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Abstract:
This document compiles all the results from the MONET workshop held in Madrid on June 7th, 2010 involving end-users from different public safety entities. To achieve the goal of defining the mission and technical requirements for the MONET system, a set of questionnaires and personal interviews have been held and a summary of the results from this investigation was presented during a workshop to refine the information collected. The result of all this process is presented in this document.

[1] Nature of deliverable: **R** = Report; **P** = Prototype; **D** = Demonstrator; **O** = Other
[2] Dissemination level: **PU** = Public; **PP** = Restricted to other programme participants (including the Commission Services); **RE** = Restricted to a group specified by the consortium (including the Commission Services); **CO** = Confidential, only for members of the consortium (including the Commission Services).

Document History

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Executive Summary

In order to set the functional and technical requirements to be fulfilled by MONET system, so that end users expectations can be met as much as possible, it is essential to collect all information from them to provide the end users requirements. To achieve this goal, a set of questionnaires and personal interviews have been held and a summary of the results come from this investigation was presented during a workshop to refine the information collected. The result of all this process is presented in this document.

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List of Acronyms

Acronym	Meaning
MONET	Mechanisms for Optimization of hybrid ad-hoc networks and satellite NETworks
ATEX	An ATEX certificate is needed to demonstrate that an equipment can be safely operated in a potentially explosive atmosphere created by the presence of flammable gas, vapour, mist or clouds of combustible dust. CBRN (Chemical, biological, radiological, nuclear) or at least chemical products
BO	Back office
CP	Command Post
FR	First Responder
GIS	Geographic information system (GIS), or geographical information system, is any system that captures, stores, analyzes, manages, and presents data that are linked to location
GPRS	General packet radio service (GPRS) is a packet oriented mobile data service available to all users of the 2G cellular communication systems global system for mobile communications (GSM), as well as in the 3G systems.
GSM	Global System for Mobile Communications. It is a standard for mobile telephony systems
MANET	A mobile ad hoc network (MANET), sometimes called a mobile mesh network, is a self-configuring network of mobile devices connected by wireless links.
MONET	Mechanisms for Optimization of hybrid ad-hoc networks and satellite NETworks
ORSR	The Optimized Link State Routing Protocol (OLSR) is developed for mobile ad hoc networks. It operates as a table driven and proactive protocol, thus exchanges topology information with other nodes of the network regularly.
PMR	Professional Mobile Radio (also known as Private Mobile Radio (PMR) in the UK and Land Mobile Radio (LMR) in North America) are field radio communications systems which use portable, mobile, base station, and dispatch console radios.
TETRA	Terrestrial Trunked Radio (TETRA) is a digital trunked mobile radio standard developed by the European Telecommunications Standards Institute (ETSI). The purpose of the TETRA standard was to meet the needs of traditional Professional Mobile Radio (PMR) user organisations
UMTS	Universal Mobile Telecommunications System is one of the third-generation (3G) mobile telecommunications technologies

Table 1 - List of acronyms.

1 Introduction

1.1 Workshop objective

On June 7th, 2010, the End User Requirements Workshop for MONET project was held in Isdefe premises in Madrid, Spain. The workshop was focused on discussing and agreeing general end users requirements to be translated into MONET specifications. Major goals of this workshop were:

- Present the scope and general objectives of MONET to potential end users.
- Present the description of studied scenarios in MONET.
- Obtain more specific user requirements from participant end users.

1.2 Workshop methodology

MONET proposed functionalities might affect a number of potential end users. Capturing the user requirements is, therefore, a first and key, step of any project since any project can be considered successful only if its outcome serves its potential end users.

Given this context, the methodology used to better reach the workshop objectives emphasizes the active contact with end users even previous to the workshop itself. The methodology followed is split into three steps, namely:

- Preparation for the workshop.
- During the workshop.
- After the workshop.

Figure 1 and subsections 1.2.1 detail the methodology for each of these three steps.

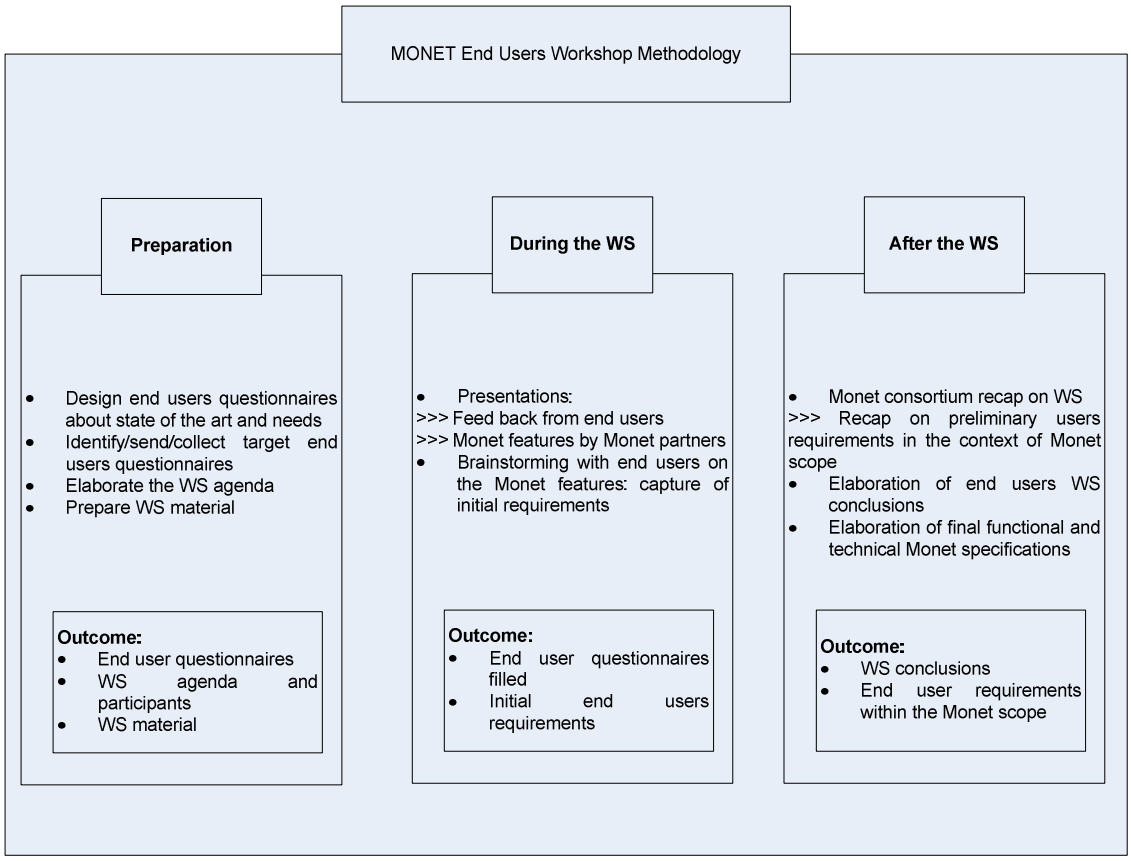

Figure 1 - Monet End Users Workshop Methodology.

1.2.1 Preparation for the workshop

It was agreed by MONET partners that a precise and previous knowledge about end users state of the art technology and procedures was necessary previous to the workshop. To gather this knowledge the following steps were followed:

- Design of end users questionnaires

The end users questionnaires have been the vehicle to gather end user information previous to the workshop and are enclosed in annex 1x of this document.

- Elaborate the WS agenda

The WS agenda was elaborated considering end users answers to the questionnaires. Emphasis was done on those aspects of the Monet functionalities where users expressed doubts, existing gaps and /or special interest.

- Prepare WS material

According to the agenda elaborated, presentations were prepared by the consortium. Specifically, those organizations in charge of developing Monet technology were requested to prepare a presentation on the added value for end users of implementing such a technology.

1.2.2 During the workshop

The workshop intended, as a final objective, to collect functional requirements for the Monet project. Additionally, it intended to establish a closer rapport among the Monet consortium

and the potential users of Monet technology. The workshop was, then, prepared to be highly proactive. The following activities took place:

- Feedback from end users

A summary of the end user response to the questionnaires was presented through the presentation of studied scenarios. Emphasis was done in those aspects that end users expressed doubt.

- Monet features by Monet partners

Presentation of Monet features (functional and some technical aspects) was done specially focused on studied scenarios

- Brainstorming with end users on the Monet features: Capture of initial requirements.

1.2.3 After the workshop

After the workshop, the elaboration of Monet functional and technical requirements should be done in sufficient detail for technical partners so they would be able to develop the expected system.

