ETSI TS 103 260-1 V1.1.1 (2015-05)

Satellite Earth Stations and Systems (SES);
Reference scenario for the deployment of emergency communications;
Part 1: Earthquake

Reference
DTS/SES-00341-1

Keywords
emergency, satellite

ETSI

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

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

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

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Foreword

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

The present document is part 1 of a multi-part deliverable covering the reference scenario for the deployment of emergency communications, as identified below:

Part 1: "Earthquake";

Part 2: "Mass casualty incident in public transportation".

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**may not**", "**need**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Introduction

Major emergencies or disasters may result in a need for additional resources in local telecommunications networks, especially if they are damaged or overloaded, in order to maintain or enhance the ability of emergency services to respond and coordinate their activities effectively. Satellites can play a role in replacing or supplementing other telecommunications links in these scenarios. For example satellite systems can provide:

- broadband and secure communication facilities anywhere/anytime in locations where no other facilities are available; and
- temporary replacement of broken/saturated infrastructures by means of backhauling;
- fast deployment of temporary communication networks in emergency situations.

Hence a basis for requirements for such links needs to be established, and it is intended that the scenarios defined here may be used for this purpose at a later stage.

The present document is also a response to EC mandate M/496 [i.12], specifically dossier 9 "Disaster Management" part 2: "Emergency Telecommunication Services" which aims to support standardization for the optimal needs of the emergency responders.

The use of satellite communication in disasters is described in ETSI TS 102 181 [i.1].

In the present document clause 4 defines the scenario, in terms of physical effects, what actions need to be taken by which actors (who will have communications needs) and what their tasks are. This definition constitutes a basis for clause 5, which defines the nature of information exchanges needed. Clause 6 defines the detailed parameters relating to positions and movements of scenario actors, which are intended to forma basis for modelling of the scenario response topology. These parameters are generic enough to be applicable or adapted to similar but different scenarios, and may eventually be used to model the requirements for actors' communication exchanges, and associated capacities.

1 Scope

The present document defines an earthquake disaster scenario. The scenario includes definition of the responders involved and their gross communication needs without specifying the network technologies involved. Finally the topology modelling of the responders involved is defined, in terms of their disposition in the Incident Area, their time evolution and their movements (if any).

The scenario is not generic in the sense of representing all emergencies of this type, but is intended to be a "typical" example, and thus a reference in order to allow evaluation and dimensioning of required overall emergency telecommunications.

The regulations and operating procedures for Emergency Responses vary between countries e.g. the organization responsible for the emergency can be the police, the fire and rescue organization, a dedicated organization for this purpose (e.g. civil protection) or others.

The response services defined are limited to safety-related services (i.e. not security such as law enforcement).

Casualties and personnel not active in the rescue operations (e.g. the press) have been excluded, as their communications needs are not covered by the emergency communication systems considered here, but their needs are considered in ETSI TR 102 410 [i.2].

2 References

2.1 Normative references

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

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

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

Not applicable.

2.2 Informative references

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

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

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

[i.1] ETSI TS 102 181: "Emergency Communications (EMTEL); Requirements for communication between authorities/organizations during emergencies".

[i.2] ETSI TR 102 410: "Emergency Communications (EMTEL); Basis of requirements for communications between individuals and between individuals and authorities whilst emergencies are in progress".

[i.3] ETSI TR 102 643: "Human Factors (HF); Quality of Experience (QoE) requirements for real-time communication services".

[i.4] Recommendation ITU-T G.114: "Series g: Transmission systems and media, digital systems and networks. One-way transmission time".

[i.5] European Union Handbook on assistance intervention in the Frame of community mechanism for the cooperation of civil protection.

[i.6] United Nations Disaster Assessment and Coordination UNDAC Field Handbook.

[i.7] Hamdi Monia, Franck Laurent and Lagrange Xavier: "Topology modelling and network partitioning: an application to forest firefighting". Radio science bulletin, 2013, pp.8-20.

[i.8] Franck Laurent, Hamdi Monia and Giraldo Rodriguez Carlos: "Topology modelling of emergency communication networks: caveats and pitfalls"; The International Emergency Management Society Workshop 2011, The International Management Society, 22-23 June 2011, Nîmes, France, 2011.

[i.9] Aschenbruck Nils, Gerhards-Padilla Elmar and Martini Peter: "Modelling mobility in disaster area scenarios". Performance Evaluation, 2009, vol. 66, n 12, p. 773-790.

