively used by rescue organisations. Many of them operate in the VHF or UHF frequency bands. In contrast to regular telephone systems for analogue radio point-to-multipoint communication is a built-in feature. Radio sets can be operated either locally in direct (called "tactical") mode or as part of a regional transceiver network (e.g. common-wave broadcasting). The communication infrastructure is reliable as long as the interconnections of the radio stations and relay transmitters (repeaters) are available. In case of a disaster these repeaters might be damaged resulting in a restricted (in terms of range and coverage) but still working communication system. Analogue radios provide mostly voice service in direct or relayed mode. Data communication are also supported for bit rates below 10 kb/s (e.g. packet radio).

Analogue radios are also used by radio-amateur societies who provide assistance to administrations in case of emergency (e.g. F.N.R.A.S.E.C in France (http://www.fnrasec.org/), or TRAC in Turkey (http://www.trac.org.tr/).

Transmitted contents are normally not protected by strong ciphering/scrambling schemes so that confidentiality can not be granted. Contrariwise this can be an advantage especially if members from different organisations without common hierarchy have to exchange information.

4.1.2 Digital radio

Digital PMR systems are successors of these analogue systems and many countries have set up or are setting up digital PMR networks for team and operation coordination, both for police and non-police organisations (e.g. firebrigades) and Non-Governmental Organizations (NGO). These systems support similar to their analogue predecessors talkgroups, but are much more effective in terms of frequency usage. Their major disadvantage is the most likely incompatibility with existing PMR communication infrastructure outside the regular deployment area since the operation of PMR networks is, due to obvious security requirements, very much restricted and PMR handhelds typically need explicit clearing before booking into the network. Ciphering of transmitted content is possible but can turn out to be an obstacle to information exchange between different user groups too (e.g. in multi-national operations).

In several countries base-stations of digital PMR systems are considered to be critical components which means that uninterruptible power supplies and redundant network connections are used. Depending on the deployed technology it is partly possible to run a base-station in island mode without connectivity to the core network. Many digital PMR systems support a direct mode between terminals without using a base station transceiver too.

4.1.3 GSM/UMTS

Since cell phones are widely available, communication via GSM/UMTS has become popular in disaster situations too. As an example, the German rescue forces in Phuket during the tsunami were equipped with GSM mobile phones to coordinate evacuation of victims to Europe.

The major drawback to using public cell phone systems is their full availability to the public without any mechanism for priority calls. Especially in abnormal situations with high relevance for media, networks easily get into saturation. There is no possibility to establish calls directly between cell phones, i.e. without the GSM/UMTS network infrastructure up and running (location registers, network links, power supply) cell phones cannot be used.

Finally, Public Land Mobile Networks (PLMN) do not necessarily implement group calls (push-to-talk functionality), which is a key requirement for effective operation management.

4.1.4 Satellite phones

International rescue forces are using more and more satellite communications. E.g. almost all air rescue fixed wing providers in Central Europe do have Iridium mobiles on their aircraft, as it is a reliable communication means independent of terrestrial infrastructure. Usually satellite phones are used for speech only and not for data communication. Key advantages are that there is practically no time needed for deployment and mobile usage is possible. Main drawbacks are that there are usually not enough satellite phones available for the team and communication is always point-to-point without the possibility to set up group calls.

4.1.5 Very Small Aperture Terminals (VSAT) and portable satellite systems

VSAT provide satellite based communications for voice and data services. Deployment of a VSAT station can take from a couple of minutes to few hours depending on the characteristics and capabilities of the equipment (antenna size, manual or automatic pointing). Data rates of up to a few Mb/s are supported, but VSAT terminals normally require an external power source for operation or else are limited to a few hours of operations on batteries.

VSAT systems are not intended for landmobile usage, which means that they are deployed for a certain period of time (e.g. close to a local coordination centre).

4.1.6 Wireless local area networks and DECT

Wireless Local Area Network (WLAN, IEEE 802.11) systems plays currently a minor role for emergency data communication. With the availability of robust handhelds and emergency management applications this is likely to change soon. WLAN used for IP telephony has the potential to compete with DECT systems (see below).

WiMAX (IEEE 802.16) is suitable both for mobile devices and directional radio, but at time of writing the present document there are not too many commercially available WiMAX-based handhelds. Besides setting up a directional wireless connection might be an option for the recovery phase, but it might be too time consuming during the reaction phase directly after a disaster.

Sometimes rescue organisations use DECT (Digital Enhanced Cordless Telecommunications) phones in the direct vicinity of local coordination centres. Cell radius in buildings is typically between 30 m and 50 m, outdoors up to 300 m. As before, connectivity to a Public Switched Telephone Network (PSTN) depends on the availability of an access to this network.

4.2 ECCS challenges and roles

4.2.1 ECCS concept

TR 102 641 [i.3] identifies different categories for telecommunications equipment: fixed, transportable and mobile. The basic assumption for ECCS is that the ECCS terminal deployed in the field is (trans)portable, ECCS server components and access to core networks are fixed and only user terminals in the coverage area of ECCS-networks (see Figure 1) are mobile.

Furthermore [i.3] defines a number of parties and stakeholders during and after a crisis situation and the information flows between them. An ECCS is intended as a flexible means to support information transfer between remote control centers/authorities and teams active in the field.

Primarily ECCS are meant to be deployed directly after an incident/crisis/disaster as one of the first actions of the response phase, but for planned or plannable situations an early set-up as part of the preparedness phase is possible too. From the above it is clear that with different organisations involved there will be different needs.

Although the single pieces of technology are readily available as successfully shown in several research projects, there are only a few commercial products on the market combining the advantages of satellite communications and terrestrial wireless handhelds. In the following, this technical report will provide a non-exhaustive overview of current products and initiatives dealing with ECCS. In the present document we define ECCS as a combination of a satellite component and at least one terrestrial wireless service to be deployed in the field. The terrestrial wireless service can be considered as a small subnetwork which is connected via a satellite backhaul link to its core network. Figure 1 shows a simplified example ECCS architecture consisting of two satellite terminals:

- one located in the field, interconnected to a wireless network supporting mobile actors equipped with handhelds (voice, data, or combined);
- one located remotely, interconnected to core networks.

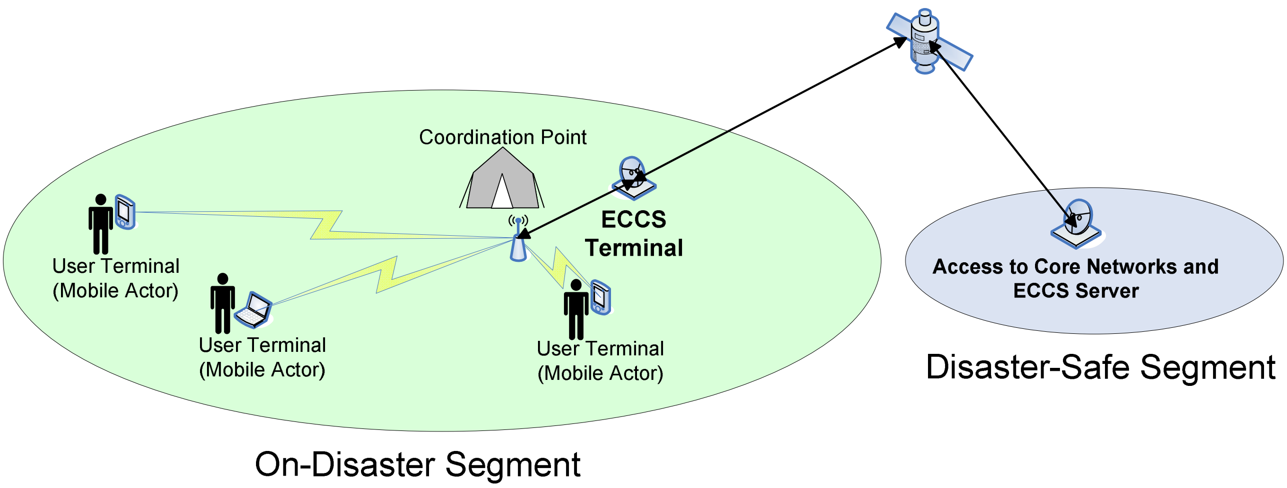


Figure 1: Example ECCS Scenario

In Figure 1, the ECCS terminal deployed in the field is co-located with a local coordination point. For practical reasons this configuration will be the normal approach, but it is not required for operating an ECCS. Reference [i.3] distinguishes between different operational authorities (e.g. temporary local operation control vs. remote operation control) and employer authorities (e.g. fire brigades vs. medical rescue), but throughout the present document we will not make a difference between user groups.

4.2.2 Overall challenges of an ECCS system

The peculiar environment and context of deployment requires versatile solutions, which have to match actual requirements. Since there will be conflicting design constraints (e.g. size vs. functionality), it is likely that several classes of ECCS devices will co-exist, for example:

- Portable yet basic ECCS systems: easily packaged in an airborne-cabin-format suitcase, providing voice and data access via satellite.
- Transportable and elaborate ECCS systems: packaged in an airborne-container format or multiple man-carried containers. They typically provide a wide range of interoperability services (including among multiple ECCS).
- Mobile ECCS systems with "on the move" access.

Moreover, ECCS models will be declined taking into account criteria such as:

- Power supply: an ECCS with moderate power consumption might be powered by a rechargeable battery which can be used either for temporary autonomous operation, for bridging the set-up time of a power generator, or as uninterruptible power supply to cope with unreliable electrical power supply. Generally, power consumption should be as small as possible.
- Deployment time: an ECCS intended for coordination of immediate first response needs to be deployed as quickly as possible, whereas an ECCS for medium to long-term usage may require a more time-consuming set-up phase.
- Environmental protection: an ECCS has to cope with a variety of environmental conditions, e.g. humidity, high/low temperatures, dust, etc. A dust-tight design and protection against powerful water jets is for outdoor-components (and possibly for indoor-components too) mandatory; heating or cooling of (electrical) components may be required too.

4.2.3 ECCS role model

An ECCS role model has to follow typical organisational structures in handling of global, regional or national disasters, whereby current practice but also ongoing efforts and future plans for an improved (re)organisation of disaster relief operations should be taken into account. Nevertheless basic design goal should be to support as many as possible different organisation structures.

Note that the role model discussed in this clause takes only into account the telecommunication point of view. The various actors and interactions presented in this clause have been identified by considering only the role they play in the communication system. Taking into account an ECCS system deployed with full functionality the following roles can be identified (see Figure 2):

- ECCS operator or service provider - being the central role in the considered system and interfacing with all of the following roles, as illustrated in Figure 2. The ECCS operator acts as a kind of "concentrator" for a complete and tailored service provisioning - in terms of communications services, content and infrastructure - to the system users and should be their main/single direct interface.
- Affected persons or citizens, who come in as passive (called) or active (calling) users from a communications system viewpoint.
- Rescue organisations, including both early phase (immediate search and rescue) and response phase (rescue, transport and medical treatment etc.); here the main relation is provisioning of services (communication, coordination, location based services and content) via an ECCS system available to the rescue organisations.
- Coordination centers which mainly coordinate and command field rescue forces.
- PMR operators like national/regional Terrestrial Trunked Radio (TETRA)/TETRAPOL operators, which have an established operator/provider relationship with the users and obviously should be interfaced also in the more general ECCS role model and architecture.
- Content providers like geo information service (GIS)/map data providers; providers for location based services.