Two main activities were foreseen during this phase:

- Monet consortium recapitulation on preliminary users requirements
- After the workshop, a recap of its brainstorming discussions and initial user requirements collected was conducted by the Monet consortium. The goal of the session was to sum up the user requirements, considering the scope of Monet, and the identification of issues to be discussed with end users as a result of conclusion derived from the workshop.
- Elaboration of final functional and technical Monet specifications

The ultimate result of the workshop is to elaborate user requirements that will make the results of the Monet project useful to end users. Previous steps have all been geared towards this objective.

1.3 Agenda

ITEM	DURATION	START	END	OWNER
Welcome words and presentation of the agenda	15min	9:30	9:45	Isdefe
Brief presentation of the attendance and expectancy about the WS (round table)	15 min	9:45	10:00	All
Brief presentation of the consortium & role in MONET project TEKEVER. ASTRIUM. CRAT. UoS. Slovenian Civil Protection Isdefe	15 min	10:00	10:15	TEKEVER
MONET overall presentation	10 min	10:15	10:25	TEKEVER
Introduction to MONET Questionnaires Results: Introduction and objectives	15 min	10:25	10:40	Isdefe

ITEM	DURATION	START	END	OWNER
List of participants List of Scenarios Analyzed				
Presentation of MONET Questionnaires Results: Scenario 1: Public Safety – Forest Fire	30 min	10:40	11:10	Isdefe
Coffee Break				
Presentation of MONET Questionnaires Results: • Scenario 2: Public Safety – Mountain Rescue in a Remote Area	20 min	11:25	11:45	Slovenian Civil Protection
• Scenario 3: Border control – Coastal Monitoring.	20 min	11:45	12:05	Isdefe
• Scenario 4: Airport Control	20 min	12:05	12:25	Isdefe
Presentation of requirements: • Common Operational Requirements for all Scenarios • Operational Requirements beyond MONET (for further developments)	20 min	12:25	12:45	Isdefe
Presentation of MONET Technical Requirements	20min	12:40	13:00	ASTRIUM
MONET high level architecture	20min	13:15	13:30	TEKEVER
Lunch				
Discussions & Conclusions	10min	14:40	14:50	ALL (moderate by Isdefe)
Next steps	10 min	14:30	14:40	Isdefe/TEKEVER

Table 2 - Agenda

1.4 Document structure

This document provides a chronological overview of the workshop and its results.

- Chapter 1 gives the workshop objective, and the overall methodology that was followed in order to collect the end users needs and translate them into functional and technical requirements.
- Chapter 2 summarizes the welcome and general session.
- Chapter 3 gives an overview of the results from questionnaires and interviews held with end users before the workshop.
- Chapter 4 provides general requirements obtained form the end users during interviews and the workshop.
- Chapter 5 summarizes the general conclusions from the interaction with the end users.
- Annexes 1 and 2 contain the list of participants of workshop and the questionnaires sent to the end users.

1.5 Applicable and reference documents

REFERENCE	DOCUMENT DESCRIPTION
D2.4 Monet Study Scenarios	A set of scenarios where MANET networks are a pre requisite, are analyzed and evaluated

Table 3 - Reference documents

2 Workshop Welcome

Isdefe opened the workshop and welcomed all participants. After presenting the workshop programme, a round table was performed in order to know all the participants of the workshop, the Monet consortium members and their roles in the project, the users and their functions and expectations from the workshop. After completing the round table, the Monet coordinator gave an overview of the Monet project, including some background information about Crisis intervention and Communication networks, which is summarized below:

Crisis Intervention

In most cases, an Emergency Plan is edited by municipalities. The emergency Plan contains the classification of types of emergencies and the intervention protocol to carry out in each of them including means and resources needed and coordination between different First Responder (FR) units. In order to optimize the effective response to an emergency, the Emergency Plan set up an organizational framework that set the coordination between all the services, resources and means involved in the intervention.

When a disaster occurs, emergency numbers are used as notification mechanisms to alert about an emergency situation. Emergency number services put FR on alert.

When arriving at disaster site, mobiles control centre are deployed in the crisis area. In general, one mobile control post (CP) per FR service is deployed but it is also possible that one unique mobile control post composed of representatives from each FR service will be deployed. The communication flows from FR units to their CP and from the CP to the central (back) offices (BO), where last decisions are taken.

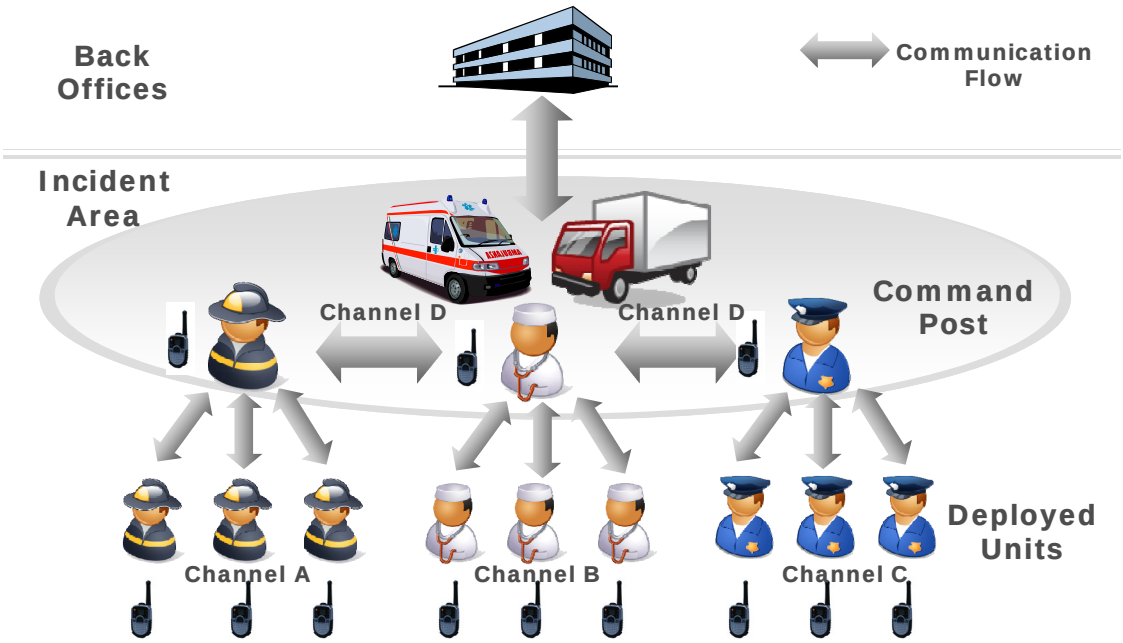

Figure 2 - Crisis Intervention

Communication Network
Different protocols (e.g. TETRA, GSM, GPRS, etc.) are used depending on the country and the FR service. One major concern is that the means and protocols of communication currently used do not support broadband applications such as video and GIS data. This kind of information should be transmitted to the CP in order to optimize crisis management and safety matters for the FRs. MONET network makes supporting broadband application possible.

Another major concern of the current networks is the reliability and availability of the coverage since outdoor and indoor conditions can affect considerably the network communications. The MONET wireless network will be designed to have a reliable coverage, also in restrictive environments.

Finally MONET will be flexible and adaptable to different organization models and fit as many emergencies cases as possible.

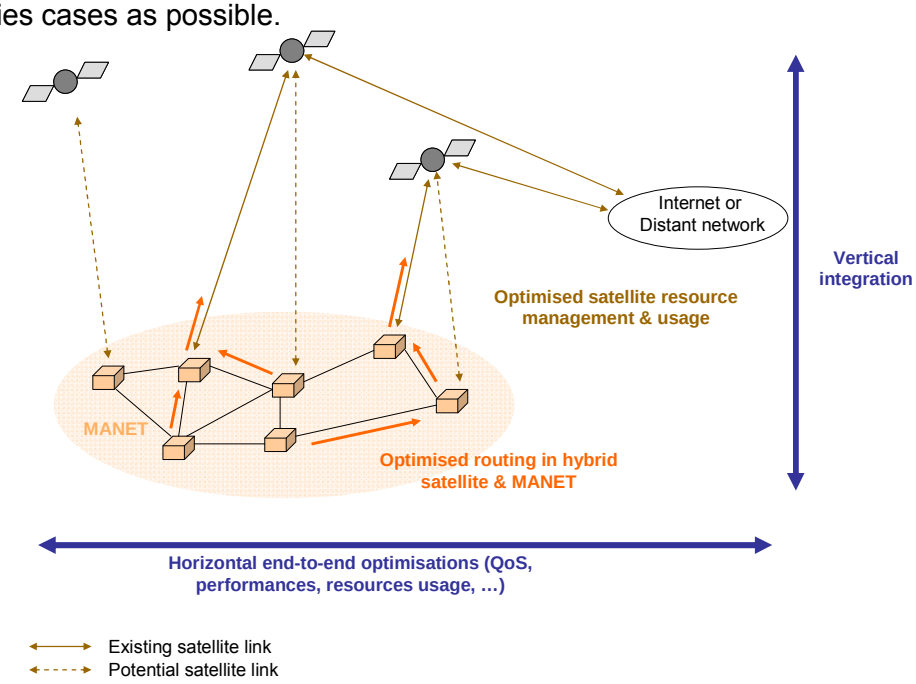

Figure 3 - MONET communication network

3 Questionnaires Results

This section presents the results obtained from the interviews held with end users before the Workshop. It reflects a high level compilation of the current situation on the one hand and a list of end user needs on the other hand and was used as the starting point of the workshop discussion.