[i.10] Schwamborn Matthias, Aschenbruck Nils and Martini Peter: "A realistic trace-based mobility model for first responder scenarios". Proceedings of the 13th ACM international conference on Modeling, analysis, and simulation of wireless and mobile systems, Bodrum, Turkey, October 17-21, 2010.

[i.11] Huang Ying, He Wenbo, Nahrstedt Klara and Lee Whay C.:"CORPS: Event-driven mobility model for first responders in incident scene". Proceedings of the IEEE Military Communications Conference (MILCOM08), November 2008, pp. 1-7.

[i.12] EC mandate M/496: "M/496 Mandate addressed to CEN, CENELEC and ETSI to develop standardisation regarding spaceindustry (phase 3 of the process)".

3 Definitions and Abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

casualty: individual in the incident area and requiring evacuation including those who are:

(i) non-injured, but affected,

(ii) injured and treated on site,

(iii) injured and needing treatment off-site (medevac), and

(iv) deceased.

common operating picture (COP): single display of information collected from and shared by more than one agency or organization that contributes to a common understanding of a situation and its associated hazards and risks along with the position of resources and other overlays of information that support individual and collective decision making [i.5]

control centre: operations centre from which the management and co-ordination of the response by each emergency service to an emergency are carried out [i.5]

emergency control centre (ECC): facilities used by emergency organizations to handle rescue actions in response to emergency calls ETSI TS 102 181 [i.1]

emergency service: service, recognized as such by the member state, that provides immediate and rapid assistance in situations where there is a direct risk to life or limb, individual or public health or safety, to private or public property, or the environment but not necessarily limited to these situations [i.1]

field emergency control centre (FECC): facilities used by emergency service organizations to manage, command, coordinate, and control rescue works and logistics in the incident area

hazard area: area with obvious or supposed threats to physical/psychological health, properties, and/or environment

holding area: generic term for an area to which resources and personnel not immediately required at the scene or being held for further use, can be directed to standby [i.5]

incident area: area where the incident occurred, and/or the area which needs communication coverage to manage the response implemented ETSI TS 102 181 [i.1]

incident commander: nominated officer with overall responsibility for management, command, coordination, and control of rescue and relief works in the incident area

local emergency management authority (LEMA): local organization within the public services fully or partly responsible for emergency preparedness and handling of incidents (based on ETSI TS 102 181 [i.1])

mass casualty incident (MCI): incident (or series of incidents) causing casualties on a scale that is beyond the normal resources of the emergency services [i.5]

non-governmental organization (NGO): organization that is neither run or controlled by a government nor a profit-oriented business

personal protective equipment (PPE): protective clothing, helmets, goggles or other garment designed to protect the wearer's body from injury [i.5]

public safety answering point (PSAP): physical location where emergency calls are received under the responsibility of a public authority ETSI TS 102 181 [i.1]

site incident officer: representative from the affected organization, when an incident occurs within the perimeter of an industrial or commercial establishment, public venue, airport or harbour, to liaise with the emergency management structures [i.5]

triage: assessment of casualties and allocation of priorities by the medical or ambulance staff (based on [i.5])

3.2 Abbreviations

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

CCP	Casualty Collection Point
CFECC	Coordinating Field Emergency Control Centre
CFEEC	Coordinating Field Emergency Control Centre
COP	Common Operating Picture
DCP	Deceased Collection Point
ECC	Emergency Control Centre
EM-DAT	The International Disaster Database
EMTEL	EMergency TELecommunications
EQ	Earthquake
ET	Emergency Team
ETSI	European Telecommunications Standards Institute
FECC	Field Emergency Control Centre
IC	Incident Commander
ICC	Misprint for ECC
ID	IDentification
IPR	Intellectual Property Right
ITU-T	International Telecommunication Union Telecommunications Sector
LEMA	Local Emergency Management Authority
LPG	Liquefied Petroleum Gas
MCI	Mass Casualty Incident
MIC	Medical Incident Commander
MT	Mid-Term Step
NGO	Non Governmental Organization
PMR	Private Mobile Radio
PPE	Personal protective equipment
PSAP	Public Safety Answering Point
QoE	Quality of Experience
QoS	Quality of Service

SAR	Search and rescue
SatEC	Satellite Emergency Communications Working Group
SECC	Sub Service Emergency Control Room
SES	Satellite Earth Station and Systems
SQ	Scenario Quantities
TCC	Temporary Care Centre
TR	Technical Report
TS	Technical Specification
UMTS	Universal Mobile Telecommunications System
USGS	US Geological Survey

4 Disaster scenario

4.1 General

This clause defines an earthquake (EQ) scenario, firstly in terms of its main constituent events and secondly by its physical consequences. Subsequently the response actions by emergency services to this scenario are defined in terms of the casualties involved, the actors and organizations, overall operating modes, duration and dimensioning factors, etc.