- Satellite transport service operator/provider providing the key backhauling link from the disaster area to the disaster-safe segment with a preferably simple and direct relation to the ECCS service provider.
- Internet service provider, providing access to Internet services.
- Public land mobile network (PLMN)/PSTN operator/provider providing voice/data communication and gateways to the fixed and mobile legacy networks, mobile positioning and messaging.
- For the local access domain, a mobile network operator (MNO) - potentially the same as the previously mentioned PLMN operator/provider - may come in as a specific player if the ECCS operator/provider does not act at the same time as a (virtual) MNO itself; here the main relation would be a tailored contract for provisioning of vendor-specific subscriber identity module (SIM) cards, specific roaming agreements and use of its licensed frequencies.
- Regulatory authorities taking care of a global licensing process for dedicated reserved emergency frequency bands (both terrestrial wireless and satellite) or facilitating temporary access to spectrum (e.g. through the Tampere convention) only in emergency situations, etc.

It is clear from the above that as many roles as possible should be covered by one single organisation or company. Every single interaction between the different roles has to be formalised with a framework contract and this needs to be done early in advance.

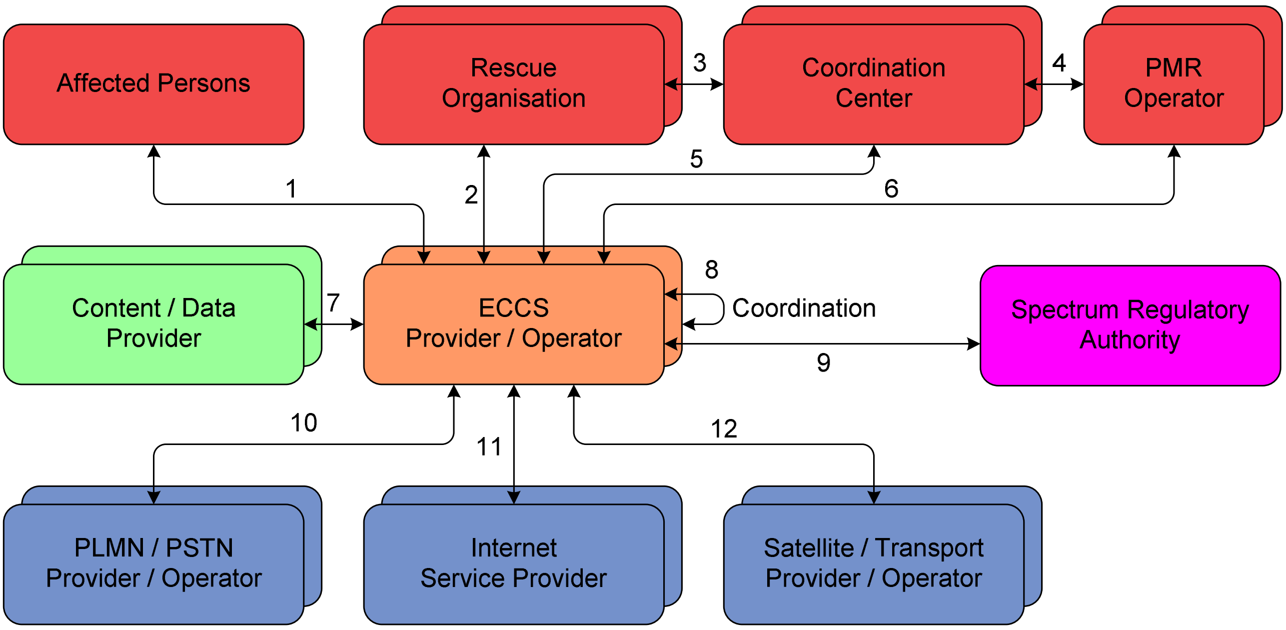


Figure 2: Example ECCS role model and interaction/communication channels

The interactions and communication channels between the different roles depicted in Figure 2 are as follows:

1) Affected persons may be integrated in the ECCS communication system by means of their standard equipment (mainly mobile phones), which may be used both in active and passive modes (active calling/sending SMS or being called/located within a certain cell or receiving information/warning SMS).

2) ECCS provider/operator and rescue organization(s) interact through a contractual relationship and communication via different means (voice, data, etc.), both in the field and in the disaster-safe area.

3) Coordination center(s) may interact with the ECCS provider indirectly via a rescue organization (or directly, see 5).

4) Coordination center(s) either maintain their own PMR network or are customers of a dedicated PMR operator.

5) Coordination center(s) may have a contract with the ECCS operator and use the communication services provided by the ECCS operator.

6) PMR operators interact with the ECCS operator either directly or via the coordination center (4).

7) Data from content/data providers is transmitted via the ECCS system. This might be done either directly so that local operation controllers in the field can take decisions from the transmitted data, or indirectly via the coordination center (not shown).

8) If more than one ECCS provider/operator is involved, then coordination among them might be necessary for deployment and location of ECCS terminals in the field, frequency usage (e.g. WLAN), etc.

9) Frequency bands to be used by ECCS terminals both for satellite and terrestrial communication are most likely subject to local regulatory issues (except for unlicensed frequencies).

10) Connectivity to PLMN/PSTN and gateways has to be agreed between ECCS operator and the respective network operator.

11) A gateway to the public Internet needs to be agreed with an Internet service provider.

12) Finally, a provider for backhaul capacity has to be involved.

4.3 ECCS architecture

4.3.1 Introduction

An example architecture of an ECCS system, as illustrated in Figure 3, is typically based on a modular approach where at least one access and one transport solution can be supported. The ECCS middleware should be able to interwork between the various terrestrial access and satellite transport solutions. Different rescue and humanitarian organizations have different requirements and the depicted modular architecture allows both full scalability and is open for possible future extensions.

Despite the multitude of technical solutions that could be used to implement an ECCS system, several logical blocks can be distinguished. In the following we define these logical blocks, so that a common high-level ECCS reference architecture and terminology is introduced.

An ECCS system enables the communication between the disaster end-users (affected persons, victims, rescue teams or any other kind of involved people) located inside or outside the disaster area using different sorts of communication devices; the transmission path involves a number of network elements, which compose an ECCS communication chain.

The domains represent network elements involved in the ECCS communication chain and playing logically neighbouring functionalities in this chain (e.g. a WLAN access point and a GSM base station) or jointly enabling the provision of a given functionality (e.g. local access) belong to the same domain.

An interface between the two main segments is provided by the transport (backhaul) domain. One part of the network elements of the Transport Domain is located in the On-Disaster Site Segment whereas another part is located in the Disaster-Safe Segment. Throughout the present document we do not make a difference whether a satellite terminal is a VSAT terminal or a gateway/hub station.

The segments represent sections of the ECCS communication chain involving network elements physically located in (roughly) the same geographical area with respect to the disaster. All network elements in the same segment are subject to similar usage constraints.

White boxes in each domain represent possible groups of network elements with complementary or similar characteristics. Inside a network domain group there might be several network elements involved in the communication.

In Figure 3 in the transport domain a number of N satellite systems is depicted, serving a number of M different ECCS terminals in the disaster-safe segment with $N \leq M$, since ECCS terminals might be directly interconnected without involving a remote ECCS system. These direct interconnections can be both satellite or terrestrial wired/wireless links.

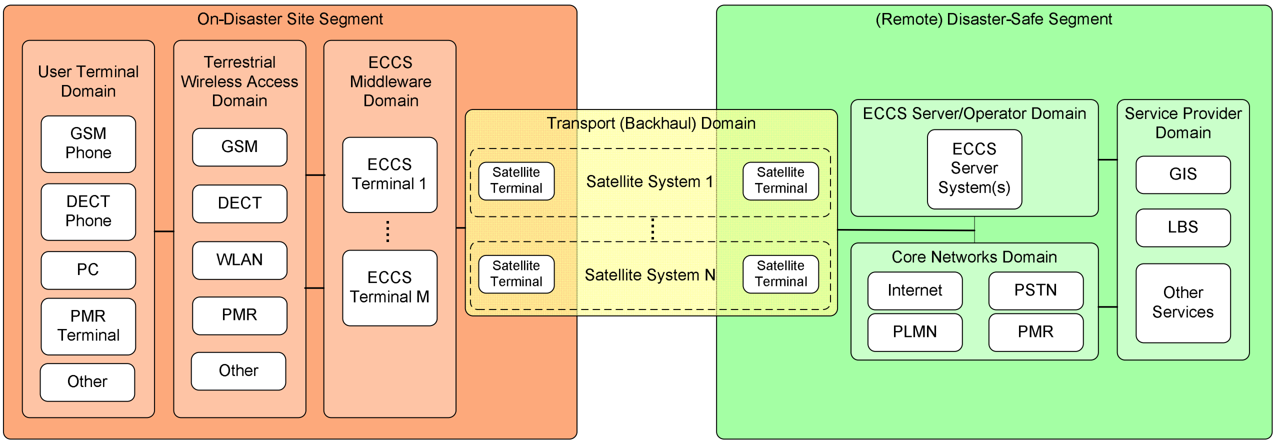


Figure 3: Example ECCS functional diagram

4.3.2 Service interoperability

The main challenge for ECCS is not only backhauling single services via satellite, but also providing interconnectivity and interoperability between different services. This interoperability is provided by gateways, which are defined as network nodes equipped for interfacing with other networks using different technologies/protocols.

For IP-based data networks interconnectivity between ECCS terminal, ECCS server and IP core networks (Internet) is comparable to terrestrial installations. When using source network address translation (Source-NAT), which is typically applied to handle a shortage of IPv4 addresses, two different architectures are possible:

- The NAT router is located at the ECCS server and subsequent ECCS terminal(s) and other systems attached form a private subnet.
- The NAT router is located at the ECCS terminal.

In general, a satellite link within an IP data-network needs special attention. In order to cope with the large bandwidth delay product of Geostationary Earth Orbit (GEO) satellites, performance enhancing proxies (PEPs) are needed for accelerating TCP/IP. On the one hand the broadcast nature of satellites requires encryption of transmitted contents, on the other hand encryption standards like link Virtual Private Network (VPN) collide with resource management algorithms and bandwidth optimization techniques like header compression. Furthermore, applications using out-of-band signalling and return channels can suffer from NAT (e.g. VoIP protocols), but a detailed discussion of all these implications is out of the scope of the present document.

Voice communication is supported by different technologies: PSTN, PLMN, IP telephony and PMR. The first three standards are widely distributed and interoperability between them is supported by public gateways, whereas PMR systems exist in many different variants which are not necessarily interoperable among each other. PMR networks are designed for closed user groups with partly specific confidentiality requirements so that gateways to other voice networks are always subject to security policies implemented by the operator. Furthermore additional PMR service attributes like group calls can hardly be mapped to calls in telephone networks.

Public gateways between PSTN and PLMN exist in core networks, so for an ECCS operator there is normally no need to set up his own gateways - unless there is a specific requirement that the ECCS terminal has to support calls in the field between these two standards without satellite connectivity. The same considerations apply to gateways for VoIP.

