DISASTER

Data Interoperability Solution At Stakeholders Emergency Reaction

285069

D5.10 EMS analysis & target selection: data models and data formats used

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Abstract

This report analyses existing EMS that are in use around Europe, mainly in the countries involved in DISASTER. This study gives a technical view of the emergency management situation; firstly, the report shows an overview about the systems and standards in use in each country. Secondly, it tackles the classification of the EMS at three levels, Government level which includes National, Regional and Local systems, Management level and Stakeholder level. Finally, a study about data services provided by third-party entities is presented; this study provides information about domain-specific third-party services related to the scenarios and information about those services used by all EMS. Based on these studies this report shows some features that should be present in EMS to consider it as DISASTER-enabled.

Executive summary

This document presents a technical analysis of different EMS already in use in Europe and this study is made at different emergency management levels. First of all the deliverable presents an overview of the present situation of the emergency management in the countries that are present in DISASTER, i.e. United Kingdom, Germany, The Netherlands, Denmark and Spain, analysing what laws applies, national/federal systems already in use and a summary of commercial systems. If there is any information exchange proposal or standard it is included to complete the study.

The second point classifies the existing EMS at three different levels. At Governmental level the document differentiates national, regional and local systems, and compares differences amongst the same five countries studied before. At Management level the classification introduces the concepts gold, silver and bronze for strategic, tactical and operational levels respectively, and, once again, shows a comparison of the structure amongst the countries. And last but not least, the Stakeholder level compares how police, fire brigades, civil protection and healthcare services work in each country.

Emergency management requires data and information not available directly from emergency brigades, so this information is provided by third-party services. These third-party services are divided in two main types, those that are generic and used in almost any possible scenario, e.g. weather information, and those that are specific services in a concrete scenario, i.e. information from a logistics company.

After all a summary of tools and standards is presented to describe a set of desirable features that an EMS would provide to consider it a DISASTER-enabled EMS, among others the EMS should share information by digital means, this information should be structured to be machine readable and the EMS should include communication interfaces with other EMS.

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Abbreviations

ARCE: Emergency Network Application

CECIS: Common Emergency and Information System

COP: Command Operational Picture

DEMA: Danish Emergency Management Agency

denis: *Deutsches Notfallvorsorge-Informationssystem* (German Emergency Preparedness Information System)

DIN: *Deutsches Institut für Normung* (German Institute for Standardization)

EMS: Emergency Management System

ERR: Emergency response room

ES: Emergency Services

EU: European Union

GIS: Graphical Information System

GML: Geography Mark-up Language

GMLZ:*Gemeinsames Melde- und Lagezentrum des Bundes und der Länder* (Joint Information and Situation Centre)

GMS: *Gemeenschappelijke Meldkamer Systeem* (Integratedemergency response room system)

GPS: Global Positioning System

ICT: Information and Communication Technology

KML: Keyhole Mark-up Language

LCMS: *Landelijk Crisis Management Systeem* (National Crisis Management System)

MDT: Mobile Data Terminal

MIC: Monitoring and Information Centre

SICLE: Emergencies Information System Luso-Spanish agreement

SIGAME: Emergencies Administration and Management Integrated System

SIGE: Emergency Management System Information

Tetra: Terrestrial Trunked Radio

UK: United Kingdom

WCS: Web Coverage Service

WFS: Web Feature Service

WMS: Web Map Service

XML: Extensible Mark-up Language

Definitions

Bronze: This term refers to the operational level in emergency management; Bronze level deploys the resources of their respective services within a geographical sector or specific role and implements the tactics formulated by Silver.

Emergency Management System (EMS): Is the tool that allows communication and collaboration amongst first-responders and gives support to the decision makers to do their job with all the information available about the situation. An EMS supports the activities performed by emergency stakeholders from operational to strategic level, including tactical level.

Gold: This term refers to the strategic level in emergency management; it is the commander who is in overall charge of each service, responsible for formulating the strategy for the incident.

One-stop-shop: Facility offered by the Government or local authorities to discuss and arrange services with officers of the authority.

Silver: This term refers to the tactical level in emergency management; Silver level attends the scene, takes charge and is responsible for formulating the tactics to be adopted by their service to achieve the strategy set by Gold.

External data services: All information providers needed by the EMS that are not specifically related with the emergency and security environment, e.g. weather, traffic, maps and population information.

1 Introduction

The work package, in which this document is developed, is focused on analyzing technical features of a representative compilation of Emergency Management System used in the European Union.

1.1 Objectives of the deliverable

This deliverable aims to provide:

- A first high-level technical view of the most representative collection of EMS analyzed. This study will enumerate which EMS are in use, or are expected to be used in a near future, and what kind of data is involved identifying the data providers.
- A classification of EMS based on the organisational model, management level and end user domain, along with comparison of data formats and data models on which these EMS are based.
- A definition of a set of desirable technical features for "DISASTER-enabled" EMS.
- Results and conclusions to serve as an input for the next technical decisions and analysis in this working package.

1.2 Descriptions of the studied systems

This section contains descriptions that are useful to assist the understanding of concepts and ideas that will be discussed in the following sections.

1.2.1 Emergency Management System (EMS)

Emergency management is a collaborative and multi-organizational effort that must manage multidisciplinary emergency workers who address extreme events across all hazards. The scope of **Emergency Management System (EMS)** is to support the activities performed by theses emergency management stakeholders.

An EMS has to provide communication channels and collaborative tools for teams that could be geographically distributed. It has a range of advanced communications systems that enable the information traffic between management organizations who are competent in emergency management.

Nowadays, many organizations for emergency management use different types of EMS as a support tools for cooperation and coordination in different emergency phases. Technology to facilitate crisis management in the emergency sector supports these phases, enabling greater efficiency and improved decision-making without imposing fundamental changes on the way people currently work.

A key challenge is the level and rollout of EMS to effectively share information and to communicate the necessary information to others. This challenge is compounded by different stakeholders involved in disaster coordination, and the heterogeneous EMS these organisations already have in place, amongst whom some level of interoperation is desirable.

From the point of view of technical implementation, the most common types of EMS are:

- **Radio based EMS**: Use digital and analogical radios with joint communications interoperability. They are able to use common talkgroups to communicate whilst still maintaining the integrity of their own individual talkgroups. There are several categories of shared communications talkgroups, such as Emergency Services (ES), Inter-Agency Talkgroups (IAT), Multi-Agency Mutual Aid (MAMA) and others.
- **Web based EMS**: Employ Internet protocols and facilities for communication during coordination and management activities. These types of services imply high multi-platform availability, because

all devices with an Internet connection can access them. They enable efficient communications and sharing information [1].

Finally, it is important to consider that all existing EMS types should ensure at least the following features:

- Flow of information and resources: Information must be validated, organize and distribute to provide it, in the right way and moment to the right user from different sources of information.
- Interoperability between responding agencies and stakeholders: Reliable communications and efficient and effective arrangements for cooperation and coordination at on-site, local, national and international levels.

1.2.2 External data services

Any EMS may request the temporary assistance of information of another service or EMS. These external data services are hardware and software tools for data gathering that assist an EMS. These services communications are needed at command level and first responder level, and provide detailed information and situational awareness of the disaster scene to ensure effective response to an emergency. These kinds of services provide solutions such as:

- Global positioning system (GPS)
- Geographic Information System (GIS)
- Weather information services
- Traffic information systems
- Vessel traffic services

These services are treated deeply in section 3.

2 International EU analysis

This section presents a survey about existing EMS in EU to identify common characteristics and technical aspects to support analysis in the following sections. In addition, it is necessary to study relevant EU polices and directives that should be taken into consideration in defining EMS for the DISASTER project.

2.1 EU policies, standards or directives of application

With a focus on DISASTER, we consider EU policies that are relevant for information systems.

EU activities in the area of Civil Protection do not appear in the founding treaties, and there is no policy of civil protection for the time being. However, the Community Mechanism for Civil Protection has a number of tools intended to facilitate both adequate preparedness as well as effective response to disasters at a community level.