The scenario is used as a basis for the topology model, as defined in clause 6.

The earthquake is over in minutes, whereas the responses may continue for days and weeks. Clause 4.4 below and Annex C provide a set of timelines for the various response actions taken.

The main characteristics of an earthquake in an urban area are:

- Many casualties in the incident area.
- The damage may be distributed over a large geographic area.
- Access limitations (damage to infrastructure).
- The need for emergency services exceeds the available resources.
- Limited local hospital treatment capacities and/or treatment specialities.
- Sparse communication network coverage/capacities, both for PMR and commercial wireless services.

A summary of recent earthquakes and their effects is given in annex A as examples of the scale of events being considered.

4.2 Scenario definition

4.2.1 General

A summary of recent EQ s and their effects is given in annex A as examples of the scale of events being considered.

The disaster scenario is an EQ in an urban area. It is of a magnitude sufficient to cause a multitude of physical effects, such as collapsed buildings, disruption of infrastructure, lack of power, lack of telecommunications, fires, risks of chemical accidents, etc. Each of these incidents may not differ much from isolated similar incidents of this nature, but the added challenge is that the incidents happen at the same time, thus reinforcing the effects and strains on available resources.

The EQ hits a city with a total population of 350 000, positioned among mountains in a coastal area. The number of casualties (individuals within the incident area) is 3 000. The EQ happens on a weekday, at mid-day.

The overall physical disposition of effects of the EQ in the incident area is defined in Figure 4.1.