Connectivity in the field between two PSTN terminals can be provided by a private branch exchange as part of the ECCS terminal. This approach allows both "internal calls" (i.e. without backhaul link) and external calls via satellite. PLMNs do not implement the concept of private branch exchanges, which means that a base station attached to an ECCS terminal is either operated in a full autonomous mode without any connectivity to the core PLMN, or it is integrated in the core PLMN via the backhaul satellite link. In the latter case for local calls signalling information has to be sent via satellite although the data (voice) traffic itself is switched within the ECCS base station.

IP telephony service properties are subject to the actually implemented protocols and standards (VoIP examples: H.323, SIP). Call switching can be performed locally at the ECCS terminal, at the ECCS server, or in the core network. Public gateways to PLMN/PSTN exist, but depending on requirements gateways can be set up at ECCS terminal or server too.

4.3.3 Connection scenarios

The following clauses give examples for different ECCS connection scenarios. There are two major categories: on-disaster to/from disaster-safe area and on-disaster to/from on-disaster area. The latter case may involve the deployment of multiple ECCS terminals that are connected by means of satellite or terrestrial links.

Four different types of core networks are assumed: PLMN, PSTN, Internet and PMR. Matching representative wireless access technologies chosen for these networks are GSM, DECT, WLAN and a not specified PMR standard. Note that wired access devices might be attached to the ECCS terminal too (e.g. normal wired analogue telephones), or that end devices can have built-in gateway functionality (e.g. cordless DECT telephones with IP interfaces).

The scenarios that are presented in the next clauses make use of a reduced set of entities Figure 3. For a network scenario including multiple terrestrial technologies and several ECCS systems from different operators, see Figure 6.

4.3.3.1 On-disaster to/from disaster-safe area connection

An initial scenario is illustrated in Figure 4 where a PSTN terminal (e.g. a cordless phone) in the field is connected to a terminal in the PLMN core network (in the disaster-safe segment, not shown).

Elaborate variations of this scenario comprise the case where multiple ECCS terminals are deployed and linked using terrestrial technology. Connection to core networks may be routed to an ECCS terminal other than the one hosting the source user terminal. The reason may be load balancing or because the source ECCS terrestrial does not support the required interconnection function.

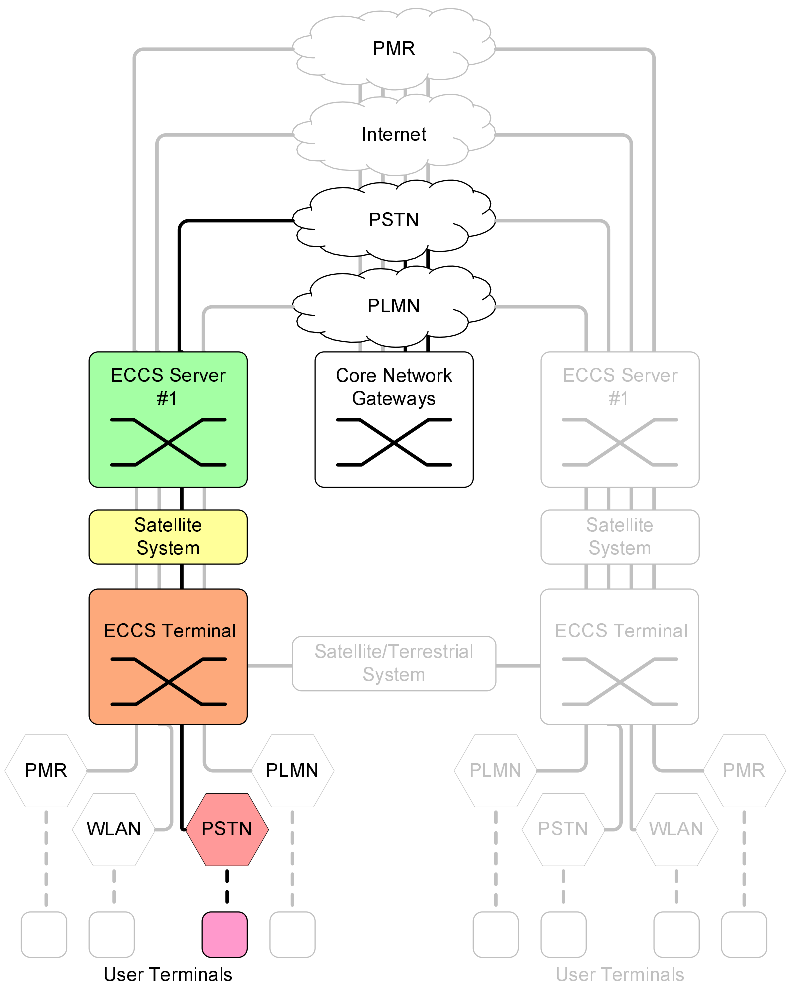


Figure 4: Example of on-disaster to/from on-disaster area connection

4.3.3.2 On-disaster to/from on-disaster area connection

This scenario is illustrated in Figure 5 where a PSTN terminal on the left hand-side is connected to a GSM terminal on the right hand side. It is interesting to note that satellite links are used two times: to interconnect both ECCS terminals and to reach the PLMN core network. This latter connection is required for carrying signalling traffic between the target GSM terminal and the operator equipments (e.g. visitor location register, VLR, or home location register, HLR). Consequently, one of the involved ECCS terminals needs gateway functionality for interconnecting PSTN and PLMN systems. Note that ECCS terminals may also be linked by means of terrestrial technology when available.

Simpler variations of this scenario cover:

- A single ECCS terminal with local connection between a PSTN and a terminal for IP telephony. In this case, communication with the core networks might be not necessary.
- A single ECCS terminal with a connection between a local PSTN and a local PLMN terminal. In this case, the ECCS needs gateway functionality and communication with the core network may be necessary for carrying PLMN signalling traffic.
- ECCS interconnection based on terrestrial systems instead of satellite.

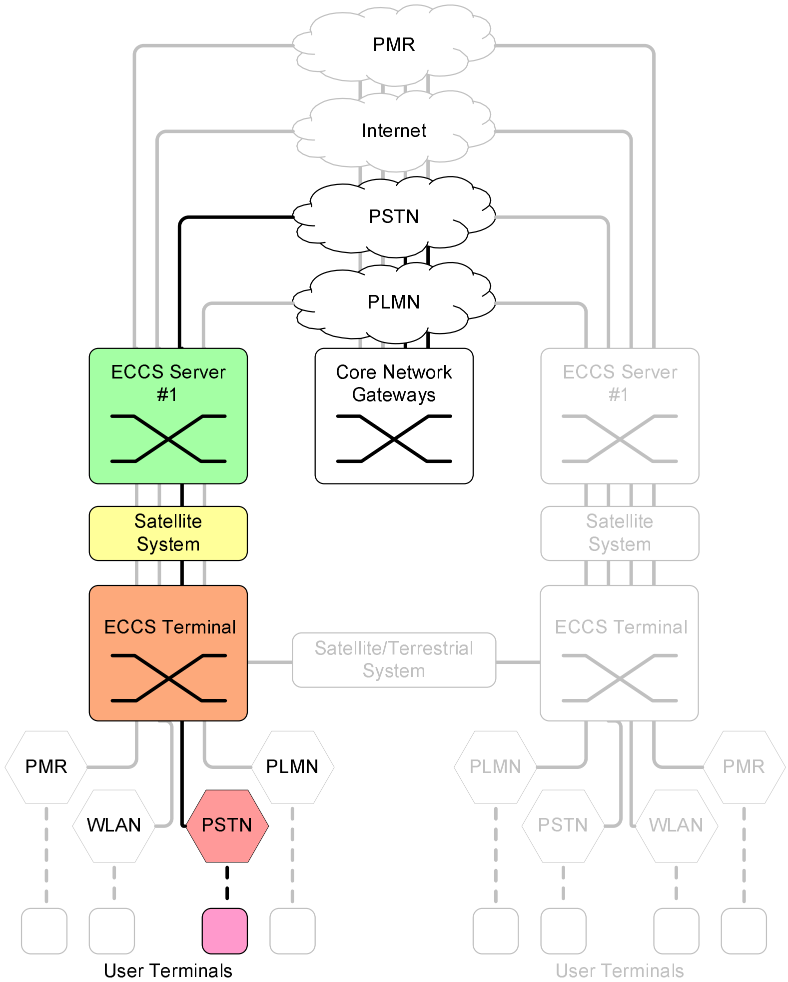


Figure 5: Example of on-disaster to/from on-disaster area connection

4.3.3.3 Summary of connection scenarios

The scenarios presented in the former clauses correspond to selected choices of where to put functionalities or - for example - whether both communicating terminals are served by the same operator. Figure B.1 in Annex B gives an overview of basic possibilities.

The scenarios presented in the former clauses correspond to scenario #13 (Figure 4) and #6/#7 (Figure 5) respectively.

4.4 Interfaces

Apart from the already mentioned gateways Figure 6 depicts four main interfaces relevant for operating an ECCS:

- A: ECCS server - core networks (most likely wired).
- B: ECCS server - ECCS terminal (satellite link).
- C and C': ECCS terminal - ECCS terminal (satellite or terrestrial link).
- D: ECCS terminal - user terminals (terrestrial wireless).

The difference between interface C and C' is that C' interconnects ECCS terminals which share the same ECCS server (operator), whereas C interconnects ECCS terminals with different servers (and operators).

Different strategies may be considered for the different interfaces depending on the involved technologies. Subsequently some examples for the B interface are provided.

Backhauling of IP data/telephony and PSTN (using a local private branch exchange) is rather straightforward, whereas for cellular radio systems different approaches exist. The next paragraphs describe architecture considerations for GSM as an example of a PLMN system and for TETRA as an example of a digital PMR system.

In the GSM architecture the interface between a base station controller (BSC) and associated base transceiver station (BTS), which form together the base station subsystem (BSS), is known as the A-bis interface. A common backhauling implementation is to tunnel the A-bis interface via satellite, so that only radio components are needed at the ECCS terminal, whereas the network "intelligence" like home/visitor location registers is provided by the core network. Main advantage is the reduced complexity at ECCS terminal side; main disadvantage is that even for local calls a backhaul link is needed for signalling.

A similar approach is imaginable for TETRA as well, but unlike GSM this interface and all others within a Switching and Management Infrastructure (SwMI) are not standardized and vendor-specific, so inter-operability between devices from different manufacturers is unlikely. For simplicity, in the following we will denote the interface between the TETRA BTS/Local Switching Centre (LSC) and main switching centre (MSC) A-bis interface too.

Another possibility for TETRA is backhauling the inter-system interface (ISI resp. I3), which has been standardized as a suite of services necessary to support vendor-independent inter-operability between different TETRA networks, both between national and cross-border SwMIs. Basic design goals are networks serving foreign terminals ("migration") and support of individual and group calls between different SwMIs.