The main tools from the point of view of the project are [2]:

- A **Monitoring and Information Centre (MIC)**: It is the operational heart of the Mechanism. It gives countries access to a platform, to a one-stop-shop of civil protection means available amongst all the participating states. Any country inside or outside the Union affected by a major disaster can make an appeal for assistance through the MIC. It acts as a communication hub at headquarters level between participating states, the affected country and dispatched field experts. It also provides useful and updated information on the actual status of an ongoing emergency. Finally, the MIC plays a co-ordination role by matching offers of assistance put forward by participating states to the needs of the disaster-stricken country.
- A **Common Emergency and Information System (CECIS)**: A specific communications network that connects the MIC with the contact points in each country. The CECIS is a web-based alert and notification application created with the intention of facilitating emergency communication among the participating states of EU. It provides an integrated platform to send and receive alerts, plus details of assistance required, to make offers of help and to view the development of the ongoing emergency as they happen in an online logbook.

Another important point is how EMS and third party services share geospatial information. Sharing geospatial data is enforced by law in EU regions. It is imposed by Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)[3][2].

INSPIRE is based on the infrastructures for spatial information established and operated by the 27 Member States of the European Union. The Directive addresses 34 spatial data themes needed for environmental applications, with key components specified through technical implementing rules. Spatial data infrastructures of the Member States must be compatible and usable in a Community and trans-boundary context, and so the Directive requires that common Implementing Rules (IR) are adopted in a number of specific areas (Metadata, Data Specifications, Network Services, Data and Service Sharing and Monitoring and Reporting).More information about INSPIRE directive is available in “D3.10Analysis of existing resources in the EMS domain”.

2.2 Relevant National Systems

This section considers countries directly related to this project, plus other relevant countries for EU Emergency Management. For each country, we have examined relevant information about specific points:

- Types of EMS: web-based EMS, radio-based EMS...
- Different software providers of EMS.
- How EMS are categorized from gazetteer organization point of view:
    - EMS at national level
    - EMS at regional level
    - EMS at local level
- Different types of third-party services providing data to these EMS:
    - Weather information services
    - GIS providers
    - Global positioning systems
- Stakeholders viewpoint: Police, Civil Protection, Fire Brigade, Medical Services:
    - Different ranks of management in relation to EMS
    - Communication systems among all regions
- Communication systems involved between strategic, tactical and operational level
- Formats, standards, end-user interfaces or devices used by subsystems

2.2.1 United Kingdom

In the United Kingdom (UK), the Civil Contingencies Act 2004 sets the legal framework for civil protection.

The Act provides a framework for civil protection at the local level, as this level provides the building block of resilience in the UK. The Act defines local responders in two categories depending on the extent of their involvement.

- Category 1: Responders include the emergency services (police / fire / ambulance etc) and local authorities. A specific part of the act requires category 1 responders to share information with other local responders to enhance coordination.
- Category 2: Responders such as transport; health authorities and utility companies are less likely to be involved but have a duty to share relevant information with other Category 1 and 2 responders. These responders also come together in Local Resilience forums which are primarily based on Police Force areas.

The Act acknowledges that information sharing is a crucial element of civil protection work, underpinning all forms of cooperation. Category 1 and 2 responders should share information formally and as part of a culture of cooperation,so there is an initial presumption that all information should be shared.

Given the devolved nature or the UK’s emergency services such as police, fire and ambulance services, the Act doesnot create a national structure or indeed a national EMS system. Response in the UK is delivered at a local level with structured collaboration at a regional or national level depending on the crisis to be managed.

2.2.1.1 Relevant National System

National systems do exist in the voice communications area, as the Airwave [4] communication system is available to all three core emergency services – mainly police, fire and ambulance. Other organisations also have access to Airwave via a sharers list and standard operational procedures are adopted for crisis situations to enable interoperable voice communications using shared talk groups and other functionality like the availability of develop specific services that should be approved to be ready to use.

Airwave is a digitally encrypted radio system that has a very high level of security. It cannot be decrypted by mass-market scanners and to date there is no known incident of an Airwave transmission having been intercepted and decrypted. To all intents and purposes it is a secure network. However, scanners to intercept fax mobile telephony or unencrypted radio transmissions on other systems may well be used to intercept information transmitted between the services and agencies. This should be borne in mind when wording any transmission, including cellular telephone conversations, which may contain sensitive information.

These include at a minimum bronze to bronze communication but assume that inter agency decisions will be made at a silver level. This single communication channel enables commanders and managers to exchange in real time information critical to decision making and helps create a common operational picture using all available sources of information.

The system is not interoperable until a major incident or crisis is declared and is activated when:

- Need to increase safety
- Minimize risk or harm to the public or other responders
- Alerting responders rapidly to an immediate hazard
- Supporting decision making
- Contributing to a common understanding and awareness
- Improving communications and coordination between responders

The Airwave system adheres to common standards for terrestrial Trunked Radio (TETRA) systems which allow all responder agencies to have interoperable systems when required. It operates via separate talk groups such as:

- Police Sharers Hailing – initial calls and communication
- Incident Command – Silver Command level
- Emergency Services – Bronze Level
- Inter-Agency – Specific users at an incident
- Multi Agency Mutual Aid – All Airwaves users at a cross border / wider area coverage
- Police Mutual Aid – Specific airwaves police users at police led operations

In addition to voice communication, the system can also provide limited telephony capacity, point to point communications (between two users), text, status messages and the creation of ad-hoc linked groups.

Whilst the above describes voice / radio interoperability, no standard national EMS is in existence in the UK. All emergency services retain responsibility for their own systems and for ensuring the safety of its staff. As such, each emergency service / first responder agency establishes its own command structure (Bronze / Silver / Gold) and is responsible for their own staff. Where the Gold (Strategic), Silver (Tactical) and Bronze (Operational) command structure has been implemented, the commanders appointed by each emergency are responsible for their own staff.

Emergency service staff / first responders at the three tiers must have the ability to communicate and coordinate with each other. When the Gold level of command is established, a strategic Coordinating Group (SCG) is usually formed. The SCG involves all the emergency services and other category 1 responders but is usually chaired by the police gold commander. The process of interoperability at the Gold level takes place within the SCG to help develop the common Operational Picture, but is not based on interoperable technical solutions and achieves inter-operation by being located in a shared command / control room. Whilst

technologically not interoperable, the SCG forms a wider support function – the Strategic Coordination Centre (SCC) and this centre address interoperable issues including:

- Common terminology
- Common process and auditing procedures
- Common briefing Formats
    - Information, Intention, Method, Administration, Risk Assessment, Communication, Human Rights Compliance (IIMARCH) used by the police
    - Information, Risk, Intention, Method, Administration and Communication (IRIMAC) used by the Ambulance Service
    - Common Recognized Information Picture (CRIP) used by the UK Government briefing
    - Common situation reporting format. Casualty, Hazards, Access/egress, Location, Emergency Services and other agencies present, Type of Incident, Safety and start a log (CHALETS) used by the police service
    - Major incident declared and call sign, Exact location, Type of incident, Hazards, Access/egress, Numbers of Casualties, Emergency services and other agencies present or needed (METHANE) used by the Ambulance service

In addition to a SCC, a Tactical Coordinating Group (TCG) is usually established at the Silver level and chaired by the police Silver commander. The TCG form the tactical plan and ensure its implementation through an agreed common aim and objectives for the incident. Again to facilitate interoperability the silver commanders should be co-located if possible and must have a method they can communicate with each other via the TCG.

The Command structure outlined previously is scalable and can be applied to incidents at a local, regional or national level. Where regional or national coordination is expected, then the national ACPO (Association of Police Chiefs) assumes the role of the National police Gold Commander and be placed at the police National Information coordination Centre (PNICC). The post represents the police at the UK Government level meetings, however each police force involved will also establish a force gold commander, and these force gold commanders will establish SCG teams as outlined above.

From the above it can be seen that aside from the ability to voice communicate via the Airwave system, interoperability in terms of EMS systems is not yet in operation in the UK. Interoperability at a command level is delivered by well defined and practiced multi-agency operating procedures at an organisational and not technical level.

2.2.1.2 Commercial systems

Numerous commercially available systems are in operation by the UK emergency services for command and control, and may be of interest for future interoperability initiatives. These include for example:

- SteriaSTORM [5]: Allows control room operators to deploy resources quickly and effectively and supports them in providing the best possible response. It is a multi-service, multi-agency product, with specific functions and interfaces developed for each service type, including police, fire and rescue or ambulance. It has an interface to TETRA Radio, which provides operational level monitoring and control of those resources. Status updates and short messaging functions are supported. This solution provides many features. The most important ones are shown below(Table 1):

Table 1 SteriaStorm features

SteriaSTORM tool	Features
Management Information System(MIS)	Allows an operator to retrieve incidents according to any number of selection parameters and to generate a graphical display of those calls distributed by priority.
GIS interface	- Real-time display of resources - Assistance in identifying the exact location of the incident

	- Geographical presentation and analysis of MIS information
Integrated Communications Control System (ICCS) interface	- Automatic dial from STORM - Incoming Calling Line Identity (CLI) - TETRA Radio Interface
Geobase enquiry	A separate module allows gazetteer searches outside incident handling
webSTORM	Provides both view access to data and entry of new incidents. Functions include: - Active Incident Lists with list filters - Active Resource Lists with list filters - Incident details - Attached Resource Display - Location comments - Incident type comments - Previous Call History - New Incident creation
MobileSTORM	Designed to run on PDA's and MDT's.