The following tables are split into areas and sub-areas addressing different issues concerning potential MONET users protocols of actuation

Current Situation

AREA	SUBAREA	INFO PROVIDED BY DIFFERENT END USERS
Crisis intervention	Players involved in a crisis and coordination between them	1. Emergencies notification: emergencies number services put FR on alert 2. Each FR service has its own control centre. 3. CP deployed in crisis area:

AREA	SUBAREA	INFO PROVIDED BY DIFFERENT END USERS
		• One per FR service • One unique CP composed of representatives from each FR service. 4. Communication flow (general, major crisis): BO ↔ CP ↔ FR
Equipment	Equipment carried by FRs	**1. Protocols used:** • TETRA • GSM/UMTS • GPRS **2. Auxiliary equipment:** phones, analogue radio, wireless radios, digital radio, Sensors for respiration equipment, gas sensors, biometric sensors (sometimes fire fighters, medical units)
	Equipment in CP and BO	**Protocols used:** • TETRA • Communication via satellite • Sometimes internal channel devoted to communications between CPs
Communication networks and services provided		**Main constraints:** • Reliability • Coverage • Communication networks to support voice but not broadband applications.

Table 4 - Questionnaire Result: Current situation

End User Needs

AREA	SUBAREA	NEEDS EXPRESSED BY END USERS
Equipment requirements	Equipment carried by first responders	• Robust • Water, gas, liquids resistant • Long battery life (Autonomy according to operations) • Operating temperature range from -30ºC to +50ºC • Compatible with different systems and devices currently used (video camera, digital radio PMR and TETRA positioning, etc) • According to regulation ATEX 2C • 0.5kg (FR portable) • 10kg (intended to deploy it in a fixed place) • Minimum wireless coverage 100-300m (desirable >500m) • Compact • Coverage: intermediate MONET nodes used as relay
	Equipment in CP and BO	• Nodes in CP and vehicles: wireless and satellite link. • Nodes acting as relays (for wireless communication) needed to ensure wireless communication between FR and CP.
Expected Services: advantages and challenges		**1. Expected Services:** • Supporting broadband applications. • Avoiding congestion of voice communication • At least current voice services for communication one to one and one to many • Communication interfaces for FR sensor data,

AREA	SUBAREA	NEEDS EXPRESSED BY END USERS
		video camera, PRM, TETRA, positioning… **2. Advantages:** • Online data transfer. Data are automatically transferred to CP/ BO without FR intervention • Real time analysis: optimization of decision making and coordination. Safety of intervention team • Most of the voice communications could be replaced by data messages, so the information is recorded and updated automatically. • International cooperation: local network to prevent congestion in communication and satellite communication to communicate with their national BO. **3. Challenges:** • Network coverage in heavy terrain • Current operation procedures are adapted to the current communication technology. The operational procedures should be adapted if MONET network is applied.

Table 5 - Questionnaire result: MONET situation

4 Operational Requirements

Based on the information collected from end users a set of possible application scenarios had been developed. The initial requirements coming from these scenarios were elaborated by the MONET consortium and were presented during the workshop in order to obtain the end-user feedback, which will be used to refine the requirements definition.

4.1 Scenarios

The following scenarios were developed and presented during the workshop:

- Public Safety: Forest fire.
- Public Safety: Mountain Rescue.
- Border control: Coastal Monitoring.
- Airport Control.
- Broadband access to rural areas.

A detailed description of these scenarios and their corresponding requirements are given in D2.4 “Monet Study Scenarios”.

4.2 User requirements

This subsection presents the most relevant information collected during the workshop discussions.

Nodes classification

MONET nodes can be classified according to their functionality, but in principle each node should be able to fulfil all functionalities:

- Portable nodes: nodes carried continuously by FR team members.

- Relay nodes: nodes used network relay node to maintain full coverage. Are temporary carried by FR team members or vehicles and located at strategic places.
- Vehicular nodes: nodes located in a vehicle.
- Fixed nodes: nodes located in a fixed CP and in a BO.

Every node should have access to the MONET network through wireless access and satellite interface. However, since satellite access implies an increase in weight and size, it may not be desirable for portable or even relay nodes.

Nodes compactness and dimensions

It is desired that nodes will be as compact as possible (including short antennas). This feature is especially important in case of portable nodes in order to not impede the FRs to do their job properly (desirable 125x50x40mm). In case of relay nodes, this characteristic is a bit less restrictive since relay nodes are expected to be carried temporarily before deploying them (maximum desirable 300x200x200mm). In case of vehicular nodes, size should be suitable for emergency vehicles characteristics.

Regarding weight, the following requirements are identified:

- Portable nodes should not exceed the weight of existing TETRA terminals (less than 1kg, desirable 500g).
- Relay nodes should weigh less than 10kg.
- Vehicular nodes are without weight restrictions except for nodes carried by helicopters that should weigh less that 30kg.

Environmental conditions:

Given the environmental conditions of the proposed scenarios, the following environmental requirements are drawn up by the end users ():

- High wind resistance.
- High water/humidity resistance.
- High dust and sand resistance.
- Stand range temperatures of:
  - Portable nodes: -30ºC to 60ºC.
  - Vehicular nodes: -5ºC to 50ºC.
- Nodes should meet the ATEX certification in explosive environments.

Power Supply:

Reliable and efficient power sources are required. Electrical power supply depends on the kind of node:

- Portable and relay nodes batteries should allow continuous use during the mission.
- Vehicular nodes should be powered through vehicular battery (12V, desirable 24V).
- BothFixed nodes will be powered through the power grid.

Radio interface:

- Wireless coverage should be enough to guarantee reliable communication services, taking into account horizontal distances, terrain topography and issues concerning current operational practices performed by FRs (such as autonomy of the auto-pump fire-brigade vehicle and extensive gaps among FRs). It is therefore considered that wireless coverage should be at least 100-200m, but preferably 500m, thus avoiding the use of relay nodes.
- In case of urban fire, emergency WiFi communication used in a building should not interfere with private WiFi networks. For this reason users require a free spectrum dedicated to emergency situations.
- Madrid City Council Police proposed using a different radio frequency (900Hz) for more range.
- The functionality of one (speaker)-to-many (listeners) should be maintained.

User interfaces:

- It is desired that data sent by equipment are as much integrated as possible and also radio interfaces to facilitate FRs work.
- The existing operational procedures are based on talkgroups /dynamic group management on demand. These group calls should be covered either by developing ad-hoc applications with voice over IP through broadcasting techniques or by an interface with TETRA standard. In fact, end users expressed that the interoperability with other technologies such as TETRA is desirable.
- Electromagnetic compatibility should meet European Directive over Electromagnetic Compatibility 2004/108/CE.

Security:

In most cases it is sufficient to rely on air interface security and take no further security measures. TETRA standard allows air interface encryption for user traffic and signalling information both for individual and group communications.

It is considered though that additional security should be added to protect information, not only over the air interface but also within the network.

Public Safety Organisations have specific national requirements for their implementation of end-to-end encryption, military user groups, which have even greater security requirements. Currently they have ad-hoc security solutions based on end-to end encryption system according to their own requirements. It is standardized solution under development: just proprietary implementations on a case by case basis.

Therefore, MONET nodes should provide flexible security mechanisms. Nodes should have implemented channel security with both types of encryption.

Deployment and set-up:

MONET architecture should allow an automatic or areally simple set-up configuration. This is especially desirable for relay nodes considering their quick deployment.

Quality of Service:

The end users expressed that it is desirable to maintain/provide:

- A network capacity high enough to cope with all communications generated at least 50Mbps) and ready to deal with high data bit rates for new applications that would improve responsiveness and efficiency of the services.
- 1 second-short call set up.
- Peak traffic: 50 call/hour.
- Average call:
  - 25sec for PMR.
  - 35sec for TETRA.
- Special procedures for avoiding that all FRs are using the network at the same time.
- Update of positioning data from FRs to CP:
  - Not moving: every 5 minutes (current data provided by SAMUR medical services).
  - Moving normal operation: every 1 minute (current data provided by SAMUR medical services).
  - Emergency situation: every 30 sec.(current data provided by SAMUR medical services).
- The busiest satellite link should be able to transmit several Mbps. The rest of the satellite links will require less capacity (approximately 512Kbps).