At first glance these two TETRA backhauling architectures appear to be similar, but from a network operator and organizational point of view there are major differences. Especially operators of public-safety SwMIs have very strict confidentiality requirements and accordingly backhauling via the broadcast medium satellite needs special attention. From the call admission control point of view (i.e. the network authenticates users, TETRA terminal and services) there is no difference if the physical A-bis-link is terrestrial or satellite, which is an advantage for e.g. dynamic network extensions or temporary replacement of damaged network elements within the normally covered territory. Prerequisite is that mobile terminals served by the backhauled TETRA-cell are known by the home-SwMI. From this perspective the A-bis based backhauling is not an option for international rescue missions, since e.g. other TETRA users from other nations or organizations need explicit migration agreements for the deployed network.

ISI-based backhauling requires a complete SwMI with all network management facilities (switching centers, location registers, etc.), which has to be set-up and maintained with possibly non-negligible effort. Key advantage is that communication to and from other SwMIs is possible via the standardized inter-system interface. Additionally it would be possible to set-up a (temporary) SwMI with relaxed security constraints so that e.g. the network accepts all migration requests also from unknown TETRA-terminals. The latter would be a key advantage for the already mentioned international rescue mission example guaranteeing uncomplicated information exchange.

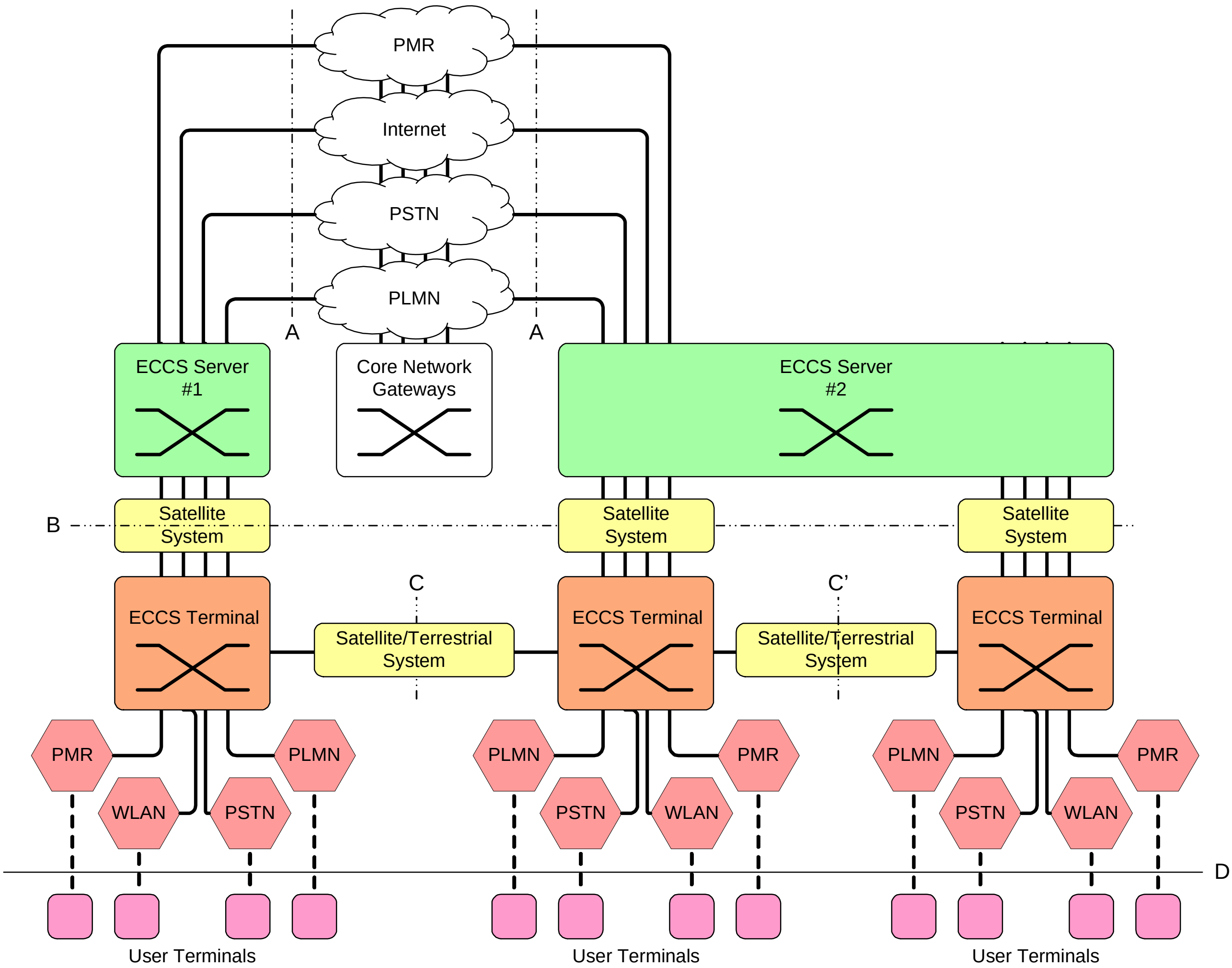


Figure 6: ECCS interfaces

4.5 Usability and operational aspects

After a disaster, civil infrastructures such as roads, buildings or power grids could be unavailable or unsafe. Moreover the environment could be harsh (violent winds, dust, humidity, temperatures, ice, etc.).

Communication means have to support an operation and may not hinder it. This means that the equipment has to match the operation's circumstances in terms of size and weight (for transportability reasons). Ideally users have experiences with the technology from daily use. In any case proper training and user-friendly (i.e. stress reducing) design are mandatory.

Since telecommunications experts are not always available in rescue and humanitarian organizations, ECCS maintenance should be facilitated and/or be the hardware and software element of a supra-regional or global service provided to the organization by an ECCS operator.

Any infrastructure cannot provide an efficient service without management tools/supports. In case of ECCS, AAA (authentication, authorization and accounting), billing, capacity management, training and hotline (help desk) are required.

Concerning capacity management, satellite network operators able to provide relevant capacity over a given area should be identified and contacted to obtain the required bandwidth. Satellite network operators have often a usage-based billing system (e.g. Inmarsat, Iridium), except when a dedicated frequency band or communication credits are bought or offered. In any case a billing system/communication monitor helps to communicate on the action related to the ECCS deployment.

NOTE: Inmarsat and Iridium are examples of suitable products available commercially. This information is given for the convenience of users of the present document and does not constitute an endorsement by ETSI of these products.

In case of end users terminals fleet, AAA management is required to dispatch efficiently resources and identify groups of users (e.g. the communications credits management or priority call management).

Concerning the help desk, technical issues should not compromise communication means during a mission. End users can be supported by a hotline reachable by different channels (e.g. telephone and web-based). Hotline services should access the relevant tools to monitor the network to identify rapidly the origins of issues.

Annex A: ECCS state-of-the-art

ECCS systems have been developed as commercial products or as demonstrator/prototype systems. In the following a non-exhaustive overview of some of these implementations is given. The descriptions were provided by manufacturers or project teams.

A.1 Commercially available products and solutions

A.1.1 Emergesat

The Emergesat solution aims at providing assistance to field operations. Emergesat is a space-based response to major crisis management. Emergesat can be defined as a humanitarian crisis management tool.

Emergesat is basically a dedicated container for relief teams working on the site - civil security, NGO, international forces, etc. Emergesat provides satellite-based communication, location and data management resources used to:

- coordinate the work of the teams in the field;
- communicate in situ and with remote control centres;
- manage crisis situation coordination logistics.

The container is designed to be:

- rapidly deployable and operational as soon as the relief teams arrive;
- easy to bring in by line aircraft, helicopter and truck;
- configurable according to the nature of the disaster;
- simple to use, user-friendly and multilingual;
- all-weather, strong, lightweight, air-conditioned and autonomous.

Emergesat responds equally to primary relief needs and requirements for the management of crisis follow-up actions. It can be enriched by the incorporation of additional services as necessary.

Figure A.1: Emergesat container before and after deployment

Dimensions and mounting:

- Size: 250 cm × 150 cm × 100 cm;
- Mass: 500 kg to 750 kg (depending on supported services).

Deployment time:

- From 15 min. (first communications) to 45 min. (fully operational).

Robustness and environmental conditions:

- -20 °C to 50 °C;
- Maximum humidity 99,9 %;
- IP55 for electrical modules - IP54 for the rest;
- Certified by European "CE" standard.

Transportability:

- ATA 300;
- Battery compliant with air transport (UN2800 certified).

Satellite terminal:

- 1,2 m antenna, Ku-band, auto-pointing;
- DVB-RCS, SCPC (single channel per carrier), meshed Skyplex, other Ku-band modems.

Power supply:

- Battery autonomy: 6 h to 9 h (for immediate usage without power generator);
- Onboard power generator.

Voice technology and services:

- VHF;
- TETRA;
- GSM;
- Onboard VoIP PABX;
- Voice capacities based on a 256 kb/s satellite uplink:
  - 12 simultaneous voice calls using IP telephony or VHF or TETRA;
  - 20 simultaneous voice calls using GSM.

Data technology and services:

- WLAN (omni-directional and directive antennas).

Other services:

- Videoconference.
- Collaborative working (optimized for satellite links).
- Telemedicine applications.

Fields of operation:

- Chad (near Darfur): humanitarian aid.
- French Guyana: medical support.
- Haïti (2010 earthquake): French Ambassy / Civil Protection / Medical support.

A.1.1.1 Inter-connectivity / inter-operability matrix

Table A.1

		ECCS Terminal						**Remote**				
		IP Voice	DECT	VHF	TETRA	GSM	IP Data	Internet	PSTN	GSM	VHF	TETRA
ECCS Terminal	IP Voice	◆		✗	✗	✗			✗	✗	✗	✗
	DECT											
	VHF	✗		◆	✗	✗			✗	✗	✗	✗
	TETRA	✗		✗	◆	✗						
	GSM	✗		✗	✗	◆			✗	◆	✗	✗
	IP Data						◆	◆				

Legend: ◆ Inter-connectivity (local or remote)

✗ Inter-operability using a gateway

Gateway in ECCS terminal

Gateway in ECCS server

Gateway in core network

A.1.2 Proximity B1

Proximity B1 has been deployed in French firebrigades.

Figure A.2: Proximity B1

These satellite communications answer First Responder needs.

Proximity B1 is a hardware and software solution optimizing satellite resource thanks to:

- Network Supervision, quality of service (QoS) Managemen.
- Fair share of the available bandwith.
- Management of communication credits.
- A rapid and simple set-up of the system.

Dimensions and mounting:

- Size: Hand Luggage Size (maximum 55 cm × 35 cm × 25 cm).
- Mass: 12 kg.

Deployment time:

- Installation duration < 6 min.

Robustness and environmental conditions:

- Maximum temperature 45 °C.
- Maximum humidity 90 %.
- IP67.
- ATA 300.

Satellite terminal:

- Inmarsat BGAN.
- Antenna reflector included in terminal.

NOTE: Inmarsat BGAN is an example of a suitable product available commercially. This information is given for the convenience of users of the present document and does not constitute an endorsement by ETSI of this product.

Power supply:

- 12 V - 240 VA (car cigar lighter adapter).

Voice technology and services:

- TETRA (plug-in module).
- GSM (plug-in module).
- 1 DECT access point (coverage up to 100 m) + DECT terminals.
- RJ-11 port for analogue phones (PABX).
- 1 physical phone terminal linked to basis (hand luggage).