- Command Support System: Vector Command [6] has developed a solution to answer the specific needs of emergency commanders and support staff. The most important customer of this solution is London Fire Brigade and the main features are:
    - GIS mapping
    - Web access
    - Access to risk databases and incident location information
    - Document management
- Telent [7]: This Company offers a range of network and communications services to emergency services communications and logistics. It provides radio and internet systems. It offers management services that will support Tetra, GSM-R and PDA units. This service is structured to support the challenging requirements of Police, Fire and other Emergency services. The service provides both network and user features to improve overall operational availability, and is designed to minimize cost of terminal ownership.
- Gaist [8]: Provides a solution for Government Agencies and Emergency Services. It facilitates multi-agency collaboration in mission critical situations such as incident command and control. Main features are:
    - GIS mapping
    - Electronic management of risk assessments
    - Rapid access to Operating Procedures and Technical Bulletins
    - Reporting
    - Full event logging

All of these systems operate to some extent to provide relevant information to the emergency responders, but are standalone systems chosen by each emergency service following tender procedures.

2.2.2 Germany

There is no general electronic support EMS established in Germany, and the most common resources to manage operations are radios and whiteboards. However, almost all fire brigades and ambulance services as well as the Police use some kind of an electronic operation diary ranging from simple EXCEL sheets to special applications.

Electronic EMS Systems used in Germany can be categorised asa system that is recommended by the federal government and used by the Joint Information and Situation Centre (GMLZ, *Gemeinsames Melde- und Lagezentrum des Bundes und der Länder*) and several commercial systems that are used occasionally in several regions, according to the preferences of the decision makers in charge.

2.2.2.1 Relevant Federal System

The *Deutsches Notfallvorsorge-Informationssystem* (deNIS II plus) [9] is the EMS used by the federal government as well as the *Gemeinsames Melde- und Lagezentrum des Bundes und der Länder*(GMLZ) and is free to be used by all emergency management organisations throughout Germany. The aim of this information system is to create a network in the area of civil protection and disaster relief so as to support crisis management in extraordinary danger and damage situations.

The core elements of deNIS II plus are three modules that support:

- Situational management
- Reporting
- Resource management

Within the module "Situational Management" tools are available to open, edit and finalize situational management. The recording of the extent of damage that occurred with regard to the personal and material damage is done via input masks. In addition, the measures introduced so far are recorded and access rights can be assigned to specific institutions and functions. The incident can be drawn into the geo-referenced map using a drawing program.

The resource management module data from government departments, countries, institutions and international institutions are centrally compiled, processed and made available to registered users. These data include information on personnel, material and infrastructural assistance opportunities, but also sites of risky assets.

These data can be saved as a layer and displayed as icons in front of a cartographic background. The available data in the database can be queried using the symbols.

Additional data included in the database, such as risk investments, or "critical infrastructure" can be selected as factual data and displayed in addition to the situational picture.

Further information on the development of the situation is imported via the reporting module. Therefore forms are available as input masks, which are able to capture specific jobs in addition to messages in deNIS II plus.

2.2.2.2 Other national systems for specific tasks

There are relevant systems for specific tasks, which could be considered third party services for EMS studied. Relevant systems that have to be considered are:

- DWD (*DeutscherWetterdienst*) [10]: is a weather information web-based system
- TIM ONLINE (Topographical Information Management System) [11]: is a web-based system representing the Topographical Information Management; this service is responsible for ensuring reference data are Up-To-Date.

2.2.2.3 Commercial systems

Commercial systems in Germany are mainly aimed at Command and Control Offices. Particularly, there are systems defined at different command structures focusing on tactical and operational levels of management. Some cases of study are described below:

- **Tactical Management**

- Ruatti 4C[12]: Web based EMS for operation commanders in the field of Authorities, fire brigades, rescue services, Police and Companies liable to statutory order on hazardous incidents.
- TecBOSGmbH[13]: A developer of software solutions for the fire service and other emergency planning organisations.
- Vomatec[14]: It provides graphical information, risk management, alerting, system control and monitoring functions.

- **Operational Management**
  - Electronic "Tactical Worksheets": Mostly in research, no commonly used system.
  - EMEREC by Rosenbauer[15]. First approach to integrate electronic support along all levels of command. It can be directly accessed through on-site mobile tablet computers and shared with other operational units.

2.2.2.4 Information exchange standard

The following standards are used to exchange information amongst EMS in Germany:

- DIN SPEC 91287[16]: XML-Schema for data exchange between Information Systems in Civil Protection.
- Protection & Rescue Mark-up Language (PRML) [17]: XML-Schema developed by the SPIDER project[18] in order to provide a common emergency management language to exchange information. Information which can be exchanged is:
  - Information about people,
  - Information for the use of fire control system
  - Information on the building management (e.g. fire service cards)
  - Information regarding the simulation of pedestrian flows and traffic flows
  - Information from the hospitals (including treatment and supply capacity)
  - Information from the DIVI[19] protocol

2.2.3 The Netherlands

The Dutch government is trying to force one technical standard for netcentric interoperability. That means that at times of crisis it is the bureaucratic organization that will provide standardized organizational principles for emergency response at the same time allowing local professionals to determine how these principles are executed.

Netcentric work means that the emergency response professionals together with administrators not only collect real-time information about a certain incident, but are able to create what is called a common operational picture (COP).

2.2.3.1 Relevant National System

The EMS system in the Netherlands that can be considered as the most relevant is the Cedric System version 1.4, now known as the LCMS (*Landelijk Crisis Management Systeem*) 1.0 system[20]it is used by 20 of the 25 public safety and security regional authorities. It can be regarded as the National EMS for The Netherlands.

LCMS (Handataport 1.1) was based on MultiTeam[21]and taken into operation in March 2010 at two safety regions. It evolved into Handataport1.4 or LCMS 1.0 during the course of the following two years and was 'adopted' by crisis management teams under political pressure. The system caters for "text modules", Geo-plot modules 'viewer' and 'editor' and it runs on National 24/24 highly redundant servers.

At operational level there is a single national communication network for police, fire brigades and the first-responders teams. C2000 (communication 2000) is a digital radio network for public safety and is part of the comprehensive approach to safety and supports Emergency response room (ERR) operations. Each ERR has specific software to connect the different sources of information, called GMS (Integrated emergency response room system). Although GMS was introduced on a national basis, the management of the Emergency response room distributed for all safety regions can decide for themselves if and how to implement the system in their organization.

The most relevant features of LCMS are:

- It provides a specific interface for each emergency role, defining different roles, activities and permissions at strategic, tactical and operational level.
- It makes a link with the central database of ERR systems (GMS), where relevant data from the automated GMS are transmitted to the LCMS.
- External web services provide geospatial data to LCMS such as: WMS, WFS, WCS, etc.
- A reporting tool is available and all activities during an incident are logged.

The system was to be upgraded by the Eagle based LCMS 2.0 EMS system [22], but this upgrade is under discussion because of performance and financial considerations. Three regions in The Netherlands make use of the *Veiligheidsnet* system (safety net). The Eagle Suite consists of the following components:

- **Eagle Command Centre**: The command centre staff can share, add and edit both geographical and textual data. This information is exchanged automatically between all users. The main entry is a map, showing the actual situation of the disaster area. Eagle contains functionality to edit both spatial data (such as incident locations or the extent of a poisonous cloud), and textual data on a variety of relevant subjects. There are also functions for analysis of data, messaging, and issuing orders to ground staff.
- **Eagle Mobile**: It gives ground staffs who are fighting the crisis in situ the opportunity to add and edit geographical and textual data over a mobile data connection. As with Eagle "Command Centre", both textual and spatial information is exchanged automatically. Other relevant functionality is available depending on the type and level of ground staff.
- **Eagle Surface**: This feature lets tactical or strategic command view the incident situation as a map on a Microsoft Surface table device, and can therefore be utilized as an easy-to-use conference tool. Using its touch screen interface, staff can navigate the map to view the current situation and issue commands by pressing their finger at a location on the map.
- **Eagle Wall**: It is a read-only view of the current status of the incident (the COP) is shown on wall-mounted displays in the command centre. It is updated automatically as status changes occur.