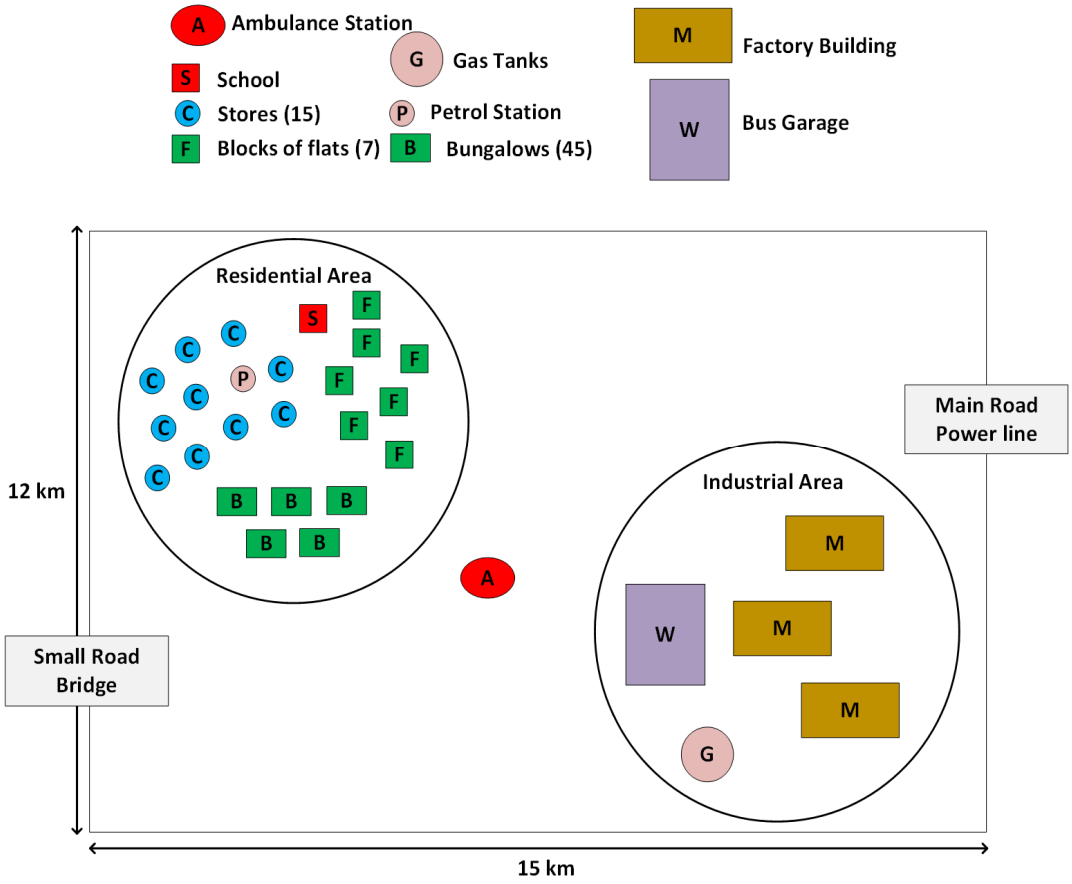

Figure 4.1: Incident area

The distances are:

- Ambulance station to residential area: 3 km
- Ambulance station to industrial area: 2 km
- Ambulance station to entrance small road/ bridge: 6 km

The epicentre of the EQ is at the outskirts of the city. Severe damages, like landslides, collapsed buildings, etc. are limited to an area within a distance of 6 - 8 km from the epicentre.

Outside this area there are limited damages, like broken windows, limited damages to buildings, etc. Hence the incident area is defined as an area 12 x 15 km.

A detailed description of the incident is provided in annex B.

4.2.2 Physical effects

4.2.2.1 Collapse of buildings

There is a large number of buildings in varying state of collapse.

In area A the damages are to domestic structures (blocks of flats) a shopping centre and a school with an enrolment of 350 students and a staff of 100 officers. A total of 1 750 individuals are initially unaccounted for, many of them suspected to be trapped within the buildings, but some may also be out of the area (e.g. at work).

In area B, the damage is primarily to industrial buildings, the total number of individuals in the area at the time of the EQ was 1 500.

4.2.2.2 Fire

There is a fire in a department store in the shopping centre (area A), threatening to spread to other shops as well.

In Area B there is a fire in a bus garage/ workshop.

4.2.3 Disruption of infrastructure

4.2.3.1 Road access

The landslide covers the main road leading into the incident area. Alternative road to the area is via a bridge, which has a weight limit of 3 tons. A result of the limit is that trucks, such as standard fire engines, are unable to enter into the incident area. It is initially unclear whether this bridge has got structural damage.

4.2.3.2 Power

There is a complete loss of power within the incident area. As one of the major power lines pass through the area, there is also a reduced power capacity in the city at large. Some critical facilities, e.g. hospitals, have separate emergency power supply, but others are faced with periodical power cuts.

4.2.3.3 Water supply

Water pipes, both in areas A and B, have been broken, leading to a total loss of water supply.

4.2.3.4 Sanitation

Sewage systems, both in areas A and B, have been broken and are non-functional.

4.2.3.5 Telecommunication

There are widespread damages to telecommunications systems in the incident area. Expert teams are brought in to do repair.

4.3 Tasks and activities

This clause defines the response entities (actors) and their roles within the incident area in handling the disaster. Depending on local/ national organization of services and division of tasks/ responsibilities, the entities involved and their individual areas of work may differ in practice.

In addition to their primary roles, actors may participate in other tasks. The roles will differ between countries, but a typical distribution of roles is given below.

1) Emergency management: setting up of management structures for all involved emergency services, coordination of emergency services, and reporting to the emergency control centre (ECC) and to the local emergency management authority (LEMA) [i.6] and [i.5] leading the coordinating field emergency control centre (CFECC).

2) Fire-fighting: securing the hazard area, fighting fires.

3) Rescue: securing the hazard area, rescuing casualties.

4) Casualty logistics: triage, registration, and treatment of the injured, organizing and conducting medical evacuation out of the incident area, organizing and conducting evacuation of non-injured casualties out of the incident area.

5) Maintenance of public order: documentation.

6) Provisions: providing supplies, shelters and transport.

7) Temporary replacement of destroyed infrastructure/ utilities.

4.4 Disaster response actions

4.4.1 General

The actions of the actors (defined in clause 4.3) in the incident area of this particular scenario are further defined below including overall duration for each action. A more detailed timeline is given in annex C.

Figure 4.2 shows the general organizational hierarchy of the teams of actors (responders) involved.