Data technology and services:

- WLAN (area covered up to 100 m around access point), also secured WLAN.
- LAN Ethernet 10 Mb/s to 100 Mb/s.
- VPN (IPsec, OpenVPN).
- Firewall.
- Local cache (web, DNS).
- TCP accelerator (BGAN modem).

Other services:

- Private portal for Internet access.
- Control access for incoming and outgoing calls.
- Administration software:
    - Communication credit management.
    - QoS management.
    - URL filtering.
- Remote control software.

Fields of operation:

- French Firebrigade.

A.1.2.1 Inter-connectivity / inter-operability matrix

Table A.2

		ECCS Terminal						**Remote**				
		IP Voice	DECT	VHF	TETRA	GSM	IP Data	Internet	PSTN	GSM	VHF	TETRA
ECCS Terminal	IP Voice	◆	✗	✗	✗	✗	✗		✗	✗	✗	✗
	DECT	✗	◆	✗	✗	✗	✗		◆	✗	✗	✗
	VHF	✗	✗	◆	✗	✗	✗		✗	✗	◆	✗
	TETRA	✗	✗	✗	◆	✗	✗		✗	✗	✗	◆
	GSM	✗	✗	✗	✗	◆	✗		✗	◆	✗	✗
	IP Data						◆	◆				

Legend:
◆ Inter-connectivity (local or remote)
✗ Inter-operability using a gateway
Gateway in ECCS terminal
Gateway in ECCS server
Gateway in core network

A.1.3 Proximity Drive Away

Proximity Drive Away is a complete satcom connectivity solution delivering reliable Internet access and voice access, thanks to a constant monitoring and network management operated from a teleport. This infrastructure enables communications between satellites and the ground. It is also the starting and arrivals points of all the communications (telephone, internet video, audio, data).

This solution has been adopted by French Civil Security Direction under its operational programme and also by Fire brigade in Val d'Oise (in Parisian area) for its operational interventions. As theatre fields are various in Val d'Oise (country, airport, cities, suburbs, industrial areas), Fire brigades from Val d'Oise have decided to embed a Proximity Drive away solution on their interventions vehicles. The objective is to develop communications means dedicated to on-field deployment teams.

This equipment can be embedded on a vehicle or a trailer. It is composed of an auto-deployable antenna (around 0,9 m or 1,2 m diameter) with an amplifier and a modem and if needed, a multi adaptor for ad hoc networks.

Figure A.3: Proximity Drive away trailer solution

Figure A.4: Proximity drive Away Embedded solution on truck deployed in SDIS 95 (Val d'Oise)

Proximity Drive Away is a solution optimizing satellite resource thanks to:

- Network Supervision, quality of service (QoS) Management.
- Fair share of the available bandwidth.
- Management of communication credits.
- A rapid and simple set-up of the system.

Dimensions and mounting:

- Volume < 1 m^3;
- Mass < 100 kg.

Deployment time:

- Installation duration < 10 min.

Robustness and environmental conditions:

- Maximum temperature 50 °C; min temperature -30 °C;
- Maximum humidity 90 %;

- ATA 300.

Satellite terminal:

- Ku band;
- Auto pointing Antenna.

Power supply:

- 220 VA.

Voice technology and services:

- TETRA (plug-in module);
- GSM (plug-in module);
- DECT access point (coverage up to 100 m) + DECT terminals;
- RJ-11 ports for analogue phones (PABX).

Data technology and services:

- WLAN (area covered up to 100 m around access point), also secured WLAN;
- LAN Ethernet 10 Mb/s to 100 Mb/s;
- Firewall.

Other services:

- Control access for incoming and outgoing calls;
- Administration software:
    - Communication credit management;
    - QoS management;
    - URL filtering.
- Remote control software.

Fields of operation:

- French Fire brigades.

A.1.3.1 Inter-connectivity / inter-operability matrix

Table A.3

		ECCS Terminal						Remote				
		IP Voice	DECT	VHF	TETRA	GSM	IP Data	Internet	PSTN	GSM	VHF	TETRA
ECCS Terminal	IP Voice	◆	×	×	×	×			×	×	×	×
	DECT	×	◆	×	×	×			◆	×	×	×
	VHF	×	×	◆.	×	×			×	×	◆.	×
	TETRA	×	×	×	◆.	×			×	×	×	◆.
	GSM	×	×	×	×	◆.			×	◆.	×	×
	IP Data						◆	◆				

Legend:
◆ Inter-connectivity (local or remote)
× Inter-operability using a gateway
Gateway in ECCS terminal
Gateway in ECCS server
Gateway in core network

A.2 Research projects

A.2.1 WISECOM

The WISECOM project (Wireless Infrastructure over Satellite for Emergency Communications) was co-funded by the European Commission within the 6th Framework Programme. The project started in September 2006 and ended in June 2008; involved partners were German Aerospace Center (DLR) as coordinator, TriaGnoSys GmbH, AnsuR, EADS Astrium SAS, Steinbeis Forschungs- und Entwicklungszentren GmbH, Reach-U Ltd. and Thales Alenia Space.

The main objective of the WISECOM project was the design, development and test of a lightweight and rapidly deployable communication infrastructure for providing terrestrial wireless services in the field directly after a disaster. With this approach WISECOM is positioned between commercially available satellite phones which can be directly used without any infrastructure and more powerful (in terms of supported services and bandwidth) and self-contained but more bulky and/or heavy solutions like Emergesat for which typically more effort for transport is needed.

Two different versions of the WISECOM system have been developed in order to satisfy the communication needs of the different phases after a disaster situation. The first version of the system integrates GSM and WLAN networks using the Inmarsat BGAN (Broadband Global Area Network) satellite system and is intended to be deployed in the early phase after the disaster event in order to cover the basic services that victims and rescue teams need, such as voice communication, Internet access and Location Based Services (LBS). The second version of the system integrating GSM, WLAN/WiMAX and TETRA over DVB-RCS is intended to be deployed in a later phase after the disaster event in order to provide services that require a higher bandwidth, such as transferring earth observation data, photos and maps of the affected area and setting up video conferences.

TETRA connectivity has been validated in a test-bed environment, but was not implemented in the final demonstrator systems.

Apart from the main ECCS-related works a location based service based on commercial PDAs for basic victim registration and a corresponding map display software for emergency managers were developed.

A.2.1.1 WISECOM Access Terminal based on Inmarsat BGAN

This solution consists of an Inmarsat BGAN satellite terminal supporting a high priority streaming class with up to 128 kb/s and a low priority background traffic class. As GSM BTS an *ip.access nanoBTS* was chosen which provides a coverage radius of approximately 350 m; WLAN is supported with a standard semi-ruggedized access point and the system allows VoIP calls via satellite too. All these components are controlled by a ruggedized industrial mini-computer with a software performing the following functions:

- Call control, i.e. the software requests the required bandwidth from the satellite modem and blocks incoming calls if necessary.
- Base station controller signalling suppression, i.e. most periodically sent GSM signalling messages are suppressed in order to minimize bandwidth usage.
- GSM voice codec selection and IP header compression, i.e. by using the GSM advance multi-rate narrow band speech codec with 4,75 kb/s plus IP header compression techniques the available satellite bandwidth is used very efficiently.

All components except the BGAN terminal were mounted inside a housing suitcase which fulfils airlines' cabin luggage requirements, i.e. the system can be easily carried by one person. Only the BGAN terminal with integrated satellite antenna needs to be operated outside the housing (but can be carried within the suitcase too) and directed to the satellite.

Dimensions and mounting:

- Complete suitcase: 24 cm × 38 cm × 49 cm.
- WLAN Antennas Mast height: 2,5 m.

Deployment time:

- 5 minutes (including deployment and starting of the system).

Robustness and environmental conditions:

- All equipment carried in a ruggedized suitcase.
- Weather-proof: minimum IP-65 equipment.

Satellite terminal:

- Thrane and Thrane Explorer® 500 BGAN satellite terminal:
  - Dimensions: 21,8 cm × 21,7 cm × 5,2 cm.
  - Up to 128 kb/s (return link) and 256 kb/s (forward link).
  - Manually pointed.

NOTE: Thrane and Thrane Explorer® 500 BGAN are examples of suitable products available commercially. This information is given for the convenience of users of the present document and does not constitute an endorsement by ETSI of these products.

Power supply:

- Lithium ion battery (10 Ah) for up to 3 hours running time.
- Direct connection to the general power supply.

Voice technology and services:

- GSM calls.
- VoIP calls.
- Several simultaneous calls depending on available bandwidth.

Data technology and services:

- WLAN (350 m radius) or wired Ethernet.
- Local IP switching/routing, Internet access.

Other services:

- Collaborative working.
- Location based services.

Fields of operation:

- Demonstration in the frame of the WISECOM project (Oberpfaffenhofen, Germany, May 2008).

A.2.1.2 WISECOM Access Terminal based on DVB-RCS

The second version of the WISECOM system uses DVB-RCS as a satellite link to integrate GSM, WLAN/WiMAX and TETRA networks and connect them with the respective core networks in the disaster-safe segment. This configuration was intended to be deployed in a later phase after the disaster event in order to provide services that require a higher bandwidth, such as transferring pictures or maps of the affected area and establishing video communications over the satellite link.

In order to transport and deploy the system, all the necessary equipment were mounted on a rack that, together with a 1,2 m DVB-RCS antenna can be transported with the help of a vehicle, such as a 4-wheel drive or a helicopter. Mounting and deployment of the system can be easily performed by only two people in approximately 15 minutes to 30 minutes, taking into account the time needed to mount and point the antenna and the time for cable connecting and starting the system. Rechargeable batteries cannot provide sufficient running time so that a power generator is needed, Once the communication infrastructure is deployed, it offers the possibility of connecting using GSM, a hybrid WLAN/WiMAX access network and also TETRA.

Dimensions and mounting:

- Mounted in a 19" rack.
- Dimensions of the equipment mounted in the rack: 79 cm × 52 cm × 52 cm.
- Antenna Dimensions: 1,2 m × 1,5 m × 1,5 m.

Deployment time:

- Approximately 15 minutes to 30 minutes (including deployment, pointing of the antenna and starting of the system).

Robustness and environmental conditions:

- All equipment but the antenna carried in a 19" rack.
- Antenna carried in a ruggedized case.

Satellite terminal:

- 1,2 m parabolic reflector (fly-away):
    - Antenna weight: 35 kg.
    - Advantech 4100® DVB-RCS terminal.
    - Up to 512 kb/s (return link) and 3 Mb/s (forward link).
    - Manually pointed.

NOTE: Advantech 4100® is an example of a suitable product available commercially. This information is given for the convenience of users of the present document and does not constitute an endorsement by ETSI of this product.

Power supply:

- Power generator.

Voice technology and services:

- GSM calls.
- VoIP calls.
- TETRA calls.
- Several simultaneous calls depending on available bandwidth.

Data technology and services:

- WLAN (350 m radius) or wired Ethernet.
- Local IP switching/routing, Internet access.
- WLAN/WiMAX hybrid configuration provided.

Other services:

- Collaborative working.
- Location based services.

Fields of operation:

- Demonstration in the frame of the WISECOM project (Oberpfaffenhofen, Germany, May 2008).