The above features and components are related to each other in Figure 1 below:

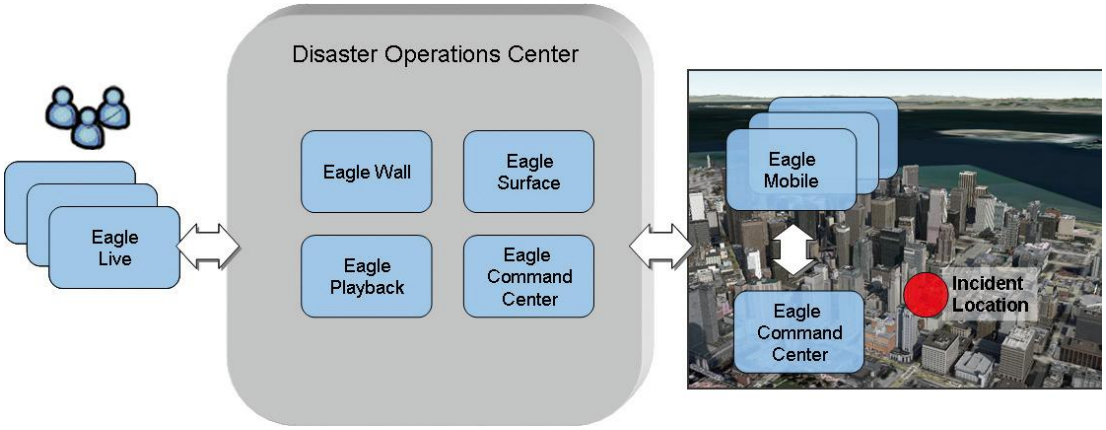

Figure 1 Eagle components

2.2.3.2 Commercial systems

There are systems defined at tactical and operational level of management. Some relevant examples are described below:

- Multiteam: It supports Police, Fire and Medical services with its disaster combating programmes. It also enables the teamwork between management, co-ordination centres and all those involved with the disaster management team during large-scale operations. Communication possibilities are dealt with per user via a log-in, and are independent of each service, team or region. The filters on the applications and the communication are determined by the regions and are meant to avoid anyone being flooded by irrelevant information.

2.2.3.3 Information exchange standard

The following standards are used to exchange information amongst EMS in The Netherlands:

- Firebrary[23]: XML Schema for data interchange between Information Systems in Civil Protection

2.2.4 Denmark

In Denmark, communication systems are based in tetra radio, formerly known as Trans-European Trunked Radio, which is a professional mobile radio and two-way transceiver (colloquially known as a walkie-talkie) specification. All emergency authorities include police, fire, and ambulances are using it and it provides nationwide coverage (99,5%).

2.2.4.1 Relevant National System

The supplier of the national system is SINE.

SINE (Safety Network) is a digital radio communication system used by emergency services dealing with public order, safety and health. SINE is to secure the foundation of a stronger co-operation and co-ordination between the police, the fire brigades, the ambulance services and parts of the Danish Defence in Denmark.

In addition to voice and dispatch services, the system supports several types of data communication. Status messages and short data services (SDS) are provided over the system's main control channel, while packet-switched data or circuit-switched data communication uses specifically assigned traffic channels.

SINE provides for authentication of terminals towards infrastructure and vice versa. For protection against eavesdropping; air interface encryption and end-to-end encryption are available.

The common mode of operation is in a group calling mode in which a single button push will connect the user to other users in a selected call group and/or a dispatcher. It is also possible for the terminal to act as a one-to-one walkie-talkie but without the normal range limitation since the call still uses the network. The terminals can act as mobile phones (cell phones), with a full-duplex direct connection to other system users or to the public service telephone network (PSTN). Emergency buttons, provided on the terminals, enable the users to transmit emergency signals to the dispatcher, overriding any other activity taking place at the same time.

All emergency services are to use SINE. Some of them are listed here:

- Police
- Fire Brigades
- Ambulance Services
- Danish Home Guard
- Danish Maritime Safety Administration
- Danish Emergency Management Agency

- Private companies which offer an emergency service for a public authority

The ITS network covers all of Denmark. In many places the coverage is so good that you can use ITS network indoors with a handheld terminal. In the rest of Denmark you must either go outside or use a mobile terminal, which sits firmly mounted in a car with an antenna on the roof.

The theoretical coverage is:

- 99.5% of Denmark SINE coverage with a mobile terminal mounted in a vehicle and the antenna on the roof.
- 97.6% of Denmark, handheld basic coverage.
- The 143 largest cities have extra good coverage.
- In total, 62% of Denmark's land area and 86% of people have extra good coverage.
- In addition, a special part of the ITS network that covers the airspace up to 500 meters - the so-called Air-Ground-Air-mesh or AGA network, ensuring that helicopters can communicate with forces on the ground.
- Areas in Denmark which are treated specially as HIS deck. The Great Belt Link, the Oresund Link, Limfjord Tunnel, Guldborgsund tunnel, the Copenhagen Metro and the border areas.

The radio coverage is not 100 percent predictable. Radio waves find their own ways and they can be disturbed by the landscape and buildings. ITS Secretariat therefore invites users to explore the coverage specified in their locality. For example, they should be aware that the following may generate radio coverage:

- Reinforced concrete construction
- Metalized windows / energy efficient windows
- Basement-storey
- Buildings with thick walls
- Deep and wide buildings
- Leaves on trees
- Deep gorges, cliffs and dunes.

The ITS network is built in 3 levels:

- If a mast goes down, take the next over.
- In the event of a prolonged power outages, a number of specially protected sites alone to provide coverage. They will ensure mobile coverage of 96% of the country.
- And if there is no coverage, the handheld terminals are used as walkie-talkies, which in a small geographic area can communicate with each other - without a net. It is called Direct Mode Operation or DMO.
- In addition, vehicle mobile terminal used as a gateway such a connection between handheld terminals in DMO and ITS network.

If a mast goes down and the next to take over, drops coverage in the area while one level from basic handheld coverage for mobile coverage. In such situations will typically only be able to connect via a mobile terminal mounted in a vehicle with an external antenna.

SINE's power supply is generally secured to the emergency. Danish Emergency Communications A / S is responsible for the ITS network covers Denmark, as agreed with the state. It is also Danish Emergency Communications responsibility to repair the ITS network if problems arise.

There are 2 alarm centres in Denmark covering the entire country. In Copenhagen, there is the fire brigade of the town, responsible for 1 extra central, which is not compatible with the 2 others. It means that if one day, the central from Copenhagen gets too busy, the calls will be transferred to the two others, but the same is not possible the other way around.

The alarm centres recently installed a new IT system where 1 module is to enter the information of the caller and why he is calling. The other one is for maps. Cartography information is maintained regularly by update coming from the municipalities and sometimes by the police working at the central themselves. They do this update 1 time /month.

The map of the accident will be transmitted to the actors who will respond to the case. It goes directly on their GPS system in their car so when they drive, they know where they are going.

The police are responsible for the centres, but they are not the ones taking the decision on how much equipment is sent out and so on. They don't have the power to give advice, but they need to choose the right case number on their list, so that the first responders who get the message know what to bring to the scene.

This list is called the PIC list, they can choose all from military flight accident, to a person with a heart attack.

When needed, the operator who takes the call can get an extra caller on the line, for example, when it is for a medical reason, they can get a doctor on a line to give advice. So even though you are already on the line with someone reporting a case, you can call in extra help.

When the situation evolves, a first responder or even a citizen can call back to 112 and give more information. The operator will then update the case number so it fits the new situation. This will automatically call the first responders responsible and so they can get the extra equipment they need to adapt to the new situation.

The system itself uses colours to show if the call was taken or not, or if they got extra information on the case.

This emergency system is of course for the entire country and for Police, Fire brigade and Medical services. If the military needs to be called in, it will be done by the Police leader at the scene; if he thinks he needs that kind of help. This does not go through the emergency system.