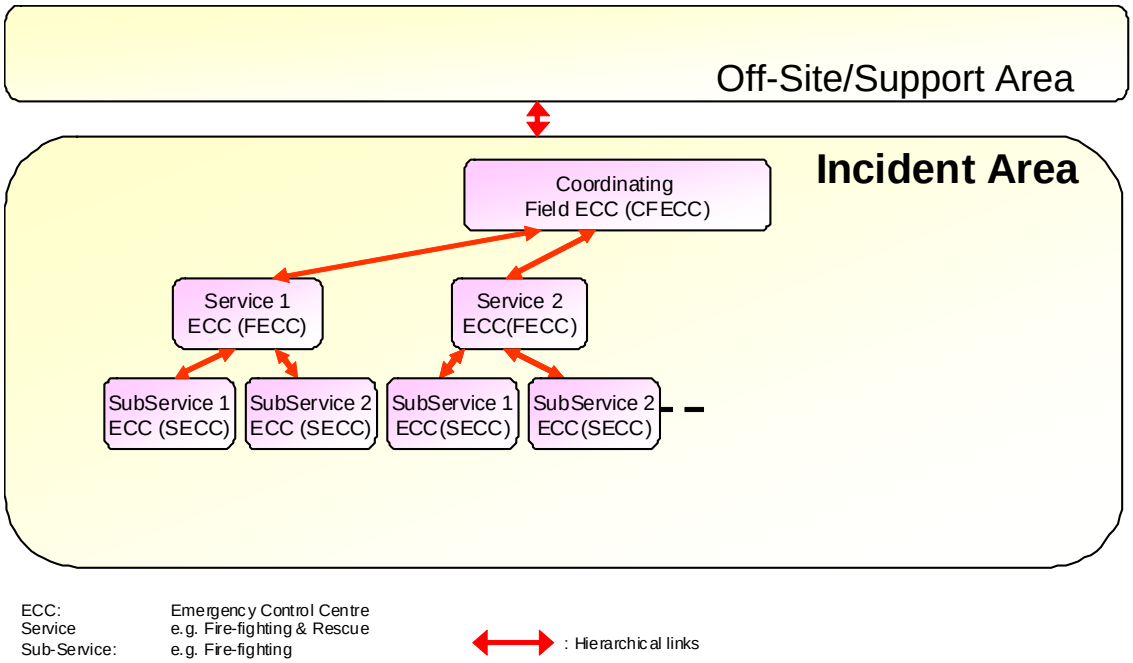

Figure 4.2: Responder Organizational Hierarchy

4.4.2 Emergency management

Deployed emergency services set up their own management structure in terms of service field emergency control centres (FECCs) and SubService emergency control centres (SECCs), as shown in figure 4.2. The actions in table 4.1 are sorted according to their ideal occurrence. In fact, nearly all actions of all involved actors are conducted nearly simultaneously so that there is no distinct order.

Table 4.1: Emergency management

Involved actors	Actions	Start point	Intermediate point	End point	Duration
All involved emergency services	Transport of emergency management personnel and equipment (e.g. command vehicle) to the incident area	First alerting	Arrival	Arrival	Minutes/ hours
Incident commander (IC)	Establishing emergency management structures	Arrival	CFECC in place	End of emergency response works	Days
Fire service	Establishing emergency management structures	Arrival	All FECCs/SECCs in place	End of emergency response works	Days
Rescue service	Establishing emergency management structures	Arrival	All FECCs/SECCs in place	End of emergency response works	Days
Health service	Establishing emergency management structures	Arrival	All FECCs/SECCs in place	End of emergency response works	Days
Relevant authority/non-governmental organization (NGO)	Establishing emergency management structures	Arrival	All FECCs/SECCs in place	End of emergency response works	Days
Site incident officers	E.g. roads department representatives; Consulting to emergency services	Arrival	-	End of emergency response works	Days

4.4.3 Risk management and damage mitigation

Table 4.2: Road access

Involved actors	Actions	Start point	Intermediate point	End point	Duration
Roads department/ geologists	Initial assessment	30 minutes after the EQ when problems are reported by operational emergency services	When assessment is made and reparative actions are initiated.	Temporary repair completed	Hours
Roads department,	Assessment/ Repair of broken roads/ removal of landslide/	Once assessment is completed		Temporary repair completed	Days