A.2.1.3 WISECOM inter-connectivity / inter-operability matrix

Table A.4

		ECCS Terminal						Remote				
		IP Voice	DECT	VHF	TETRA	GSM	IP Data	Internet	PSTN	GSM	VHF	TETRA
ECCS Terminal	IP Voice	◆				✕ (gateway in core network)		◆	✕ (gateway in core network)	✕ (gateway in core network)		
	DECT											
	VHF											
	TETRA											
	GSM	✕ (gateway in core network)				◆			◆ (gateway in core network)	◆		
	IP Data						◆	◆				

Legend:
- ◆ Inter-connectivity (local or remote)
- ✕ Inter-operability using a gateway
- (orange) Gateway in ECCS terminal
- (green) Gateway in ECCS server
- (olive) Gateway in core network

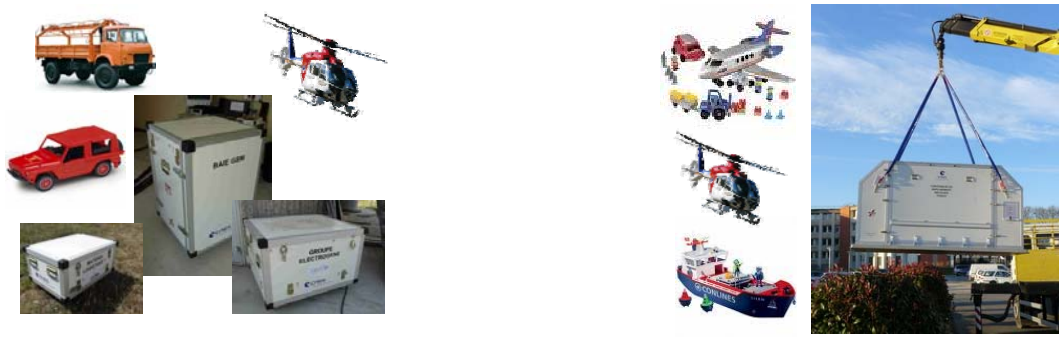
A.2.2 RECOVER and MOBIDICK

The French space agency (CNES) devised two mobile stations. One is packed in little transportable containers (called "RECOVER"). The second one is "on wheels" (called MOBIDICK), see Figure A.5 to Figure A.7.

Both have similar specifications and functionalities.

A.2.2.1 RECOVER

Figure A.5: RECOVER description



NOTE: Equipment can be packed as one standard civil aviation container.

Figure A.6: A modular, light and transportable solution based on small containers (< 50 kg)

Dimensions and mounting:

- Rapidly deployable tent.
- Portable containers with the possibility to pack everything in an airborne grade container.
- 10 m high telescopic mast.

Deployment time:

- Deployment time: 1 h.

Robustness and environmental conditions:

- Heated tent (14 m²) for 4 persons.
- ATA 300.

Satellite terminal:

- 1,20 m manually pointed parabolic reflector (fly-away).
- DVB S2/RCS or SCPC, 16 W HPA;
- Bandwidth between 1 to 10 Mbit/s.
- Backup with Inmarsat BGAN.

NOTE: Inmarsat BGAN is an example of a suitable product available commercially. This information is given for the convenience of users of the present document and does not constitute an endorsement by ETSI of this product.

Power supply:

- Gasoline power generator.

Voice technology and services:

- IP (WLAN) phones.
- DECT terminals (600 m radius).
- GSM picocell.
- Onboard VoIP PABX.
- 20 kb/s for one call. Number of simultaneous calls depending of the available bandwidth.

Data technology and services:

- WLAN (300 m radius) or wired Ethernet.
- Local IP switching/routing, Internet access.

Other services:

- Videoconference with dedicated SIP terminals or PC/webcams.
- Live video streaming from pan-tilt-zoom cameras.
- Collaborative working.

Fields of operation:

- Demonstration in the frame of the TANGO project (Cahors, France 2008 and Madeira, 2009).

A.2.2.2 MOBIDICK


Figure A.7: MOBIDICK

Dimensions and mounting:

- Vehicle-mounted.
- 10 m high telescopic mast to support wireless antennas.

Deployment time:

- 10 min.

Robustness and environmental conditions:

- Space for 3 operators.
- Separate air conditioning.

Satellite terminal:

- Auto-steerable, roof-mounted 1,20 m parabolic reflector and operation from within the vehicle cabin.
- DVB S2/RCS or SCPC, 8 W HPA.
- Backup with Inmarsat BGAN.

NOTE: Inmarsat BGAN is an example of a suitable product available commercially. This information is given for the convenience of users of the present document and does not constitute an endorsement by ETSI of this product.

Power supply:

- Power generator (gasoline for 48 h operation).

Voice technology and services:

- IP (WLAN) phones.
- DECT terminals (600 m radius).
- GSM picocell.
- Onboard VoIP PABX.
- 20 kb/s for one call. Number of simultaneous calls depending of the available bandwidth.

Data technology and services:

- WLAN (300 m radius) or wired Ethernet.
- Local IP switching/routing, Internet access.

Other services:

- Videoconference with dedicated SIP terminals or PC/webcams.
- Live video streaming from pan-tilt-zoom cameras.
- Collaborative working.

Fields of operation:

- Demonstration in the frame of the TANGO project (Cahors, France 2008).

A.2.2.3 Networking RECOVER and MOBIDICK

RECOVER and MOBIDICK can be deployed on the same field. To secure and help each other, an HiperLAN/2 link is set up between the two stations.

Such a link is possible with the Hiperlan technology, capable of broadband wireless communications over several kilometres (with several Mb/s), even if the stations concerned are not in a direct line of sight.

Inter-cell link advantages:

Resilience: The terrestrial link secures connections between the cells and the hub by letting one cell use the satellite connection of the other one, if its own satellite link fails.

Optimization: Terrestrial data transfer between the two cells saves satellite bandwidth.

Latency on the satellite link: Voice and video communications between the two stations take two round trips over the satellite links, introducing considerable latency. A long-distance wireless link between each other solves the problem of latency for more comfortable inter-ECCS communications (voice, videoconference).

Load balancing: A (wireless) terrestrial link makes it possible to balance the load. Each cell has two paths, either directly via its own satellite link or, over the Hiperlan connection, via the other cell's satellite link. Sharing the load would mean that the satellite link resources could be used in a more balanced manner with a view to avoiding letting one link become overloaded when the other has spare capacity.

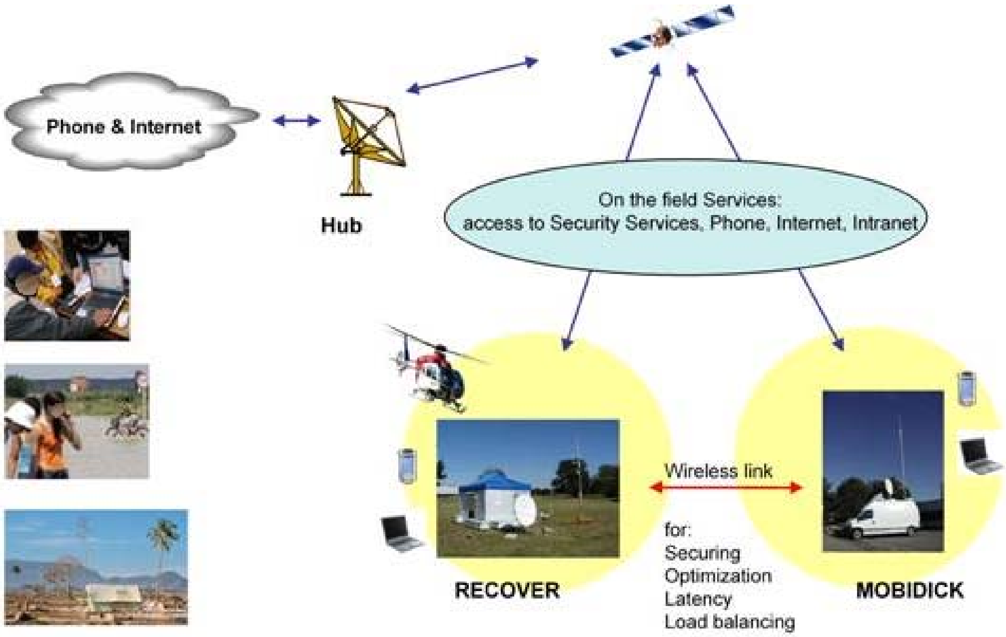


Figure A.8: Architecture of RECOVER and MOBIDICK with terrestrial link between cells

A.2.2.4 RECOVER or MOBIDICK inter-connectivity / inter-operability matrix

Table A.5

		ECCS Terminal						Remote				
		IP Voice & Visio	DECT	VHF	TETRA	GSM	IP Data	Internet	PSTN	GSM	VHF	TETRA
ECCS Terminal	IP Voice & Visio	◆	◆ (Gateway in ECCS terminal)			◆ (Gateway in ECCS terminal)		◆	✕ (Gateway in ECCS server)	✕ (Gateway in core network)		
	DECT	◆ (Gateway in ECCS terminal)	◆			◆ (Gateway in ECCS terminal)		◆ (Gateway in ECCS terminal)	✕ (Gateway in ECCS server)	✕ (Gateway in core network)		
	VHF											
	TETRA											
	GSM	◆ (Gateway in ECCS terminal)	◆ (Gateway in ECCS terminal)			◆		◆ (Gateway in ECCS terminal)	✕ (Gateway in ECCS server)	✕ (Gateway in core network)		
	IP Data						◆	◆				

Legend:
- ◆ Inter-connectivity (local or remote)
- ✕ Inter-operability using a gateway
- (orange) Gateway in ECCS terminal
- (green) Gateway in ECCS server
- (olive) Gateway in core network

A.2.3 ABCSat

ABCSat is a standalone telecommunication solution, easily transportable and autonomous in terms of energy supply.

Figure A.9: ABCSat deployments

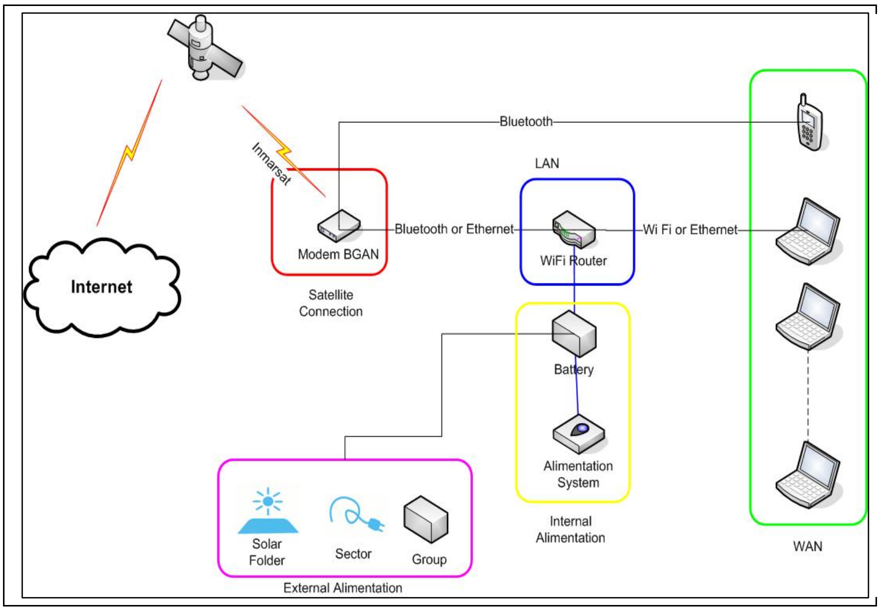


Figure A.10: ABCSat architecture

A.2.3.1 ABCSat specifications

Dimensions and mounting:

- All components (PC, phone, webcam, solar panel, satellite terminal and antenna) fit in a compact ruggedized and wheeled suitcase.
- Dimensions: 559 mm × 351 mm × 229 mm / 13 kg (conforming to air companies' requirements on hand luggage).
- Autonomous in terms of energy supply: high capacity battery (8 hours) and a light foldable solar charger.