2.2.4.2 Commercial systems

There are commercial systems focused on different levels of Emergency Management. Some examples are described below:

- Netdesign [24]: Advisor and IT network integrator of secure communication solutions and services. This company provides communication services, among others, for emergency management in Denmark.
- Innovate Business Software (IBS) [25]: It provides software tools which are used in Control Rooms to monitor alarms from intrusion and fire panels, terminals or devices.

2.2.5 Spain

The Directorate General of Civil Protection and Emergencies in Spain has a range of advanced communications systems that enable the information traffic between this state management organization and other organizations competent in emergency management and citizen safety. However, there is not a single EMS at national level used by all Autonomous regions.

2.2.5.1 Relevant National System

Some relevant EMS used by some autonomous regions are listed along with their most important features.

Emergency Management System Information, SIGE

This system is a support tool in risk management and emergency situations developed by the Indra Company, facilitating the quick assessment and risk management, and therefore, the decision-making.

SIGE system is configured as an integrated group of information management tools necessary to deal with protection and emergency situations that may occur, concerning warning, prediction, precaution and action stages, allowing the necessary information flow among the decision centres of the State General Administration.

Emergencies Administration and Management Integrated System, SIGAME

SIGAME is a national project involving all Autonomous regions and is focused on improving national coordination [26]. It is a technology platform, accessible through any web browser; its aim is to facilitate the provision of resources located outside of an Autonomous Region to deal with an emergency situation or event, produced in it, at the request of the competent organization to manage it.

This platform seeks to encourage an interregional and a multi-directional communication to ensure more effective and efficient the response to emergencies without interfering with existing management protocols in the Autonomous Communities.

Unified Information System of Fire Protection and Rescue Services, ESA6

In this system are integrated Municipal Fire Stations, Consortiums, Town Councils, County councils and Autonomous Communities, as well as the Directorate General of Civil Protection and Emergencies. Each user enters the information into the system and can manage the data and statistics.

The Autonomous Communities validate its territorial statistics and the system integrates into the State territorial field the statistic which it is responsible for.

Other systems

I addition to the mentioned national systems there are other systems in Spain that are related with emergencies and/or cooperation between countries but cannot be considered EMS:

- **INFORIESGOS:** It is a website promoted by Directorate General of Civil Protection and Emergencies, whose aim is to inform all citizens [27]. It provides warnings and civil security alerts and it is updated daily with risk information.
- **ARCE [**28]**:** It is a Latin American project involving 21 governmental organisms improving international coordination. This application is a mechanism to share information and to update it constantly, including all the members of the Iberoamerican Association of Defence and Civil Protection Government Institutions.
- **SICLE:** It is a bilateral project between Spain and Portugal. Both countries agreed on May 9th, 2012 to develop this system to improve international cooperation [29].

2.2.5.2 Commercial systems

A set of providers of commercial systems are showed on the list below:

- Collaborative [30]: It provides a solution, SIRE (Intelligent System for Efficient Response),which support the management of multi-agency centres, such as Emergency Services (112), Health Service, Police and Fire Service, and in which the different agencies share the information that is of common interest to them, while at the same time each manages the part of the incident that pertains to them.

2.3 EMS types, classifications

This summary focuses on relevant features of identified EMS analyzed from the point of view of Disaster project in previous section, International EU analysis. Care is taken, wherever possible, to identify what types of systems are involved and what function is assigned for each one, and depends o the level of openness of various system providers. This approach aims in analyze these systems at different levels:

- **Governmental level**: Systems involved at this level are related with organizational structures of each country studied, identifying common systems existing at different governmental level.
- **Management level**: Systems involved at this level are related to command structure of emergency management to establish a hierarchical framework for the command and control of incidents and disasters.
- **Stakeholder level**: Systems involved at first responders level, showing systems used by different stakeholders in each analyzed country.

2.3.1 Governmental level

From the point of view of organizational structure of each country, it is defined three organizational systems levels:

- National systems
- Regional systems
- Local systems

2.3.1.1 National Systems

Table 2 National systems features

Country	Organizational Structure	Competencies	Systems
UK	Local Authority level plus Police force level (43)	Civil Contingencies Act 2004 places duty to collaborate on Category 1 and 2 responder organisations	Airwave (Tetra Radio)
Germany	16 autonomous constituent states	- Not established a common national model in exception in case of civil protection in time of war (Civil Defence Act) Federal Office of Civil Protection and Disaster Assistance (BBK) and Federal Government: Federal Police and - Federal Criminal Police Office	- Denis II plus (EMS-web) - German Joint Information and Situation Centre (GMLZ)
The Netherlands	25 Safety Regions (*veiligheidesregio*)	- Ministry of the Interior and Kingdom Relations is responsible for emergency preparedness en emergency management on national level and operates a national crisis centre (NCC) - All regions operate according to the Coordinated Regional Incident Management Procedure (GRIP)	- LCMS 1.4 (EMS-web): Used by 20 safety regions - Eagle based LCMS 2.0
Denmark	5 regions	- Minister of Defence is responsible for the coordination of civil preparedness planning. - Danish Emergency Management Agency (*Beredskabsstyrelsen*; DEMA) has the co-ordinating responsibility on behalf of the Minister of Defence	SINE (Tetra Radio)
Spain	19 Autonomous Regions	- Not established a common national model	SIGAME (EMS-web)

2.3.1.2 Regional Systems

Table 3 Regional systems features

Country	Competencies	Systems
UK	Local Authority areas have direct coordination of their own areas but procedures exist for collaboration at a regional and national level when the scale of the emergency indicates this is required.	Airwave (Tetra Radio)
Germany	At the regional level the state governments and district governments are regulating and monitoring the local emergency response organizations. They coordinate in	Uniform public safety radio. (Tetra (from 2013) ->The

	particular the local support. However, there are no disciplinary action due resort to the work of the local authorities. Country: Office of Criminal Investigation	Federal Agency for Digital Radio of Security Authorities and Organisations (BDBOS)) - GSM/GPRS/UMTS Satellite phones
Denmark	National Operational Staff (NOST) (National Police, Police Intelligence, Chief of Defence, Defence Intelligence Service, Emergency Management Agency and Health Protection Agency	SINE (Tetra Radio)
Spain	Autonomous Regions have assigned the direction and coordination of the emergencies in their territorial areas	- Tetra radio - GSM/GPRS/UMTS

2.3.1.3 Local Systems

Table 4 Local systems features

Country	Competencies	Systems
UK	Local deliver but all duties defined in the UK Civil Contingencies Act 2004	- Own radio systems - Airwave (Tetra Radio)
Germany	County or county-level city: medical services, police Municipality or county-level city: fire department	Uniform public safety radio. (Tetra (from 2013) ->The Federal Agency for Digital Radio of Security Authorities and Organisations (BDBOS)) - GSM/GPRS/UMTS Satellite phones
Denmark	Local Police, Local Fire Department, Local Medical Services.	SINE (Tetra Radio)
Spain	Municipalities have their own legislation.	- Tetra radio - GSM/GPRS/UMTS - Satellite phones

2.3.2 Management level

The command structure of emergency management and functions adopted for Emergency Management at different levels:

- **Gold (Strategic level):** For systems involved at Gold level, it is the commander who is in overall charge of each service, responsible for formulating the strategy for the incident. Each Gold has overall command of the resources of their own organization, but delegates tactical decisions to their respective Silvers.
- **Silver (Tactical level):** Systems at Silver level support commanders, who attend the scene, take charge and are responsible for formulating the tactics to be adopted by their service to achieve the strategy set by Gold. Silver should not become personally involved with activities close to the incident, but remain detached.
- **Bronze (Operational level):** Systems at Bronze level support command that controls and deploys the resources of their respective services within a geographical sector or specific role and implement the tactics formulated by Silver.

Table 5 Coordination groups systems features

Country	Coordination group	Competencies	Systems
UK	Gold	For major incidents multi-agency command structure is established Police (normally chair the meeting): - Overall Incident Commander - Administrative support Fire and Rescue Service: - A Chief Fire Officer or an appropriate representative	Airwave (Tetra radio)
	Silver	Multi-Agency silver or via regular agency meetings during crisis	
	Bronze	Police (interoperability protocol)	
Germany	Gold	Local Emergency Coordination Centre	Uniform public safety radio. (Tetra (from 2013) ->The Federal Agency for Digital Radio of Security Authorities and Organisations (BDBOS)) - GSM/GPRS/UMTS Satellite phones
	Silver	Local Emergency Coordination Centre	
	Bronze	An advanced Control Post at emergency place and action groups (police, fire brigades and healthcare services)	
Denmark	Gold	National Operational Staff (NOST) (National Police, Police Intelligence, Chief of Defence, Defence Intelligence Service, Emergency Management Agency and Health Protection Agency	Tetra
	Silver	Command Station, inspectors and vice inspectors.	Tetra
	Bronze	Command State and Commanders on site	Tetra
Spain	Gold	Regional Ministry with competencies in civil protection, even the President of the Regional Government	- VHF (terrestrial radio) - Tetra radio
	Silver	Regional Emergency Coordination Centre	
	Bronze	An advanced Control Post at emergency place and action groups (police, fire brigades and healthcare services)	

2.3.3 Stakeholders

Main stakeholders considered for this approach are: Police, Fire Brigade, Healthcare services and Civil Protection.