4.3 Summary

The following table shows a summary of the user requirements:

SUBJECT	Nº	REQUIREMENT
WEIGHT	REQ1	• Wearable nodes should not exceed current emergency terminals (< 1kg) • Portable nodes should not exceed 10kg
RELIABILITY	REQ2	• Rugged and reliable nodes.
	REQ3	• Enough autonomy. Reliable and efficient power sources. Simple battery and charging solution.
CAPACITY	REQ4	• Wireless nodes should reach 50Mbps of capacity • CP satellite nodes should reach 8 Mbps of capacity • Vehicle satellite nodes should reach 512 Mbps of capacity
COVERAGE	REQ5	• Nodes should have enough coverage to guarantee reliable communication services Nodes should reach at least 200m. Desirable more than 500m.
	REQ6	• Intermediate nodes should be strategic allocated to avoid coverage gaps among FR and vehicles.
ENV. FACTORS	REQ7	• high wind resistance • high water/humidity resistance • high dust and sand resistance • high vibration and shock resistance • stand maximum range temperatures between **-30 and 60 ºC**.
	REQ8	• Nodes should meet the **ATEX certification** in explosive environments

SUBJECT	Nº	REQUIREMENT
COMPACT AND INTEGRATED	REQ9	• Nodes should be as compact as possible (short antennas) • User interface should be integrated with wearable node • Nodes integrated with the FR equipment (handsets in the helmets) • Desirable integrated GPS receiver
INTEROPERABILITY	REQ10	• The system should provide communication interoperability between and with legacy terminals: TETRA, TETRAPOL, VHF, UHF and GSM.
INTERFACES	REQ11	• Wireless connection with equipment carried by the FR (wearable sensors and video cameras)
	REQ12	• Integrated User Interface. Simplified keypad with large button
NODES TYPE	REQ13	• Nodes with satellite access reserved for vehicles and CP • Desirable intermediate nodes with satellite access • FR will carry nodes with just wireless access.
SECURITY	REQ14	• All kind of communications should be encrypted due to privacy issues in emergency communications. • Desirable Air-Interface Encryption (AIE) and End-to-End Encryption (E2E)
WIDEBAND	REQ15	• Wideband communications between Back Office and CP (more than 8 Mbps)
	REQ16	• Wideband Internet access for CP to access crucial information. • Examples for forest fire scenario: o Access to detailed maps for geo-localization o Access the fire risk assessment indices of the affected area
LATENCIES	REQ17	• Instant voice communications between Back Office and FR • Lower latencies than 200ms (typical delay for satellite communications)
OPERATIONAL PROCEDURES	REQ18	• Trade off between adapting current operation procedures to the new communication structure and vice verse
	REQ20	• Comprehensive user safety features

Table 6 - Summary of MONET user requirements

5 Conclusions

FRs operational procedures are adapted to the use of current communication technologies such as trucking radio, PMR or TETRA. If MONET is used in daily operations, procedures must be adapted to this technology. As an example, operation procedures using intermediate MONET nodes with satellite link should be described if it is decided to use them to establish parameter that consider where these nodes should be deployed in order to assure coverage. This means that MONET should provide them with interesting advantages as it does. Various applications could be supported by broadband provided by MONET for sending data:

- To send real time video to CP in order to determine the incident magnitude.
- To send automatically video and audio to CP if FR push an emergency bottom when a dangerous situation occurs. This device is currently included in all TETRA terminals but only identification of terminal sending the alarm is possible without including more data.
- To send location of all units to CP (real time) in order to manage the emergency in a more effective way.
- To send data form all sensors carried by FR in hot area to CP.

FRs pointed out that MONET architecture provide an interesting advantage since it makes communication available in cases of disasters that currently can not covered. For example, disaster in METRO tunnels (currently TETRA does not allow FR communication from 60m deep to assist people in tunnel with medical vehicle deployed on surface) or international disaster (ex. Haiti) where the lack of communication between emergency units from different countries and lack of interoperability of protocols and channels used made communication impossible and communication via satellite were massively used (congestion).

It is intended that MONET will be easily deployed in crisis area and met, as much as possible, requirements in order to ease their work and movements, In order to provide a local communication network preventing congestions and make coordination and personnel safety more effective.

6 Annexes

6.1 Annex 1: Questionnaire for final users

6.1.1 Slovenian Civil Protection:

MOUNTAIN RESCUE SCENARIO				
SUBJECT	**AREA**	**Q NR.**	**QUESTION**	**ANSWER**
MOUNTAIN RESCUE SCENARIO	**AREA 1:** CRISIS INTERVENTION PLANNING	Q1	• Do you agree with the general emergency action plan described?	Yes
		Q2	• Which coordination centres, command posts and players are usually involved?	Regional notification centre - (112 centre) Mountain Rescue Service – MRS
		Q3	• What is the relationship and coordination between them	112 centre activates MRS
		Q4	• In how many interventions (in %) do you think the helicopter is needed?	30% in mountains
	AREA 2: EQUIPMENT	Q5	• Which auxiliary Equipment is carried by First Responders (phones, PDA, IR camera, CCD camera, types of wearable sensors, etc).	Hand held radio stations, Mobile phones
		Q6	• What are the requirements for specific equipments to be carried by a First Responder.	Robust, water resistant, long battery life, operating temperature range from -30 to +50 °C
		Q7	• Which equipment is used by command post/s?.	Mobile radio, mobile phone
	AREA 3: COMMUNICATION NETWORKS	Q8	• Which of the following communication networks do you currently deploy and what is their capacity: o Back Office-mobile CP o mobile CPs of different emergency bodies o mobile CPs of the same emergency body o mobile CP- FR of the same emergency body o FR-FR of the same emergency body	Analog radio (all rescuers) DMR (Digital Mobile Radio) – currently not used, planned for future purchases TETRA (in progress) GSM/UMTS

MOUNTAIN RESCUE SCENARIO				
SUBJECT	**AREA**	**Q NR.**	**QUESTION**	**ANSWER**
	AREA 4: USER SERVICES	Q9	• What sort of information (voice, data, sound, images, video, any other) is used between: ○ Back Office-mobile CP ○ mobile CPs of different emergency bodies ○ mobile CPs of the same emergency body ○ mobile CP- FR of the same emergency body ○ FR-FR of the same emergency body	Voice Sometimes data
	AREA 5: NEEDS CURRENTLY NOT SATISFIED	Q1(	• Does your current communication network satisfy all the needs you require to perform an efficient emergency work?	Voice – yes Data–no (except for small data packages)
	AREA 6: MONET APPLICATION	Q1	• Do you find the MONET infrastructure application in this scenario useful? Give some advantages and drawbacks.	Advantage: Online data transfer Real time analysis and decision making Safety of the rescue team Disadvantages: Great challenge for network coverage in heavy terrain
		Q1	• Would you apply hybrid satellite MONET networks in a different way from the one showed in this scenario?	No

FOREST FIRE SCENARIO				
SUBJECT	AREA	Q NR.	QUESTION	ANSWER
FOREST FIRE SCENARIO	**AREA 1:** CRISIS INTERVENTION PLANNING	Q13.	• Do you agree with the general emergency action plan described?	Yes
		Q14.	• Which and how many Coordination Centres, command posts, vehicles and players of your organization would be involved in a similar situation?	Regional notification centre - (112 centre) , 2 CP's, 40- 50 vehicles, 200 - 350 players
		Q15.	• What is the relationship and coordination between the involved emergency agencies?	Notification centre alerts fire-fighters, they are coordinated by CP's on the field, medical services and police are coordinated by their coordination centres.
		Q16.	• Would any State Armed Force take part of emergency operations? What would be their function?.	Only when helicopter support is needed
		Q17.	• What is the average duration of such operations?	2 days
	AREA 2: EQUIPMENT	Q18.	• Which auxiliary equipment is usually carried by First Responders (phones, PDA, IR camera, CCD camera, wearable sensors, etc)?	For forest fires just hand held radios and mobile phones
		Q19.	• Would your emergency agency count on aerial units?	Yes
		Q20.	• Which equipment is used by Command Post/s and regular vehicles?	Mobile radio, mobile phone