Deployment time:

- Less than 10 min.

Robustness and environmental conditions:

- Water "splash" proof and dustproof (IP54).

Satellite terminal:

- Inmarsat BGAN.

NOTE: Inmarsat BGAN is an example of a suitable product available commercially. This information is given for the convenience of users of the present document and does not constitute an endorsement by ETSI of this product.

Power supply:

- High capacity battery (8 h) and a light foldable solar charger.

Voice technology and services:

- Via Inmarsat voice service.
- Legacy telephony, RJ11 plug.

Data technology and services:

- WLAN or wired Ethernet.
- Local IP switching/routing, Internet access.

Other services:

- Videoconference.

Fields of operation:

- In the frame of the NETADDED project in the Republic of Benin (2009).
- Haiti (2010).
- Oceanographic boat "La Boudeuse" (2010 - 2011).

A.2.3.2 ABCSat inter-connectivity / inter-operability matrix

Table A.6

		ECCS Terminal						**Remote**				
		IP Voice & Visio	DECT	VHF	TETRA	GSM	IP Data	Internet	PSTN	GSM	VHF	TETRA
ECCS Terminal	IP Voice & Visio	◆						✗	✗	✗		
	DECT		◆					✗	✗	✗		
	VHF											
	TETRA											
	GSM											
	IP Data						◆	◆				

Legend: ◆ Inter-connectivity (local or remote)

✗ Inter-operability using a gateway

Gateway in ECCS terminal

Gateway in ECCS server

Gateway in core network

A.2.4 OSCAR

OSCAR stands for "On the move Satellite Connectivity for Applications of Radiocommunications".

Figure A.11: OSCAR mobile station

Interest of mobility

Need for continuous communication while on the move. This vehicle enables broadband access to the Internet while driving and at a standstill without deploying hardware.

It will for example, in case of emergency, making shots and account records in real time, without leaving the vehicle.

For example:

- rapid inventory in case of forest devastated by a storm, fire, snowstorm, earthquake, etc. (for Civil Security);
- rapid inventory in case of attack, public demonstrations, etc. (for the Police);
- monitoring of dangerous transport.

Problem of mobility

- Using an auto-steerable antenna.
- Environmental constraints: attitude of the vehicle (speed, shock, vibration), masking (weather, vegetation, buildings, other vehicles, etc.).
- Comply with regulatory constraints at European level by the relevant bodies.

A.2.4.1 OSCAR specifications

Dimensions and mounting:

- Light utility vehicle.

Deployment time:

- None (auto-steerable antenna).

Robustness and environmental conditions:

- (vehicle mounted).

Satellite terminal:

- Auto-steerable elliptic Ku antenna (equivalent diameter: 0,45 m).
- 25 W Ku amplifie.
- SCPC or DVB/RCS/S2. Bandwidth: 1 Mb/s (up) - 2 Mb/s (down).
- About 80 % of downlink availability while driving (countryside and urban environment).
- Complies with regulatory constraints at European level by the relevant bodies.

Power supply:

- Batteries: 1 h power supply autonomy (car engine stopped).

Voice technology and services:

- VoIP telephone.
- Backhauling via satellite to CNES PABX or a voice operator network.

Data technology and services:

- Wired Ethernet.

Other services:

- Live video.
- Videoconference.
- Collaborative working.

Fields of operation:

- Research and trials.

A.2.4.2 OSCAR inter-connectivity / inter-operability matrix

Table A.7

		ECCS Terminal						**Remote**				
		IP Voice & Visio	DECT	VHF	TETRA	GSM	IP Data	Internet	PSTN	GSM	VHF	TETRA
ECCS Terminal	IP Voice & Visio	◆						✕	✕	✕		
	DECT											
	VHF											
	TETRA											
	GSM											
	IP Data						◆	◆				

Legend: ◆ Inter-connectivity (local or remote)

✕ Inter-operability using a gateway

Gateway in ECCS terminal

Gateway in ECCS server

Gateway in core network

A.2.5 DECISION

Funded by ESA, the Decision consortium is composed of Infoterra France, the project lead, TRADIA Spain, Astrium Satellites France, EADS Secure Networks France and Skysoft of Portugal. Enhancing interoperability during European civil protection operations is the objective of an ESA project named Decision. In the context of this project, field trials were held in Chartres, France, focusing on satellite solutions to improve cooperation between civil protection agencies in crisis theatres - whether they occur in Europe or outside.

The Decision (DEvelopment of CIvil protection Satellite communication services: enhancing Interoperability during deployments Outside Europe - also referred to as 'Multinational Telecoms Adaptor') project aims to increase the efficiency of co-operation between different national civil protection units working within the same foreign crisis theatre and between members of national teams.

The demonstration covered two intervention scenarios. The first focused on a national situation where an industrial disaster has occurred and, as a consequence, the terrestrial communications infrastructure has been destroyed. In this instance, telecommunications satellite links are used to support coordination between the command post in the field and the regional crisis operations centre. The second scenario dealt with an intervention outside Europe (such as an earthquake or a tsunami) involving a number of different civil protection agencies. For international disasters, rescue activity coordination needs to be performed between units in the field, as well as between national centres in Europe. In such a situation, telecommunications satellites are needed so as to ensure, on the one hand, communications between field units and, on the other hand, between those units and their national centres.

The Chartres trial allowed the validation of the satellite multi-adaptor use concepts that are applicable both in a national and an international context. It also helped to assess the added value of the multi-adaptor in a joint operation by different civil protection agencies working within the same foreign crisis theatre. The involvement of civil protection agencies as end users is of primary importance since, by its nature, the project has a user-need oriented approach rather than a technology-push one. The field trial was conducted with a cooperative spirit and a complementary contribution, through which fruitful results and end-user feedback were collected. This will lead to the definition of new perspectives and extensions of the current work.

The results truly demonstrated the need for adapted tools such as the Multi-Service Adaptor Communication Facilities and some tracking facilities. These technical assets can ease the work of agencies in case of emergencies and also show the importance of developing interoperability solutions adapted to in-the-field needs and constraints.

The field trial benefited of the attendance and involvement of the French authorities and the French Civil Protection Agency (Direction de la Défense et de la Sécurité Civiles - DDSC), the German Technical Relief Agency (Technisches Hilfswerk - THW), the Belgian Civil Protection Agency and the Austrian Civil Protection Support Unit.

A.2.6 Multi-national Telecom Adapter (MTA)

To help increase the efficiency of rescue operations during large-scale national or international emergencies, the European Space Agency (ESA), in partnership with European civil protection agencies, has launched an initiative to develop new satellite programme dedicated to European civil protection. The first phase of this initiative included among two other topics a satellite adaptor project, which was addressed in parallel by two projects: DECISION (cf. above section) and MTA. The MTA project team was headed by Telespazio and also comprises Thales Alenia Space, Indra and Hispasat. As part of the project, the Piedmont civil protection authorities had the task of "validating" the functions of the new satellite technology.

By financing this project, ESA wished to encourage the standardisation of new systems and favour dialogue between European civil protection agencies. This would lay the foundation for "harmonised" technological development in accordance with the requirements of these agencies, which would be able to take action anywhere in the world using a satellite system that integrating the various national systems and providing high quality, reliable audio and video communications.

At the heart of MTA is the concept of PEA (Pan-European Satellite Telecom Adaptor) which is based around an integrated communications system transportable by vehicle or helicopter enabling each civil protection agency to connect its operations centre with the emergency scene. The main new development with this system is its interoperability with satellites based on different standards which, thanks to the PEA, are able to interact one with the other to ensure a secure and reliable broadband connection. Another development, which constitutes a first, is the integration of all the wireless and satellite telecommunications components. The transportable satcom system is able to create analogue and digital radio cells in situ and connect them to the civil protection agency's operations centre via satellite link. In this way operators are able to use the communications systems in service and connect them with terrestrial networks. The satellite is therefore essential to extend the coverage of wireless communication systems and to provide ever more convergence between the various technologies.

A field trial was held in May 2008 in Andorra, with the involvement of several Civil Protection Authorities and the demonstration of interoperability between 3 different satellite systems based on 3 different satcom technologies.

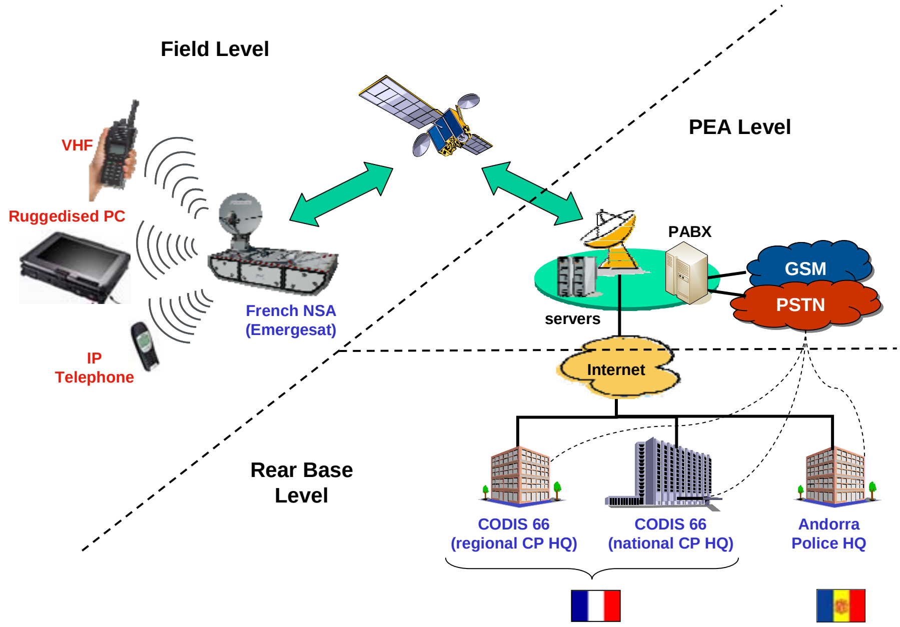


Figure A.12: MTA field trial setup

A.2.7 TANGO

A.2.7.1 The TANGO Project Goal

The objectives of TANGO "Telecommunications Advanced Networks for GMES Operations" European Commission (EC) programme are to develop, integrate, demonstrate and promote new satellite telecom services dedicated to GMES (Global Monitoring for Environment and Security) requirements. TANGO is a 36-month program of the European Commission FP, started November 2006.