Table 4.3: Assessment and handling of specific risks

Involved actors	Actions	Start point	Intermediate point	End point	Duration
Geologist	Assessing risks for further landslides/ rock falls	Request made	Arrival on scene	Conclusion	Hours
Building surveyors	Assessing risks for further collapse of buildings	Request made	Arrival on scene	Conclusion	Days

Table 4.4: Fire fighting

Involved actors	Actions	Start point	Intermediate point	End point	Duration
Fire service	Transport of emergency teams and fire-fighting equipment to the incident/hazard area	First alerting	Arrival	Arrival	Minutes/ hours
Fire service	Risk assessment Set-up of exclusion zone (i.e. inner cordon) Immediate life-saving measures Handing over of casualties to health service at casualty collection point(s) (CCP) Fire-fighting, securing the hazard area Reporting to CFECC	Arrival	All fires out, hazard are secured	End of emergency response works	Days

Table 4.5: Rescue

Involved actors	Actions	Start point	Intermediate point	End point	Duration
Rescue	Transport of emergency teams and rescue equipment to the incident/hazard area	First alerting	Arrival	Arrival	Minutes/ hours
Rescue	Risk identification/assessment Localization of individuals in hazard area Rescue/evacuation of affected individuals out of hazard area (e.g. medical evacuation with stretchers, vehicle extrication) Immediate life-saving measures Handing over of casualties to health service at CCP Reporting to CFECC	Arrival	All casualties localized	End of rescue works (all casualties rescued/evacuated from hazard area)	Days

Table 4.6: Maintenance of public order

Involved actors	Actions	Start point	Intermediate point	End point	Duration
Police/ defence forces/	Public order Documentation	Arrival of first police officers		End of emergency response works	Days

Table 4.7: Power supply restoration

Involved actors	Actions	Start point	Intermediate point	End point	Duration
Power corporation/ local authorities/ civil protection/ NGO	Temporary deployment of emergency generators	Realization of loss of power supply/ request for assistance	Arrival of first generators	Generators deployed to critical areas/ supply lines for fuel established and working	Days
Power corporation	Replacement of power lines	Once area is declared safe	Arrival of repair teams	Permanent power supply re-installed	Days/ weeks

Table 4.8: Water, food and sanitation

Involved actors	Actions	Start point	Intermediate point	End point	Duration
Relevant authority/ NGO	Emergency supply of water and food (both to casualties and emergency staff).	Request for assistance	Arrival of supplies (4 hours after EQ)	Goes on till the end of the handling of the disaster	Days
Relevant authority/ NGO	Temporary deployment of portable toilets, implementation of routines for maintenance	1-2 hours after EQ	Arrival of supplies (4 hours after earthquake EQ)	Goes on till the end of the handling of the disaster	Hours

Table 4.9: Telecommunication

Involved actors	Actions	Start point	Intermediate point	End point	Duration
Telecom provider(s)	Installing/ deploying telecommunication services in the incident area	Telecom providers realize immediately after EQ that services are down	Arrival of repair teams in the incident area (120 minutes after EQ)	All lines re-installed	32 hours (the contractual limit set by some Member States)

4.4.4 Casualty Logistics

The activities related to casualty management are depicted in figure 4.2. Injured casualties are either transported directly to hospitals ("immediate medevac") or taken to the temporary care centre (TCC). Depending on their health status and available resources these casualties are either handed over to temporary shelter or transported to hospitals.

Non-injured casualties are guided to a temporary shelter and then evacuated to shelters outside the incident area.

For the scope of the present document, logistics related to deceased casualties are not considered.