FOREST FIRE SCENARIO				
SUBJECT	AREA	Q NR.	QUESTION	ANSWER
	AREA 3: COMMUNICATION NETWORKS	Q21.	• Which communication networks are currently deployed and what is their capacity: o Back Office-mobile CP o mobile CPs of different emergency bodies o mobile CPs of the same emergency body o mobile CP- FRs and vehicles of the same emergency body o mobile CP- aerial units if deployed o FR-FR of the same emergency body	Analog radio network, GSM/UMTS
		Q22.	• Related to security issues, do you use coded communications? In which services?	Yes – voice
	AREA 4: USER SERVICES	Q23.	• What sort of information (voice, data, sound, images, video, any other) is used between: o Back Office-mobile CP o mobile CPs of different emergency bodies o mobile CPs of the same emergency body o mobile CP- FRs and vehicles of the same emergency body o mobile CP- aerial units if deployed o FR-FR of the same emergency body	Voice
	AREA 5: NEEDS CURRENTLY NOT SATISFIED	Q24.	• Does your current communication network satisfy all the needs you require to perform an efficient emergency work?	No

FOREST FIRE SCENARIO				
SUBJECT	AREA	Q NR.	QUESTION	ANSWER
	AREA 6: MONET APPLICATION	Q25.	• Do you find the MONET infrastructure application in this scenario useful? Give some advantages and drawbacks.	Advantages: Real time analysis, decision making, coordination, Rescue personnel safety, Disadvantages: Hard to establish reliable network (sat communications and ad hoc networks) in forest
		Q26.	• Would you apply hybrid satellite MONET networks in a different way from the one showed?	no

6.1.2 Results come from interview with Madrid Civil Protection Fire Brigades

1. State of the art

- Currently Madrid Civil Protection Fire Brigades use digital radio terminal for voice services and some data (low transmission rate) including location. In some cases FR use respiration equipment sensors, gas sensors and biometric sensors, transmitted to CP using a different radio system form the one uses for voice Communications. FR desire a system which integrates all the data collected by the sensors and sends them automatically without the FR intervention.
- It is used mostly PRM digital radio. Some time ago, TETRA was not compliant with European ATEX regulation. They were not adapted to stand certain conditions such as appropriate temperature ranges. Madrid Civil Protection Fire Brigades have TETRA in vehicles and for fire man.
- Voice services over PRM and TETRA are point to point and point to multipoint between FR, vehicles, CP and back offices. Most common point to point communication is direct communication (Direct mode operation, DMO) (direct communication from terminal to terminal). Point to multipoint communication is named push to talk (PTT). In this case, when a bottom in the terminal is pushed, a half duplex or full duplex channel is established in PRM or TETRA with a group of users.
- In addition to digital radio, other Systems are used, above all, between CP and back office, such as satellite link or GSM/GPRS/UMTS technologies.
- Currently, Fire Brigades have a navigation system installed in all vehicles. In that way, when an incident occurs, the exact location is loaded in navigation system to ease the displacement.
- Point to multipoint service is established between FR teams and CP which shared the same channel. There can be one or more channel assigned for this

communication. The working team can be split into subteams composed for an amount of people (from 4 to 12 people). There are reserved channels for these subteams for private communication. During an emergency, terminals are connected to a specific team depending on channel picked up.

- Current Communications architecture used by FIRE brigades is a tree architecture. It is, a coordinator is allocated to a subteam (usually 6, 8 or 12 members). This coordinator is in charge of contact with the rest of coordinators. Coordinators communicate with the assigned CP, CPs communicated with each other and with BO.
- It can be considered that a FR separates from the vehicle from 100m to 300m. This constraint is determined by the autonomy of fire extinguishing equipment not by communication system coverage. Currently, coverage is not a parameter that is a constraint for operations. This situation must be maintained by MONET.
- As an example, the deployment of resources in a forest FIRE scenario could be:
    - Civil Protection Fire Brigades send three vehicles to area considering 3 hectares burnt.
    - A Mobile command post is set up in the area.
    - Intervention of 24 firemen. One of them is assigned as coordinator.
    - The coordinator is in charge of establishing Communications between his unit and the command post.
    - Considering a second source of fire it is set up a similar structure. In case of 2 hectares burnt, 2 vehicles and 16 firemen are sent. One of them acts as coordinator and establishes contact with CP.
    - CP communicates directly with BO and takes all the decisions to extinguish the fire.
    - Civil Protection fire brigades participate in rescue of people trapped in urban infrastructures (buildings, elevators, vehicles, etc.). They do not participate in mountain rescue.

2. Monet application considerations.

- Operational procedures are adapted to the use of current Communications Technologies such as Trucking radio such as PRM or TETRA. If MONET is used in daily operations, procedures must be adapted to this technology. As an example, operation procedures using intermediate MONET nodes with satellite link should be described if it is decided to use them to establish parameters that consider where these nodes should be deployed in order to assure coverage.
- Coverage range node is crucial to adapt these operational procedures. To determine coverage range, conditions in open spaces (altitude, distances, environment, etc.) and urban conditions must be taken into account.
- In order to assure the availability of broadband MANET, intermediate MONET nodes acting as relays are necessary. In case of considering an urban building, vertical coverage range must be taken into account. Different tests show that stair space eases wifi communication and build between floors is a constraint for communication and it is needed a relay every 2 floors.
- Since particular wifi nets are extensive used, if MONET nodes operates wifi with 2.4 GHZ frequencies, there would be electromagnetic interferences in urban environments. It is desired to have an ad hoc system allowing to assign free

frequencies for exclusive use for emergency units. It must be considered the appropriate security parameters to assure this assigned frequency can not be accessed by intruders.

- Monet nodes with satellite link must be reserved for Mobile command post and other Mobile units. FRs must have wireless (not satellite link) nodes to communicate among them and with the command post. Intermediate nodes acting as relays are needed to extend wireless coverage. IT is mentioned but FR that portable nodes including satellite link for pedestrian are not considered because this node would be too heavy and operations can not be easily performed. In addition equipment autonomy would be decreased. It is not desired use satellite link using IRIDIUM because this terminals are not complaint with ATES regulation, are very expensive, only communication with other similar terminals would be possible and this link would be exclusive for voice and data for location.
- It is desired to maintain current voice services. It is appreciate the applications supported by broadband communication such as delivering of data such as video, images, files, etc.

3. Requirements.

- Portable terminal must be complaint with ATEX regulation.
- Portable node Weight: 0.5kg aprox (more or less the same as current digital radio terminals). Intermediate nodes weight: 10kg aprox. Not weight requirement for vehicular nodes.
- Portable terminal autonomy enough to perform required operations.
- Current point to point and point to multipoint voice services maintained. MONET should be interoperable with TETRA or similar system to allow dynamic PTT groups management.
- MONT node must allow Communications interfaces to connect:
  - portable sensors data
  - video camera
  - PMR and TETRA connectivity
  - Positioning
- Coverage range of MONET nodes between 100-300m (direct visibility mode) but it is desired coverage distances of 500m at least.
- MONET nodes for pedestrians must be integrated in FR equipment in order not to reduce his mobility. The collection of data must be automatic and automatically sent to CP (and CP analyse these data).
- MONET nodes in CP and vehicles must have wireless and satellite link.
- MOENT node for pedestrian must have wireless link. Coordinator can use a node that have wireless and satellite link.
- It is needed intermediate nodes acting as relay (wireless) to assure communication between FR and CP.
- Coverage must not constrain operations.
- A communication system that allows dynamic management of communication channels and the use of a huge amount of channels to establish direct communication is desired.

6.1.3 Results derived from interview with SAMUR (Medical Services) from Madrid Civil Protection

ISDEFE makes a brief presentation of MONET Project.

The Special Procedures expert from SAMUR answered questions including additional information and new suggestions to MONET application in Fire Scenario and Airport Scenario.