Table 6 Stakeholders systems features

Country	Stakeholder	Competencies	Systems
UK	Police	- Coordinating the emergency services, local authorities and other agencies	Incident commander:

		- Incident log - Overall coordination and recovery / investigation phase	Tetra radio
	Fire Brigade	- Identify the risks associated with the location, including those details on the Brigade's Operational Risks database (accessed through MDT) - Coordinate a joint hazard assessment between responding agencies - Rescue Phase	Incident commander: Tetra radio Command vehicles: - UHF radio - Field telephones - Mobile Data Terminal (MDT) - Cellular faxes
	Healthcare services	- Report arrival on scene to Emergency Operations Centre (EOC) - Triage of casualties and care for living post incident – protection / preservation of life	Incident Commanders: - Tetra radio - Cellular telephones - Satellite phones
Germany	Police	Only in charge of police activities. Only in some special cases in form of formal asked assistance cooperation with the fire brigade, civil protection or healthcare services.	Own radio systems (the processes within stakeholders operate are regulated, the means of command an information gathering are not)
	Fire Brigade	Planning and coordination of actions of the defensive fire protection together with the Building Supervisory Authority. On scene responsible for the Operational Command Post (Command point, Forward control). Coordinating all units from the fire brigades, civil protection and health care services. The local municipality or city has operational control. This also applies to the foreign units.	
	Civil Protection	Units, from federal or regional level, are under control of the operational command. Most of the units are from red cross.	
	Healthcare services	Ambulance services are working in case of an all-day emergency in command of the Rescue control centre (emergency dispatching centre). In case of major incidents or participation offirebrigadestheyareworkingundercommandandcontroloftthefirebrigades. In some states they got an own operational command post.	
The Netherlands	Police	Handle emergency and major accidents (traffic directing, keep onlookers at a distance, law enforcement…)	Different GMS based radio communication: - C2000 (Digital radio network) - P2000 - C2000 Digital camera with writeable TFT-screen
Denmark	Police	Coordinates the action on the scene, contact with the media, and is responsible for the Police participation.	SINE (radio system)
	Fire Brigade	Responsible for the fire and rescue at the site of damage.	
	Healthcare services	Responsible for the casualties and other health related matters(evaluation intervention, transport)	
Spain	Police	- Alerts the population.	- Tetra radio

		- Controls the access. - Follows the evolution of the situation and informs about it.	- GSM/GPRS/UMTS - Satellite phones - Wimax
	Fire Brigade	- Evaluates and fight the accident. - Helps the victims and take pressing steps. - Provides information about the situation.	
	Healthcare services	- Assist victims. - Register the victims. - Coordinates the evacuation and transport of the victims.	

3 External data services

These are useful tools integrated with EMS that provide data-gathering opportunities. These services are part of an infrastructure that integrates and facilitates access to several data types. These type of services or tools are referred to as external data services providers.

The survey of different types of services focused relevant information types shared between EMS and third party services. The main focus is grouping services according to the type of information they exchange with each other. From the DISASTER point of view, these services are classified in two different groups according to considered scenarios analyzed:

- Transversal third party services
- Domain specific services: (services from analyzed scenarios could be related to the use case).

3.1 Transversal external data services

3.1.1 Weather information services

In order to tackle an emergency the weather information could be crucial, e.g. wind speed and direction is critical when fire brigades are extinguishing a forest fire, so the EMS needs to acquire weather information from external services.

In Europe each country has its own National Meteorological centre and this centre provides weather information to the different organisations of the country, i.e. emergency, military, government, etc., and such agreements ensure the first responders have access to this information when they need it. Some National Meteorological Institutes provides its data through Internet using structured formats, e.g. the Spanish one, AEMet [31]publishes data for free, and this data is stored in a data server and can be downloaded and processed easily.

Each country is aware of its own meteorological information. They obtain and publish information about their country but one country may be interested in information about other countries. The needed infrastructure to obtain this data would be very expensive, and maybe inefficient. To solve these problems EUMETNET [32] was created with the objective of cooperation in mind. Currently EUMETNET has 29 members that share their capabilities through cooperation programmes that enhance interoperability and integration within Europe.

3.1.2 GIS providers

First responders need geospatial information to locate an emergency situation and to assist in it. When information is presented as text some details could be lost or misunderstood, and to solve this problems the use of Geographic Information Systems is very common.

Geographic Information Systems (GIS) are computer systems that allow users to work with geospatial data. This graphic visualisation allows the user to discover relationships or situations hardly viewable in normal data tables or text descriptions. GIS are designed to consume information from other GIS; this information sharing is possible using web services and standards described by organisations such as Open Geospatial Consortium [33] and World Wide Web Consortium or by the European INSPIRE Directive.

There are several GIS software vendors (e.g. Autodesk, ESRI, GeoMEM …) but within the framework of this deliverable the vendors of maps and data are more relevant. Each EMS could select among lots of maps and data vendors from more generic ones, i.e. European maps, to those centred on specific areas, i.e. a city maps or an airport map.

There are several maps, imaging and data vendors (e.g. ESRI, Geodan, GeoEye, ImerGIS …). All of them provide data using different formats, and these formats include images (png, tiff, jpg …) for basemaps and formats like KML, GML or ESRI files to represent shapes. This data is provided using direct file download or using web services that developers can consume to retrieve the files and integrate them in their own GIS.

One of the main characteristics of GIS software is the handling of multiple layers, and these layers can be either images or vector graphics. Using this characteristic, the user can combine or filter the information available and focus attention on whatever is relevant in that moment.

Tools like QuantumGIS are used to create new layers with specific information that can be combined with existing layers to show where an incident is occurring or which area is affected by e.g. an escape of gas.

3.2 Domain-specific services

Information needs are now considered along with the services involved in specific scenarios that provide the necessary data. The process of defining scenarios from the beginning of DISASTER project is summarized in "Annex A: Scenarios analysis".

Domain specific services described are related to selected scenarios:

- Air cargo scenario: Airport incident in Schiphol airport.
- Border fire scenario: Moor fire in German-Dutch border.

3.2.1 Air cargo scenario

VOS 3 (*Vliegtuigongeval* Schiphol- level 3, airport incident)

The Air cargo scenario has a number of information needs that are summarized inTable 1.

Table 7 Information needs Air cargo scenario

Data type	Data provider
Exact Location information	Airport control
Contextual information about buildings, landing strip	Airport business group
Access route information	Military Police (KMAR)
Security information "air side"	Military Police
Passenger/crew information	Airport Control
Cargo information	Customs (Cargonaut [34])
Cargo identification support	Specialized agencies
Weather information	National service (KNMI)
Cross regional support	Control Room (MiCK)

3.2.2 Border fire scenario

The border fire scenario is a "low-technology" scenario that shows where interoperability is necessary and possible on an international level. Most information was exchanged via pictures and reports. Most information is created within the EMS organizations themselves and external providers are not always contacted. The required data is provided mostly by governmental organisations.

Table 8 Information needs Border fire scenario

Data type	Data provider
Exact Location information	- Observing person - Dispatch centre - First arriving vehicle - Incident commander
Contextual information about buildings	- Observer from EMS - County Building/Environment Authority
Size of human and environment damage	- Observer from EMS

	- Incident commander
Weather information	- Observer of EMS - Dispatch centre - National service (DWD) - Internet services
Cross regional Support	- Dispatch centre - Government
Temperature profiles at ground level (fire not visible)	- (Helicopter) thermal images of observers

4 Conclusions and further steps

This report contains a compilation of a high level view of technical features of focused EMS.

This brief analysis is the first step taken in the project to provide the general perspective supporting an interoperable infrastructure among Emergency Management Systems.