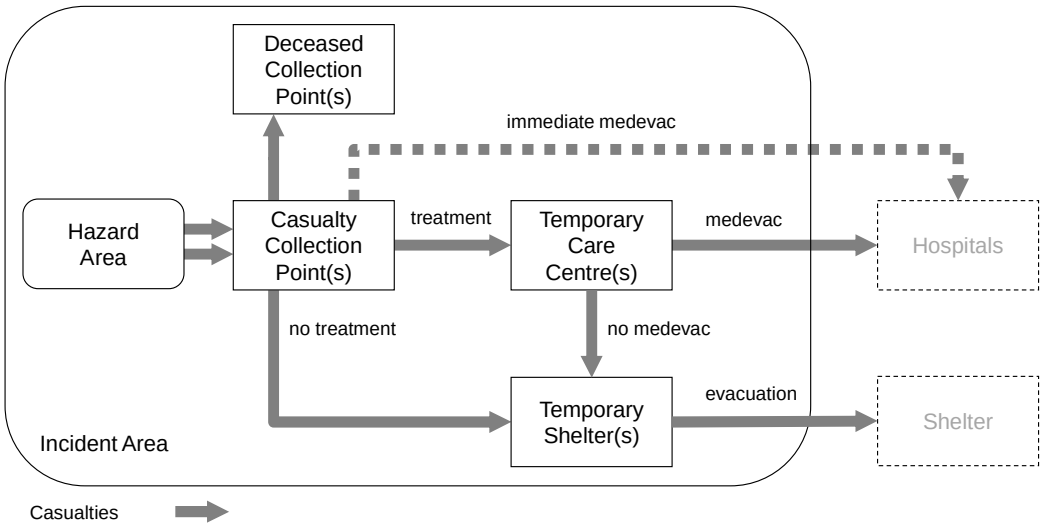

Figure 4.3: Casualty flow chart

The following tables describe the actors and actions related to casualty logistics both for injured and non-injured casualties.

Table 4.10: Treatment and medical evacuation

Involved actors	Actions	Start point	Intermediate point	End point	Duration
Health service, NGO	Transport of emergency teams and medical/shelter equipment to the incident area	First alerting	Arrival	Arrival	Hours
Health service CCP	Immediate life-saving measures Take-over of casualties at CCP(s) Search for individuals outside hazard area Assessment of all casualties (triage) and registration Initial treatment and stabilization, preparation for medical evacuation Documentation of findings and reporting	Discovery of casualties	All casualties assessed and registered	No casualties at CCPs any more	Days
Health service TCC	Assessment of casualties (triage) and registration Initial treatment and stabilization, preparation for medical evacuation	TCC available	Most urgent casualties on their way to hospitals	No casualties at TCC any more	Days
Health service medevac	Medical evacuation of casualties according to priority. Note: destination hospital has to be chosen according to treatment capacity and type of injury	Overview of all casualties' priorities available	Most urgent casualties on their way to hospitals	No casualties at TCC any more	Days

Table 4.11: Temporary shelter and evacuation

Involved actors	Actions	Start point	Intermediate point	End point	Duration
Relevant authority/ NGO	Transport of emergency teams and shelter equipment to the incident area	First alerting	Arrival	Arrival	Minutes/ hours
Relevant authority/ NGO	Provision of temporary shelter, psycho-social care	Arrival	Temporary shelter available	No casualties at temporary shelter any more	Hours
Relevant authority/ NGO	Support to health service	Arrival	(same as health service)	No casualties in incident area any more	Hours

5 Information Exchanges

5.1 General

The response organizations involved in handling the EQ will include those who are active in the incident area and others who remain outside of this area (i.e. in the off-site/support area).

Information exchanges arising from the scenario between organizations solely within off-site areas are out of scope as they are assumed to be satisfied with existing infrastructure, whilst those in the incident area may need additional emergency communications infrastructure.

Hence this clause firstly defines the information exchanges involving the actors (response entities) defined in clauses 4.3 and 4.4 within and to/from the incident area.

The overall requirements are compatible with [i.1], but this clause defines their specific application to this scenario.

This clause then describes the characteristics of the information exchanges, based on the actors and actions. Information exchanges include both physical communications and telecoms services.

Figure 5.1 depicts the organizational hierarchy and associated lines of communication in a scenario of this type. In addition, there is "horizontal" communication between the described structures and between on-site and off-site area.

Incident management involves both an off-site support area and the on-site incident area. Information exchanges between and within these areas use both face-to-face communications and telecoms services.

The off-site area comprises:

1) Public safety answering point (PSAP)s/ECCs for individual (or integrated) emergency services (e.g. fire-fighting, rescue, health service, police) plus assisting PSAPs/ECCs for support in case of major incidents.

2) LEMA represents the local government level and carries out general management and coordination of all response activities.

3) (Inter-)national resources incl. NGOs provide support to the deployed emergency services.

Within the incident area involved emergency services are organized in a hierarchical management structure:

1) CFECC is staffed with a coordinating incident commander or a coordinating task force.

2) In most cases for each emergency service there is a dedicated ECC (FECC).

3) Dedicated tasks/responsibilities of emergency services can be managed from SECCs which report to the upper layer FECC.

4) Deployed emergency teams (ETs) may be grouped as divisions.