1. **State of the art and non covered-needs by current technology.**
    - Currently, SAMUR First responders uses digital radio terminal used to communicate voice and data to send messages. Usually, two devices are used (one in vehicle and the other one is a portable device) since the members of the team (usually 2 or 3) work together during a normal operation. In special cases devices to measure gases are used to evaluate affected people status and know what kind of substances have been breathed. FR communicates to Command post or back office data come from this sensor. This communication is difficult because for the protection mask wore by FR. For this reason it is desired a system/terminal that can integrate all the data collected by the sensors and send them automatically to Command post without the intervention of FR. In NRBQ cases, FRs wear special protection clothes and carry respiration equipments and it is desired that the mentioned system sends FRs vital signs to Command post or Back office.
    - TETRA terminals are used but sometimes European ATEX-equipment is required due to the cooperation with fire brigades. Currently medical vehicles are equipped with TETRA and GSM communication devices.
    - Voice services via TETRA terminals are point to point and point to multipoint between FR, vehicles, command post, back up offices. During a normal situation and using point to multipoint option, all FRs and back up office communicate with each other using a common channel used for all the incidents. In order to prevent channel congestion (and after 11th march terrorist attack in Madrid) more TETRA channels were provided.
    - In case of major disasters, direct Communications between FR and back office is not allowed. Communication flow: communication between FR and command post (set up in disaster area) and between command post and back office. Command Post is equipped with TETRA and devices allowing communication via satellite. In these cases, internal channels are used for the communication between the different command posts set up in the area.
    - Currently some vehicles are equipped with navigation Systems but it is desired that all vehicles are provided with this kind of system and these data are processed by back up offices so that resources management is more effective and response time is decreased.
    - A FR can separate from vehicle but usually he needs to be close to it in order to get medical material. When it needed several teams to intervene, and there is coverage problem it is desired to set up various portable nodes between FR and command post.
    - As an example, it is showed an intervention during a forest fire scenario:

- Several Mobile units will be sent to the area. Each one will be composed of two or three people (driver, nurse and doctor)
- A coordination Vehicle (mobile coordination centre) is sent to disaster area and it is set up. The area chief is in this vehicle (Madrid is split into two areas). Sometimes, command post is shared between different emergencies units.
- Other vehicles to provide logistic support are deployed in the area.
- All vehicles are equipped with TETRA and communicate with Back office using the same channel. In addition, a emergency channel is available to communicate with Local Police, Civil protection Fire brigades and Metro..
- During special expected events such as Sports events, or unusual incidents such as accidents with multiple casualties/ affected people, attacks, etc, a specific channel is assigned to communicate FR with CP in order to prevent principal channel congestion for voice communication. Shot messages channel is the same for all the net.
- Medical units care for injured people and emergency staff just in case. They are set up in the warm area.
- Additional units and vehicles are prepared in back office in case of more resources are needed. Currently because of the lack of information and GPS applications, a waiting point is established next to the incident area using voice communication. New resources coming to disaster area are guided from this point.

2. MONET application considerations.

- Node coverage range parameter is decisive to adapt operational procedures. To determine the coverage range both open areas conditions (altitude, distances, environmental conditions, etc) and urban areas conditions should be taken into account.
- MONET nodes acting as relay are needed in order to assure MANET broadband in major disasters such as attacks, natural disasters, etc. (in these cases, emergency units can spread out all the disaster area.
- Operational procedures are adapted to actual Communications Technologies. If MONET is used for daily operations, operational procedures should be adapted.
- SAMUR point out that MONET architecture is very useful in case of disasters in METRO tunnels. Currently TETRA does not allow FR communication deployed from 60 meters deep to assist people in tunnel with medical vehicle deployed on surface. Using portable MONET nodes, relay intermediate nodes and vehicular node, communication would be very improved.
- MONET nodes with satellite link should be used by mobile command post and other mobile units. People should have terminals to communicate with each other and with the back office (this direct communication between FR and BO should be provided). When major disasters occur, FR communicates with CP and CP with BO. In addition wireless nodes acting as relays are needed to increase coverage range.
- There is lack of coordination and Communications between emergency units from different countries when an international disaster occurs (ex. Haiti). In general digital radios and analogical radios are used but different protocols and channels do not allow interoperability. In Haiti, communications via satellite (INMARSAT and IRIDIUM) were massively used. The deployment of a network based on MONET architecture would allow a local communication network preventing congestions and

make coordination and personnel safety more effective, saving satellite communication for communication between MANETS networks or with the BO in origin countries.

- An amount of applications Could be supported by broadband provided by MONET for sending data:
  - To send real time video to CP in order to determine the incident magnitude.
  - To send automatically video and audio to CP if FR push an emergency bottom when a dangerous situation occurs. This device is included in all TETRA terminals but only identification of terminal sending the alarm is possible without including more data.
  - To send location of all units to CP (real time) in order to manage the emergency in a more effective way.
  - To send data from gas sensors and biometric data from hot area to CP.
- It is desired broadband Communications from incident area to BO. If this kind of communication were available, telemedicine applications would be used increasing rapidness and effectiveness of medical assistance in disaster area. In addition, vehicles in disaster area would be more effectively managed from BO. If broadband communication between FR and hospitals were available, FR in disaster area could have affected people clinic history.
- It is desired to maintain current voice services. Direct communication between medical services and BO is allowed in daily operations (CP not deployed), through TETRA “push to talk” channel. This service is a challenge for MONET since it is not possible to provide long distance communications by a MANET network even though multiple intermediate nodes are used. In this cases MONET uses satellite link not adapted for this communication:
  - FR terminals do not have MONET nodes with satellite link
  - Voice communications have a delay when use satellite link.
  - Satellite link in daily operations is not profitable.

3. Requirements

- Portable terminal must be in compliance with ATEX regulation when cooperation with fire brigades is required.
- Portable terminal should be compact (including antenna) in order to use it easily and prevent terminal damage.
- Portable terminal autonomy must be enough to perform required operations.
- MONET terminals must be adapted to current operational procedures. Current point to point and point to multipoint voice services must be provided. Communications between FR and BO must be available.
  - This last service is the most difficult one for MONET. In addition, MONET must provide dynamic control of channels used to communicate subunits of units intervening in disaster and common channels to communicate medical services with other units (fire brigades, police, etc.) in order to be coordinated. It should be considered the possibility of interoperability with TETRA to offer these services.
- MONET node must have interfaces to connect the following devices and integrate collected data to send them:

- sensors carried by FR.
- video camera and microphones.
- PMR digital radio and TETRA.
- Positioning.

- MONET should prevent voice Communications congestion in major disaster (avoiding TETRA and GSM saturation since TETRA and GSM can be necessary in certain situations).
- Mobile MONET nodes set up in coordination vehicles and Mobile command post must have both wireless and satellite link. Nodes carried by medical intervention vehicles will provide wireless connection and maybe satellite link in some cases. MONET nodes carried by pedestrian FR must provide wireless communication.
- In major disaster, MONET nodes acting as relays in wireless communication are required in order to assure wireless connectivity between FR and CP.
- Communication coverage range should be enough noto t limit operations Turing any incident.

6.1.4 Conclusions of the interview with experts in Airport Systems

ISDEFE presented a brief introduction of the MONET project (scope, members, objectives, and so on).

Two experts in Airport Systems responded to questions with extra information and innovative contributions to the implementation of MONET in the scenarios of aircraft handling and airport emergency.

1. Current state of the art and needs not covered by the technology used

- Currently, radio terminals and mobile communications are used throughout the airport environment, while for fixed communications, a broadband network of optic fiber is deployed across the airport facilities. Communications systems are all redundant, to prevent the collapse of an infrastructure as important as an airport.
- The TETRA terminals, which are used for voice communications, are often used because they provide a sufficient coverage radius to encompass the entire airport area. They also allow terminal to terminal communications and point to multipoint communications. The main drawback may be the saturation of these frequencies due to the large number of actors situated in a confined space like an airport.
- Regarding aircraft handling, handling vehicles communicate with their Handling Agent, mainly to inform that they have finished providing the services required by the Airline. Moreover Handling Agent communicates with vehicles in case of any changes in schedules or any type of incidence, since normally the services are defined in advance, as well as the aircrafts arrival times. This is only for voice communication.
- In the field of airport emergencies, voice communications via radio or mobile phone are used to coordinate all actors involved. Airport Management Centre is responsible for managing and coordinating the operations required in case of snow, fire, accident and son on.
- The facilities maintenance on apron is performed periodically. Maintenance personnel moves by vehicle along the runways (with the consent of TWR) noting the

damages and then they pass a report in order to the damages are fixed. In this case any type of mobile communication is used, and that reports are reviewed later.

- Currently, a large number of vehicles, which move on apron, are not equipped with GPS technology. There are pilot projects which use different methods (CAMS, Mode S, Multilateration, GPS) to establish the vehicles and aircrafts position on apron at airports such as MAD, BCN, or PMI, but currently there isn't any vehicle guidance system based on the A-SMGCS (Advanced Surface Movement Guidance and Control System), due to the number of vehicles that are operating on apron and there are many obstacles that can not be controlled, such as boxes, cars, aircraft wings and so on.
- The communication flow to aircraft handling is as follows:
  - The hours of aircrafts landing and takeoff, including the allocation of parking positions are established in advance. This information is available to Control Tower (TWR), Airport Management Centre and airlines.
  - TWR and Airport Operations Department confirm the aircrafts schedules throughout the day and notice any change. Airport Management Centre is responsible for managing the incidences, the new parking positions and the hours of aircrafts landing and takeoff. This flow information is conducted through optic fiber.
  - Airline also has access to flight information through an information management system.
  - Handling Agent is informed about changes by the airline, then Handling Agent contact with the service teams to coordinate them. This is done using voice communication.
  - Communication between vehicles is done via voice.
  - Information flow among different entities and airport services is performed using a redundant optic fiber network deployed throughout the airport.
  - Vehicles should be authorized by TWR and Aircraft Management Centre to operate in the movement area. This type of communication is via radio.
- In situations of great emergency, the airport has an own fire fighting equipment and private security. Communication with these emergency bodies is via radio.
- The number of ground handling vehicles in a medium airport such as Palma de Mallorca can be, at worst, of 480 vehicles, since 60 flights in rush hour in high season in a main airport are supposed, also 8 handling vehicles per aircraft and a flight is one hour in the parking position on the average.