This study shows where the countries who participate in DISASTER are positioned right now with regard to EMS at national or regional level, and which commercial systems are in use. Table 9 shows a summary of the different data models, interfaces and devices involved in emergency response in the studied countries.

Table 9Technical features analysis EMS

Types of resource	Description	Available tools	Standards
Data models	*Knowledge*: Distributed datasets to be accessed through the network		- DIN SPEC 91287 - Firebrary
	Geographical data: Distributed datasets in specific spatial areas (points, spatial objects with attributes, polygons, and fields)		- ESRI files - KML - GML
Interfaces	*EMS web*: Way the information is presented including elements of navigation, content and action	- LCMS 1.4 - denis II plus - SIGAME	
Devices	Hardware tools for access and exchange information within the EMS	- iPad - Beeper (digital radio) - Cellular phone (GSM/GPRS/UMTS) - Digital camera with writeable TFT-screen	

An important point in the analysis is the EMS classification; EMS classification is not unique, so it is presented from different points of view because each level in emergency management has its peculiarities and the systems are not the same.

Moreover, analysis and classification of all this information helps to define a set of desirable features which may be considered to select a DISASTER-enabled EMS have been highlighted in the preceding sections. The primary focus of this selection of EMS is technical interoperability.

To address technical interoperability requirements, there are some high-level features for an EMS that should be taken into consideration:

- DISASTER could not cope with data or voice communications that cannot be processed automatically by a computer, e.g. phone call or radio communication. Data should be shared by digital means and should be structured. Consequently, it is not feasible to define technical interoperability issues at this level.
- All shared data might be standardized and accessible digitally by devices to be used at all management levels (tactical, strategic and operational).
- Standardization of data is not possible at source data level (ownership resides in multiple member states and many regions), and so standardization must use translation for interoperability.
- DISASTER-enabled EMS should include communication interfaces with other EMS which would be used to share information among them.

The next steps will support future work and will evaluate ICT systems from the point of view of data models and data formats identifying them in order to define specific proofs of concept.

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Annex A Scenarios analysis

A.1 Scenario Definition (Current Status)

According to the research methodology defined and adopted in DISASTER, tasks related to the definition of scenarios are on-going since the beginning of the project, and being a guide to research activities. This has also been considered for the requirement compilation.

Since no deliverable related to scenarios is being released at this stage, relevant information is being included as an annex to this document.

At this stage, two different, complementary scenarios have been identified as relevant to provide several interoperability challenges to be addressed and solved by DISASTER proposed solution:

- Border moor fire: a fire in a border area, where different response teams will be cooperating with each other from each side of the border. This scenario involves issues such as translation, information sharing procedures in an international context, different standards for information representation, different cultural background, concepts and methodologies, amongst others.

- Air cargo: an airplane crash accident involving unknown cargo. In this case, private-public information exchange is included, in addition to some of the previously mentioned issues that are shared by both scenarios.

For the technical perspective required for this document, a template was defined for a common identification and analysis of a number of issues related to interoperability. Some of them will be addressed by means of mediation techniques. A number of categories were previously identified, so that scenarios would provide details for specific situations where interoperability issues are present in current situation.

Thus, each scenario identifies a number of specific situations where interoperability issues are present in information exchange processes. Such situations are classified according to two different categories:

- Situation category, depending on the relationship among those who are aiming to share certain data:

    - 0.1: Intra-EMS-Organization Interoperability.
    - 0.2: Inter-EMS-Organization Interoperability
    - 1: National Inter-Organization Interoperability (involving non-EMS)
    - 2: International-EMS-Organization Interoperability
    - 3: International Inter-Organization Interoperability (involving Non-EMS).

- Mediation category, depending on which specific mediation issue is mentioned, and how it is being addressed by DISASTER solution:

    - Technical Interoperability issues: protocol/format mediation.
    - Linguistic interoperability: language mediation / translation needed.
    - Background/cultural issues: concept mediation.
    - Data representation issues: symbols/icons/colours... mediation.
    - Information overload: data filtering needed.

In the following sections, specific interoperability situations identified in each scenario are listed according to the common template.

A.1.1 Border moor fire Scenario: Specific issues description

A.1.1.1 Government Report

Table A 1 Border Moor fire Scenario: Supervisory Government Report

Situation category	1: National Inter-Organization Interoperability (involving non-EMS)
Mediation category	D) Data representation issues (symbols/icons/colors... mediation)
Description: what the problem to be solved is	**Current situation:** [Description of the current situation where the interoperability issue is identified from a user perspective]
	The German government has a supervisory role. That is why German incident command is requested to send periodical reports to the supervisory county government. The reports are written in plain text. The supervisory county government is not able to understand the situation properly due to a lack of visual information.
	Expected situation: [What the situation would be like after DISASTER-based solution has been deployed (proof of concept to be developed)]
	Information is shared across all participation organizations in the most effective way including images and maps wherever possible in order to include much context information.
From (Actor) [Who is the owner of the information]	German side emergency manager
To (Actor) [Who is expecting to get data]	German supervisory county government agent
From (System name) [The system the information in sent from]	Gronau district EMS
To (System name) [The system where information is expected to be received]	Münster County Government
Involved data / information to be shared [What kind of information is involved in the communication]	Situational information in plain text / Situational information including graphics
Technical details	
B) Linguistic interoperability (language mediation / translation needed)	Translation of Dutch EMS operation for the supervisory government report.
C) Background/cultural issues (concept mediation)	Translation of Dutch EMS operation for the supervisory government report.
D) Data representation issues (symbols/icons/colors... mediation)	Possibility to include graphics in a report (which is NOT just to share the situation map)
E) Information overload (data filtering needed)	Not possible since report will reduce information to the most important once.

A.1.1.2 Aerial Pictures

Table A 2 Border Moor fire Scenario: Aerial Pictures

Situation category	0.1: Intra-EMS-Organization Interoperability
	0.2: Inter-EMS-Organization Interoperability
	1: National Inter-Organization Interoperability (involving non-EMS)
	2: International-EMS-Organization Interoperability
	3: International Inter-Organization Interoperability (involving Non-EMS)
Mediation category	A) Technical Interoperability issues (protocol/format)
Description: [what the problem to be solved is]	**Current situation:** [Description of the current situation where the interoperability issue is identified from a user perspective]
	Aerial pictures of the scene are taken on a regular basis. However the decision maker is not able to locate the picture on a map since spatial data is missing.
	Expected situation: [What the situation would be like after DISASTER-based solution has been deployed (proof of concept to be developed)]
	Since situational information is tightly linked to spatial information, geographical data should be transmitted with the information wherever possible. Nevertheless the format of geodata needs to be translated.
From (Actor) [Who is the owner of the information]	Dutch helicopter crew
To (Actor) [Who is expecting to get data]	Dutch & German incident commander
From (System name) [The system the information in sent from]	Helicopter
To (System name) [The system where information is expected	EMS incident command

to be received]	
Involved data / information to be shared [What kind of information is involved in the communication]	Picture / Picture & Geodata
Technical details	
A) Technical interoperability issues (protocol/format mediation)	Maybe the camera is able to create geodata which is not transmitted. Then adding geodata to every chunk of information is a necessary requirement.
C) Background/cultural issues (concept mediation)	Helicopter crew needs to understand that geoinformation is crucial. This is something for the DISASTER handbook.
D) Data representation issues (symbols/icons/colors... mediation)	Picture cannot be represented on a map.