The project addresses key environments and security applications for 6 different themes: maritime services (including fisheries management, maritime surveillance and ocean applications), land cover, atmosphere, security, risk and crisis management and humanitarian aid. Disaster management theme is covered through Risk and Crisis management and Humanitarian Aid (both related to Emergency Response Services in and out of Europe).

During the first phase of the project, TANGO completed collection of telecommunications requirements through major GMES projects. A systematic approach for assessing the needs was established, relying on the definition of a clear and agreed terminology and reference TANGO architecture. The requirements were filled in a data base through a dedicated web interface developed within the project. Common trends among various themes were identified, highlighting the key benefits expected from telecommunications:

1) a reduction of the time to access GMES services and delay improvements in data collection and data transport;

2) higher data rates expected on all architecture segments from data collection to data dissemination;

3) trends towards global coverage;

4) portability and mobility with fast and easily deployable equipments for emergency situations;

5) combination of position, data and voice communications for effective communications on the field;

6) increased reliability of the links.

These trends were documented per each theme and synthesized in a public document.

Regarding to Emergency response themes, the following key telecommunication components and technologies have been adapted, developed and validated within the project.

- Broadband to fixed and mobile users for reliable data dissemination, relying on standard technologies (DVB-RCS and SATMODE) and adapted within the project to GMES applications.

- Satellite radio broadcast including early warning systems, through the definition of two types of terminals, including on one hand a low cost terminal and on the other hand a two-ways terminal providing feed back data support and advanced mobility and autonomy features.
- Broadband combined with terrestrial mobile systems for fast and reliable network deployment in support to rescue teams and civil protections. PMR extension by satellite solution and GSM and IP/ DVB-RCS transportable solutions have been completed. A fast and easily deployable GSM/satellite solution named RECOVER based on a kit of small size telecommunications containers was developed and demonstrated in two demonstration contexts (risk a crisis management and security).

One major objective of the project is the development of the "Common Telecommunications Services Platform", to offer a privileged interface to the GMES community and to provide an optimised access to the satellite capacity. Built to facilitate the GMES service providers access to the telecommunications solutions, the CTSP acts as broker enabling service provisioning and management between GMES service providers (customers of the CTSP through a user-friendly web interface) and telecom providers. Currently interfaced to the set of TANGO telecommunication solution, the CTSP first version, based on a generic interface will be easily extendable to other telecommunications providers.

A.2.7.2 The TANGO Project Learned Lesson toward the standardization

The following requirements relevant to emergency response and disaster management were identified.

Risk and Crisis management

The thematic covers the phases of prevention (monitoring), detection (early warning) and management (planning and deploying forces once a crisis has been triggered). The considered GMES services are from Risk-EOS (European Space Agency project) and PREVIEW European Commissions project).

Satcom solutions have to allow continuous and consistent situational awareness through regular elaboration and update of information related to the overall context and the on-field areas. This information will be based on earth observation satellites imagery, in situ and cartography data.

For crisis management coordination:

- to communicate on the crisis theatre with each other in an effective and efficient manner;
- to communicate between civil protection headquarters, public safety headquarters and on-field command centres, local authority;
- priority in communications;
- availability, reliability and robustness;
- autonomy, transportability and move;
- modularity and scalability.

A.2.8 TRACKS (transportable station for communication network by satellite)

TRACKS can provide a rapidly deployable platform that can extend coverage of existing telecommunication infrastructures or replace them in times of calamity. When deployed TRACKS can quickly enlarge the telephony and internet services of a given area including the rural areas of developing countries.

The prototype includes an easily deployable VSAT providing the satellite link in Ku band at 512 kb/s. This is sufficient for access to the Internet, a GSM MSC or directly to the PSTN.

The 12 m high mast is equipped with an omni-directional GSM antenna. TRACKS also carries its own power generator, a PC for Internet access, a micro GSM system with micro-MSC as well as a BSC and BTS equipped with up to 6 transceivers.

The platform is a two-person van weighing less than 3,5 tons. TRACKS can be fully operational in about one hour. This includes time required to start the power generator, deploy the mast and VSAT antenna deployment, as well as pointing of the antenna establishing two links, one to a satellite and the other to a GSM network.

A field trial was successfully completed on October 19th, 2005, at Cahors Airport (France) and the platform performed as expected. The basic concept was achieved with different candidate customers validating the concept. The field trial was attended by representatives from SFR, a French GSM Network operator; UNOSAT, a United Nations initiative to provide the humanitarian community with access to satellite imagery and GIS services; SDIS 46, a French Civil Security department; and Conseil Régional de Corrèze, a French Territory Administration service.

Disaster Relief Agencies can now use a new vehicle in their efforts, this thanks to EADS Astrium which has completed an ESA sponsored project for the development of TRACKS: Transportable Station for Communication Network Extension by Satellite.

A.2.9 EMERSAT

The EMERSAT project is co-funded by the Italian Space Agency (ASI) and by a team of Italian industries and universities / research centres, with Telespazio as coordinator. The project started in February 2009 and will end in September 2012. The main involved institutional users are the national civil protection department (DPC), the national fire brigade department (VVF), some regional civil protection agencies and the national Red Cross (CRI).

The main objectives of the EMERSAT project are:

- To provide new technologies and network functionalities for the National Satellite Emergency Network.
- To enhance interoperability between terrestrial and satellite technologies, to allow fast and efficient communications between operators of the different agencies involved in emergency management on-field (Civil Protection, Fire Brigades, etc.).
- To qualify a Service Model for emergency telecommunications, based on the integrated use of satellite and terrestrial technologies.

The proposed emergency network will include different typologies of satellite terminals:

- Fixed satellite terminals, to be installed in local / regional / national coordination centres.
- Transportable satellite terminals, to be deployed on field.
- Mobile satellite terminals, to test satellite communications on the move services in emergency context.

With reference to transportable terminals, the EMERSAT project provides a new satellite compact solution: a fly-away satellite station. This solution, designed on specific requirements provided by institutional users, can be quickly and easily deployed on field on the emergency theatre to support communications with the national/regional coordination centres. It will provide advanced multimedia services (VoIP, videoconference, videostreaming, etc.) and interoperability services with local terrestrial emergency networks (e.g. analogue or digital radio networks, WLAN/WiMAX local networks, etc.) through specific interfaces that will be developed within the project.

Figure A.13: EMERSAT fly-away satellite terminal

Annex B: Complete definition of potential scenarios

There are many possibilities for locating the different entities of ECCS systems. For example, gateways installed in ECCS server systems are possibly an option for PMR systems, which do not have public gateways. For PLMN/PSTN/IP telephony usage in most cases preference will be given to commercially operated public gateways.

For the sake of straightforwardness a number of variants were not included in the overview of clause 4.3.3:

- Different ECCS operators maintaining different ECCS systems.
- Variants of PMR gateways.
- Local call switching in ECCS terminals requiring a connection to core networks (for signalling).
- Gateways in ECCS terminals for local calls requiring connectivity to core networks (for signalling).
- Terrestrial connections between ECCS terminals.

Figure B.1 provides a walk-through approach to the different scenarios depending on location, connectivity means of the different entities and where to put gateways supporting interconnection capabilities. Besides Figure B.1 does not differentiate between terrestrial services which means that a real ECCS implementation can be a combination of two or more of these scenarios.

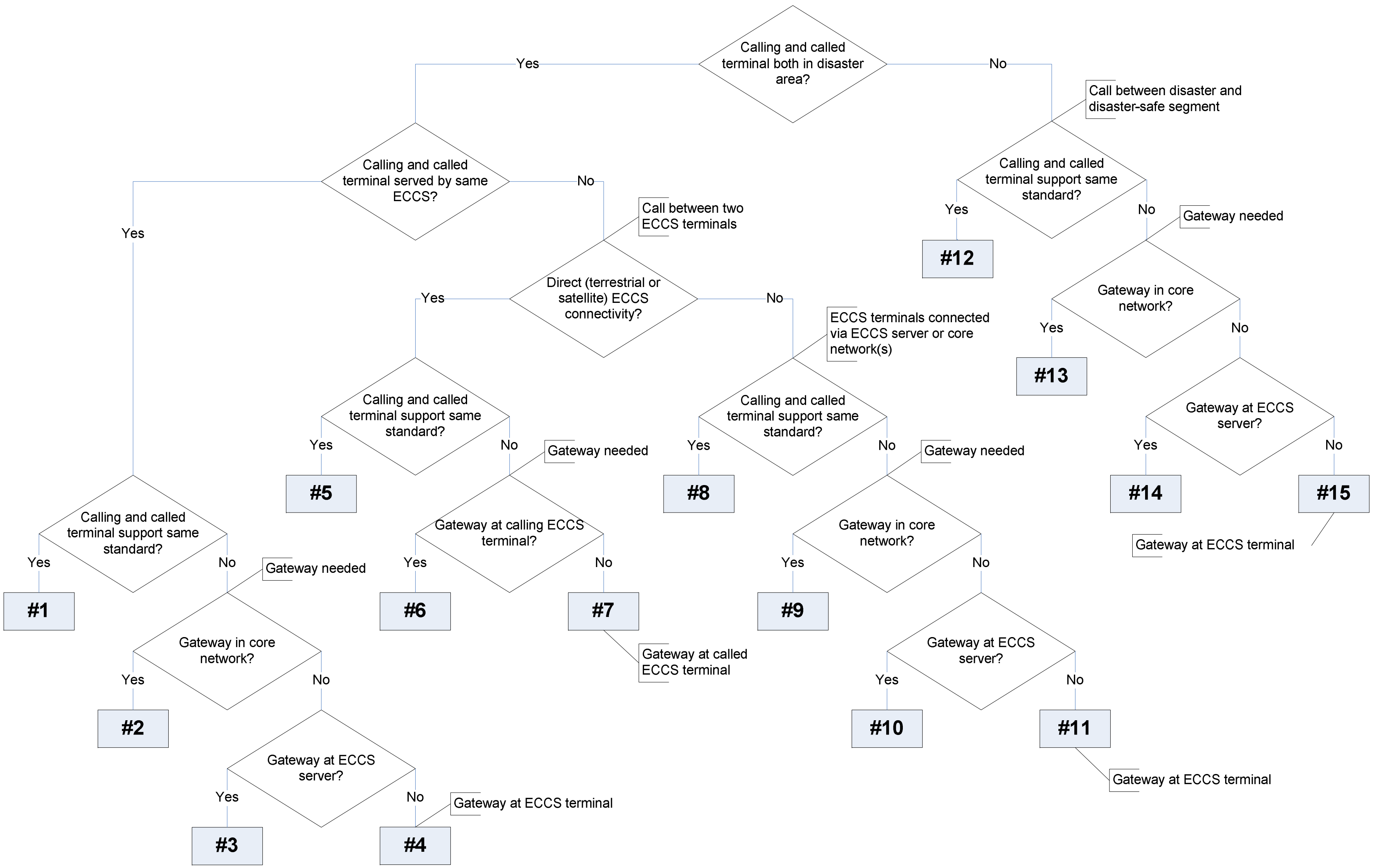


Figure B.1: Overview ECCS connection scenarios

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History

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