2. MONET applications

- The coverage radius of each MONET node is important within the airport environment. Service teams are equipped with TETRA technology in their current operation mode, this coverage reaches 10 kilometres outside the airport boundary. Full coverage should be achieved within the operation radius of the airport entities, a technology with coverage of 4-5 kilometres is required. The coverage radius should be determined taking into account both in outside conditions (topography, altitude, distance, environmental conditions) and outdoors conditions in the airport complex (with a large number of obstacles to communication).
- Intermediate MONET nodes could be used as repeater (relay) to ensure broadband network MANET (Mobile Ad-Hoc Network) in the whole airport area and to minimize the use of the satellite link.

- The current operating procedures are adapted to the current communications technologies. The operational procedures should be adapted if the MONET hybrid network is applied to daily use of aircraft handling and emergency care. Most of the voice communications could be replaced by data messages, so the information is recorded and updated automatically.
- Specifically, MONET architecture is considered by AENA very useful for coordinating of the different emergency bodies in disasters, since a unified standard and a common frequency band will be used.
- Regarding satellite communication, if the technology affords coverage radius that includes the entire airport, satellite link will be reserved for specific situations where the other wireless communication systems fail or don't have coverage.
- The user appreciates the many applications that could be developed thanks to the high bandwidth that will be offered by MONET network in terms of data transmission, for example:
    - The ability to analyse the services provided by each of the vehicles handling, so to improve its efficiency an accurate.
    - The ability to send real time video to the TWR or the Airport Management Centre, so they could have awareness of the magnitude of a possible incident and then they could make decisions with a better understanding of the situation.
    - To send all vehicles positioning on apron or at least the most important, so always their position will be known.
- Finally, the user believes that this technology would be really useful in medium and small airports where there isn't an optic fiber network deployed and therefore they haven't a broadband network that allows them to process the large amount of data that are generated at an airport. MONET will unify the fixed and wireless network, so a considerable saving could be got in the broadband network deployment.
- MONET system can be used to centralise and automate the various surveillance systems that have an airport, for example, the signal of the perimeter security cameras, thus MONET system avoids deploying cable all over the perimeter. Also an alarm system could be developed for keeping informed at all times to users what is the state of security throughout the airport. MANET networks also can be integrated into mobile security systems, such as surveillance cameras installed in vehicles.

3. Requirements

- Mobile MONET nodes, which will be installed in vehicles, are called vehicular nodes. Weight and dimensions requirements don't apply in this case.
- Vehicular node is charged by the vehicle's battery, and could further have an autonomous battery to prevent the node from not being inoperative if the vehicle can not provide energy.
- MONET nodes must adapt to the current operational conditions. The same current voice services must be offered by MONET nodes. Also it must offer a broadband network, which should be capable of replacing the optic fiber that can be deployed as an alternative in airport facilities.
- MONET nodes must be compatible with different systems that are already defined at some airports, such as specific information systems to each airport. They also

must be compatible with devices that will carry out various applications and in turn provide an interface to simplify its control:

  - Runway state measuring device.
  - Video camera or microphone.
  - Digital radios PMR y TETRA.
  - Positioning.

- MONET system must avoid the congestion of voice communications in large disasters that may occur within the operational area of airport authorities, so the saturation of TETRA or GSM is avoided.
- Vehicular nodes must have satellite and wireless link, although it can be considered equipping with satellite link only to vehicles that have to perform operations in areas farther from the airport (on movement area). The fixed nodes located in different facilities must have satellite and wireless link. On the other hand, fixed MONET nodes, which could be used as relay if necessary, will also have satellite and wireless link, although main purpose of relay nodes is to minimise the satellite communications.
- The coverage of communication systems should not restrict the operations during any kind of incidence.
- In an airport scenario, the communications network used must be redundant because a communication failure could endanger the life of thousands of users.

6.1.5 Conclusions of the interview with AENA manager of operations control in Barajas Airport (Madrid)

ISDEFE presented a brief introduction of the MONET project.

The operations control manager responded to questions with extra information and contributions to the implementation of MONET in the scenarios of aircraft handling and airport emergency. Moreover, he summed up the current state of the communication systems used in operations and the operational procedures used in the different situations.

1. Current state of the art and needs not covered by the technology used

- Currently, radio terminals and mobile communications are used throughout the airport environment, while for fixed communications; a broadband network of optic fibre is deployed across the airport facilities. Mobile communications are used to communicate several terminals.
- Communications systems are all redundant, to prevent the collapse of an infrastructure as important as an airport.
- TETRA encompasses the 100% of the coverage area in Barajas airport, whereas WIFI encompasses the 70% at this moment. But most of airports have a minimum percent covered with fixed WIFI nodes.
- There are four kinds of service teams in the operations department: marshallers, fire fighters, maintenance personnel and beacon personnel. These service teams are organized in the following way: a Control Centre that is communicated with a service team manager and the service team manager that commands vehicles that form the service team.

- The airport is divided in different areas; some of them are restricted for some kinds of users. If a user is not authorized to enter a specific area, an alarm will be activated.
- Currently, there is a navigation system installed in vehicles of the operations department. This system calculates the better route taking into account the restricted areas for each kind of profile.
- Marshallers receive flights information via radio at this moment.
- The facilities maintenance on apron is performed periodically. Maintenance personnel moves by vehicle along the runways (with the consent of TWR) noting the damages and then they pass a report in order to the damages are fixed. In this case any type of mobile communication is used, and that reports are reviewed later.
- In the field of airport emergencies, voice communications via radio or mobile phone are used to coordinate all actors involved. Airport Management Centre is responsible for managing and coordinating the operations required in case of snow, fire, accident and son on, in addition an advanced command post is established near the disaster.
- In situations of great emergency, the airport has an own fire fighting equipment and private security. Communication with these emergency bodies is via radio.
- Barajas airport has 40 vehicles, such as snowploughs, urea spreader vehicles…, which are divided in teams. Each team has a manager vehicle and goes with a marshaller who will guide the vehicles. Both manager snowplough and marshaller must have a portable terminal of communications.

2. MONET applications

- Positioning of the personnel that is on manoeuvres or emergencies, this information is refreshed every 20 seconds or 15 metres.
- To have access to meteorological information is very useful for marshallers, maintenance personnel and so on, so they can anticipate problems or different situations related with the weather and have more reaction time.
- Marshallers do periodic inspections of the runways, taxiways and so on, therefore they could use MONET system to inform about incidences and know the exact location since they carry a MONET node that saves their coordinates.
- Also marshallers can receive flights information through a portable MONET node. The next flights will appear on the screen, so a marshaller will be able to mark one flight to guide it, and then this flight is automatically deactivated on the screens of the other marshallers using an alarm. Moreover, marshallers can register parking time of aircraft to invoice.
- On the other hand, in emergencies, ambulances and other external vehicles are provided with a portable MONET node, so positioning traces, work time… can be known. Moreover, external emergency bodies could be coordinates by Airport Management Centre since this is responsible for airport area and surroundings.
- Other possible application is the control of vehicles, if each vehicle carries a MONET node, his positioning traces and speed can be controlled. In addition, fire trucks can know the consumption of liquid in real time and so on.
- MONET system could be used in case of disaster or terrorist attack to deploy a communication network and cover the minimum functions that ensure the airport operability while the incident is solved. MONET could be used as a second backup if the communication systems are disabled.