A.1.1.3 Translation

Table A 3 Border Moor fire Scenario: Translation

Situation category	2: International-EMS-Organization Interoperability
	3: International Inter-Organization Interoperability (involving Non-EMS)
Mediation category	B) Linguistic interoperability (language mediation / translation needed)
	C) Background/cultural issues (concept mediation).
Description: [what the problem to be solved is]	**Current situation:** [Description of the current situation where the interoperability issue is identified from a user perspective]
	Dutch and German EMS have agreed on a handbook that offers translations and explanations for the most relevant units and operational items.
	Expected situation: [What the situation would be like after DISASTER-based solution has been deployed (proof of concept to be developed)]
	Translation will be done automatically by DISASTER including explanations of the most relevant items.
From (Actor) [Who is the owner of the information]	Dutch / German EMS crews
To (Actor) [Who is expecting to get data]	Dutch / German EMS crews
From (System name) [The system the information in sent from]	Dutch / German EMS
To (System name) [The system where information is expected to be received]	Dutch / German EMS
Involved data / information to be shared [What kind of information is involved in the communication]	Names and description of relevant operational items
Technical details	
B) Linguistic interoperability (language mediation / translation needed)	Names of units and involved personnel
C) Background/cultural issues (concept mediation)	Organizational understanding of the others EMS concept (can be achieved by description)
D) Data representation issues (symbols/icons/colors... mediation)	Icons must be translated in the same way as the representing name of the object in order to avoid irritation

A.1.1.4 Organization

Table A 4 Border Moor fire Scenario: Organization

Situation category	0.2: Inter-EMS-Organization Interoperability
	1: National Inter-Organization Interoperability (involving non-EMS)
	2: International-EMS-Organization Interoperability
	3: International Inter-Organization Interoperability (involving Non-EMS)
Mediation category	B) Linguistic interoperability (language mediation / translation needed)
	C) Background/cultural issues (concept mediation).
Description: [what the problem to be solved is]	**Current situation:** [Description of the current situation where the interoperability issue is identified from a user perspective]
	Agreements are formulated between the Dutch and German EMS / Government in order

	to be able to use the others information
	Expected situation: [What the situation would be like after DISASTER-based solution has been deployed (proof of concept to be developed)]
	DISASTER Handbook will include advice on how to create a situation by agreements that enables the actors to use the interoperability system.
From (Actor) [Who is the owner of the information]	Dutch / German EMS / Government
To (Actor) [Who is expecting to get data]	Dutch / German EMS / Government
From (System name) [The system the information in sent from]	Dutch / German EMS
To (System name) [The system where information is expected to be received]	Dutch / German EMS
Involved data / information to be shared [What kind of information is involved in the communication]	Agreed procedures of interoperability (how and what data is allowed to be shared)
Technical details	
A) Technical interoperability issues (protocol/format mediation)	Giving access to secured data.
C) Background/cultural issues (concept mediation)	Creating the mentioned agreements / advice on how to create such agreements.

A.1.2 Air Cargo Scenario: Specific issues description

A.1.2.1 Translating, filtering and sharing.

Table A 5 Air Cargo Scenario: Translating, filtering and sharing

Situation category	3: International Inter-Organization Interoperability (involving Non-EMS)
Mediation category	A) Technical interoperability issues (protocol/format mediation).
	B) Linguistic interoperability (language mediation / translation needed)
	D) Data representation issues (symbols/icons/colours... mediation).
	E) Information overload (data filtering needed).]
Description: what the problem to be solved is	**Current situation:** [Description of the current situation where the interoperability issue is identified from a user perspective]
	A number of agents in the information chain provide vital data to identify the seriousness of the incident with considerable effects for the operations of the entire airport. The goal is to reduce the time-to-decision maker who can re-diagnose based on actual data feeds.
	Expected situation: [What the situation would be like after DISASTER-based solution has been deployed (proof of concept to be developed)]
	The expected situation is a better integration between the private operational systems, custom cargo systems and the national EMS to enable direct feed of relevant contextual data and factual data like location, freight/cargo risks and surrounding buildings in order to make fast and relevant risk assessments, appropriate emergency action and reduce impact.
From (Actor) [Who is the owner of the information]	Customs cargo
To (Actor) [Who is expecting to get data]	Chief emergency officer driving to airport in order to start bronze team who requires as much data as possible on his vehicle information system which is part of the EMS representation
From (System name) [The system the information in sent from]	Cargo information system and airport geographical system (context, location, buildings, units, symbols and icons
To (System name) [The system where information is expected to be received]	EMS and vehicle information system EMS
Involved data / information to be shared [What kind of information is involved in the communication]	Freight/cargo data overall and specific, buildings, type of buildings, location, infrastructure, units at site, Released by electronic scenario card in case of emergency.
Technical details	
A) Technical interoperability issues (protocol/format mediation).	The format of the air cargo system has to be made available in the EMS The map system of the airport has to produce some WMS services into the EMS geographic viewer.
B) Linguistic interoperability (language mediation / translation needed)	Some terms and abbreviations are IATA international terminology and may require translation. Some indications of hazardous/toxic/explosive materials may require on the fly translation
D) Data representation issues	Location of airplane, exchange of maps, exchange of indications for freight, location,

(symbols/icons/colors... mediation)	exits, buildings, vehicles, conform NEN 1414 set of symbols. Some have to be translated on the fly using RDF infrastructure.
E) Information overload (data filtering needed)	Using filtering of incident classification structure (VOS 3 = airplane incident category three)

A.1.3 Scenario Interoperability Issues Summary

Table A 6 Scenario Interoperability Issues Summary

Id.	Non-technical requirement	Scenario
A	Intra EMS Organization Interoperability	
A.1	**Technical Interoperability issues (protocol/format)**	
A.1.1	Share location and situational information by radio from Control Room	Border moor fire: Supervisory Government Report
A.1.2	Add geodata to every chunk of information	Border moor fire: Aerial Pic
A.2	**Linguistic interoperability (language mediation / translation needed)**	
A.3	**Background/cultural issues (concept mediation).**	
A.4	**Data representation issues (symbols/icons/colors... mediation).**	
A.4.1	Picture must to be represented on a map.	Border moor fire: Aerial Pic
A.5	**Information overload (data filtering needed).**	
B	Inter EMS Organization Interoperability	
B.1	**Technical Interoperability issues (protocol/format)**	
B.2	**Linguistic interoperability (language mediation / translation needed)**	
B.3	**Background/cultural issues (concept mediation).**	
B.4	**Data representation issues (symbols/icons/colors... mediation).**	
B.5	**Information overload (data filtering needed).**	
C	National Inter-Organization Interoperability	
C.1	**Technical Interoperability issues (protocol/format)**	
C.2	**Linguistic interoperability (language mediation / translation needed)**	
C.2.1	Translation of EMS operation for the supervisory government report	Border moor fire: Supervisory Government Report
C.3	**Background/cultural issues (concept mediation).**	
C.3.1	Translation of EMS operation for the supervisory government report	Border moor fire: Supervisory Government Report
C.4	**Data representation issues (symbols/icons/colors... mediation).**	
C.4.1	Possibility to include graphics and situational information in a report	Border moor fire: Supervisory Government Report
C.5	**Information overload (data filtering needed).**	
C.5.1	Reduce information to the most important once	Border moor fire: Supervisory Government Report
D	International-EMS-Organization Interoperability	
D.1	**Technical Interoperability issues (protocol/format)**	
D.2	**Linguistic interoperability (language mediation / translation needed)**	
D.2.1	Translation will be done automatically by DISASTER including explanations of the most relevant items.(Names of units, involved personnel)	Border moor fire: Translation
D.3	**Background/cultural issues (concept mediation).**	
D.3.1	Organizational understanding of the others EMS concept (can be achieved by description)	Border moor fire: Translation
D.4	**Data representation issues (symbols/icons/colors... mediation).**	
D.4.1	icons must be translated in the same way as the representing name of the object in order to avoid irritation	Border moor fire: Translation
D.5	**Information overload (data filtering needed).**	
E	International Inter-Organization Interoperability (involving Non-EMS)	
E.1	**Technical Interoperability issues (protocol/format)**	
E.1.1	Giving access to secured data	Border moor fire: Organization
E.1.2	The format of the air cargo system has to be made available in the EMS	Airport Cargo
E.1.3	The map system of the airport has to produce some WMS services into the EMS geographic viewer.	Airport Cargo
E.1.4	The systems where information is expected to be received are EMS and vehicle information system	Airport Cargo
E.2	**Linguistic interoperability (language mediation / translation needed)**	
E.2.1	Some terms and abbreviations are IATA international terminology or Customs and transportation terminology and may require translation	Airport Cargo
E.2.2	Some terms and abbreviations are IATA international terminology and may require translation or international customs and transportation terminology	Airport Cargo
E.2.3	Some indications of hazardous/toxic/explosive materials may require on	Airport Cargo

	the fly translation, probably those related to international norm set for toxic and dangerous cargo and issues like pressured air	
E.3	**Background/cultural issues (concept mediation).**	
E.3.1	Creating agreements	Border moor fire: Organization
E.4	**Data representation issues (symbols/icons/colors... mediation).**	
E.4.1	Have to be translated on the fly using RDF infrastructure	Airport Cargo
E.5	**Information overload (data filtering needed).**	
E.5.1	Using filtering of incident classification structure (VOS 3 = airplane incident category three)	Airport Cargo
E.5.2	The systems where information is expected to be received are EMS and vehicle information system	Airport Cargo