- Regarding satellite link, this communication only will be used in areas where there is not WIFI coverage or in specific situations where other communication systems fail.
- In case of aircraft crash inside airport area, Airport Management Centre will be responsible for commanding the operations and coordinating the emergency bodies involved. In this situation, satellite link will be used to transmit data such as vehicles positioning, video… from the advanced command post to Airport Management Centre

3. Requirements

- Information, which is required by service teams, must be refreshed every 20 second. This information can be meteorological information, opening or closing of runways, flights information… which is contained in a static database, or restricted areas, personnel profiles… which is contained in a dynamic database.
- All vehicles, which are used on manoeuvring area, must have a positioning system to be controlled by Control Tower.
- Vehicles must have a login system to know what person is using the vehicle, the petrol consumption by shift, the work time and so on.
- Regarding satellite link, this communication only will be used in areas where there is not WIFI coverage or in specific situations where other communication systems fail. So the use of satellite link will be minimized.
- MONET nodes must be compatible with different systems that are already defined at some airports, such as specific information systems to each airport. They also must be compatible with devices that will carry out various applications and in turn provide an interface to simplify its control:
  - Runway state measuring device.
  - Video camera or microphone.
  - Digital radios PMR y TETRA.
  - Positioning.
- MONET system must avoid the congestion of voice communications in large disasters that may occur within the operational area of airport authorities, so the saturation of TETRA or GSM is avoided.
- The coverage of communication systems should not restrict the operations during any kind of incidence; therefore a network with satellite link is very suitable to ensure the communication all the time

6.1.6 Portuguese Fire-fighters

This questionnaire is not filled completely since it was answered by operational fire fighters in the terrain.

GENERAL QUESTIONS				
SUBJECT	AREA	Q NR.	QUESTION	ANSWER
GENERAL QUESTIONNAIRE	**AREA 1:** EMERGENCY AGENCY DESCRIPTION	Q27.	• What are the coordination centres and players usually involved during a general emergency? Mention their relationship and coordination.	Typically, players involved are Fire Department, Medical Emergency Department (INEM) and Authorities (Police, GNR). Fire Department is responsible for rescue, fire fighting and pre-hospital emergency, the latter one in coordination with INEM. Emergency operations are coordinated at site by Fire Department COS (operational commandant at service) that reports to CDOS (regional centre of rescue operations). INEM are responsible by medical operations and report information to COS and CODU (orientation centre of urgent patients, this entity receives emergency calls via 112), these both entities cooperate closely. Emergency strategies are defined between CDOS and CODU. Authorities provide security to population, buildings and vehicles at emergency area. Usually, authorities are actuated by CDOS or CODU. Authorities coordinate actions with COS.
		Q28.	• What is the usual notification mechanism when alerting about an emergency situation?	Notification mechanisms used in emergency situation: • Public Service Telephone Network; • Cellular/Mobile Phone Network; • Radio (many frequencies).
		Q29.	• What is the description of the organization levels between different FR units involved in the emergency and how do they interact. Mention roles and responsibilities.	FR units are: • Fireman – assume COS responsibility, emergency operations coordination, report status to CDOS; • INEM (Medical Emergency Department) – execute medical operations and are coordinated by CODU.

GENERAL QUESTIONS				
SUBJECT	AREA	Q NR.	QUESTION	ANSWER
		Q30.	• What is the role of the Back office (Emergency Operation Centre) during the emergency situation?	Back office role during emergency situation: • Coordinate aerial vehicles; • Activate resources to operate at emergency area; • Perform coordination between all entities involved.
	AREA 3: COMMUNICATION NETWORKS AND EQUIPMENT	Q31.	• Which communication networks are currently used between different emergency bodies and among members of the same emergency body (PMR Radio TETRA, TETRAPOL, UHF Radio, Satellite links, GSM/GPRS/UMTS, Wi Fi, WiMax, etc)?	Communication networks used are PMR Radio, Radio VHF, TETRA and GSM.
		Q32.	• What is the maximum weight allowed to be carried by a First Responder? Categorize per platform considered (pedestrian, vehicle, maritime, airborne).	Maximum weight allowed to be carried by FR: Pedestrian – 15 Kg; Light vehicle (maximum 3.5 tons); Heavy vehicle (about 20 tons).
		Q33.	• Please provide the following Environmental Conditions for Equipments carried by FR: o Maximum Temperature range. o Wind resistance. o Water/ Humidity resistance. o Dust and sand resistance. o Vibration and shock resistance. o Noise and visibility conditions.	Maximum Temperature range (50ºC) Wind resistance (80 km/h) Water/ Humidity resistance (Rain resistant) Dust and sand resistance (Dust resistant) Vehicle vibrations and resistance to fall High noise and no visibility
	COMMUNICATION SERVICES	Q34.	• What type of services do you usually use in today operations? (voice, video, visioconference, streaming video, image transfer, short messaging, file transfer, etc…)	Daily operations are voice based.
		Q35.	• What type of services would you think would provide added-value in future operations? (voice, video, visioconference, streaming video, image transfer, short messaging, file transfer, etc…)	Services that could be used in future are: Video and videoconference.

GENERAL QUESTIONS				
SUBJECT	AREA	Q NR.	QUESTION	ANSWER
		Q36.	• What type of communication do you usually use? One to one / one to many / diffusion?	Type of communications: • One to one, PMR; • One to many, PMR or Radio VHF; • One to many Radio VHF.
		Q37.	• What additional service would you like to have in the future? (geolocalisation for example…)	Geolocalisation with digital maps
	AREA 5: NEEDS CURRENTLY NOT SATISFIED	Q38.	• Does your current communication network satisfy all the needs you require to perform an efficient emergency work?	No.
		Q39.	• What are the main inconveniences you find in the area of emergency communications?	Communication is unreliable, due to lack of network coverage and high noise in transmission.
	AREA 6: MONET APLICATION	Q40.	• Do you find it useful to combine wireless MANET (Mobile Ad-hoc Networks conceived for particular purposes enhancing flexibility and efficiency) with satellite links in your emergency communications? Give some advantages and drawbacks.	For emergency scenarios with high number of resources involved, ad-hoc networks with satellite links can be a solution for communication organization and systematization, likewise it could reduce response times and improve coordination of resources. Main drawbacks may be investment to equip all intervenient; equipment weight; and complexity of equipment usage.

FOREST FIRE SCENARIO				
SUBJECT	**AREA**	**Q NR.**	**QUESTION**	**ANSWER**
FOREST FIRE SCENARIO	**AREA 1:** CRISIS INTERVENTION PLANNING	Q41.	• Do you agree with the general emergency action plan described?	Yes.
		Q42.	• Which and how many Coordination Centres, command posts, vehicles and players of your organization would be involved in a similar situation?	One command post and one coordination centre.
		Q43.	• What is the relationship and coordination between the involved emergency agencies?	The same described, the CDOS activate the authorities and the INEM, if necessary.
		Q44.	• Would any State Armed Force take part of emergency operations? What would be their function?.	The Army. They have some means for fire fighting and the militaries can do the fire fighting and also perform the population evacuation.
		Q45.	• What is the average duration of such operations?	3/4 days.
	AREA 2: EQUIPMENT	Q46.	• Which auxiliary equipment is usually carried by First Responders (phones, pda, IR camera, CCD camera, wearable sensors, etc)?	Radio Phone
		Q47.	• Would your emergency agency count on aerial units?	No
		Q48.	• Which equipment is used by Command Post/s and regular vehicles ?	Radios Phones Geolocalisation devices.
	AREA 3: COMMUNICATION NETWORKS	Q49.	• Which communication networks are currently deployed and what is their capacity: o Back Office-mobile CP o mobile CPs of different emergency bodies o mobile CPs of the same emergency body o mobile CP- FRs and vehicles of the same emergency body o mobile CP- aerial units if deployed o FR-FR of the same emergency body	• VHF Radio and Phone; • VHF Radio and Phone; • VHF Radio; • VHF Radio; • VHF Radio; • VHF Radio.

FOREST FIRE SCENARIO				
SUBJECT	AREA	Q NR.	QUESTION	ANSWER
		Q50.	• Related to security issues, do you use coded communications? In which services?	No.
	AREA 4: USER SERVICES	Q51.	• What sort of information (voice, data, sound, images, video, any other) is used between: o Back Office-mobile CP o mobile CPs of different emergency bodies o mobile CPs of the same emergency body o mobile CP- FRs and vehicles of the same emergency body o mobile CP- aerial units if deployed o FR-FR of the same emergency body	• Voice and Data; • Voice; • Voice; • Voice; • Voice; Voice.
	AREA 5: NEEDS CURRENTLY NOT SATISFIED	Q52.	• Does your current communication network satisfy all the needs you require to perform an efficient emergency work?	No.
	AREA 6: MONET APLICATION	Q53.	• Do you find the MONET infrastructure application in this scenario useful? Give some advantages and drawbacks.	Yes. The capability of communicate the Global Position and Health Parameters would be an enormous advantage. One more efficient communication management, especially when a large number of actors exist, is other huge advantage in this type of scenarios where exist a rapid congestion of the communication channels. The principal disadvantage is the high investment necessary to implement that.
		Q54.	• Would you apply hybrid satellite MONET networks in a different way from the one showed?	Implement that type of communication with aerial vehicles in order to foretaste the localization of water discharges.

6.2 Annex 2: List of participants

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