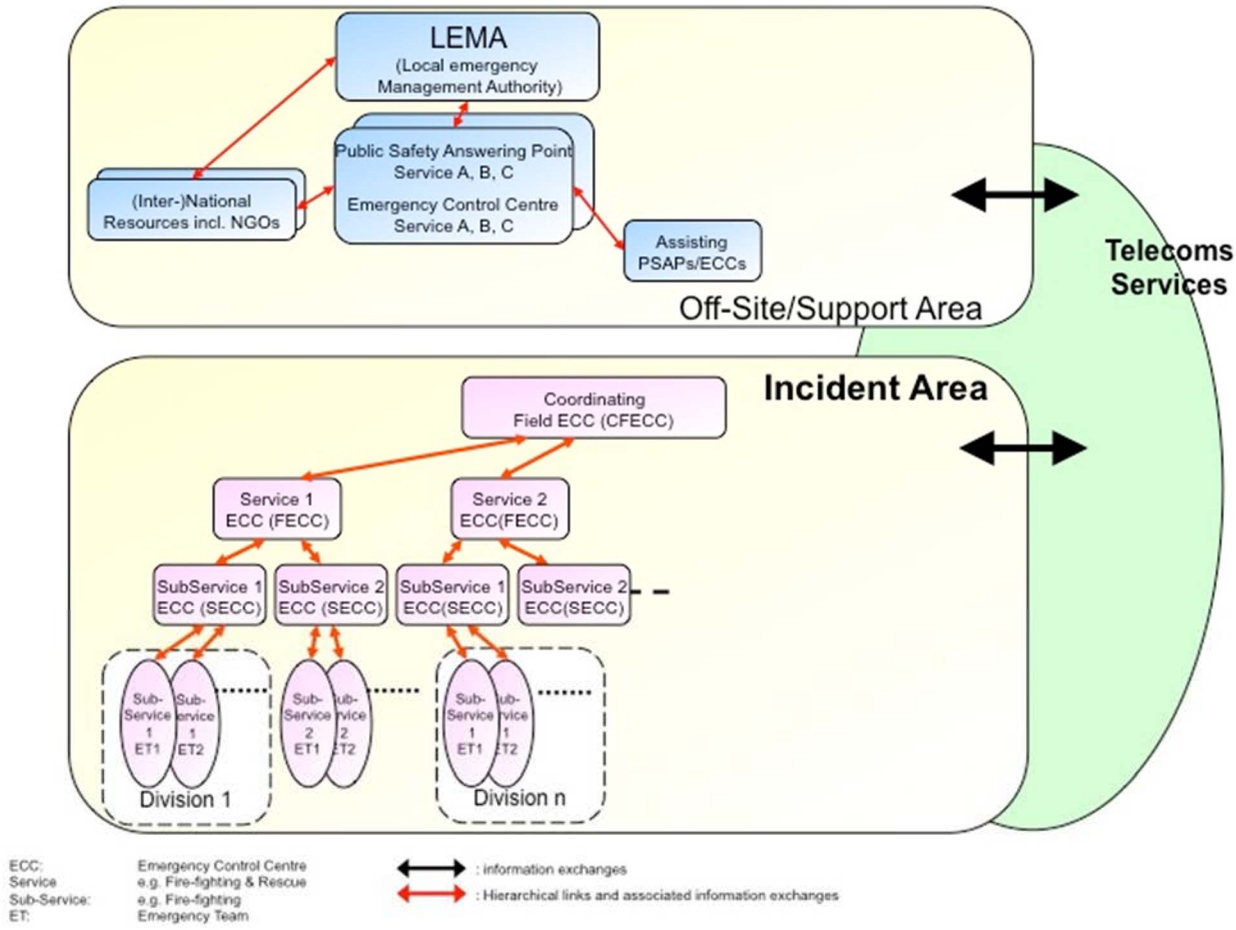

Figure 5.1: Responder Organizational Hierarchy and Related Information Exchanges

NOTE: Information exchanges solely within off-site areas and arising from the scenario are out of scope as they are assumed to be satisfied with existing infrastructure.

The following clauses define communication needs of the actions related to the EQ.

5.2 Communication needs between emergency management hierarchies

The hierarchical structure of emergency services requires information exchanges between the management levels as task descriptions from higher to lower levels and status reports in the opposite direction. All involved decision makers on all hierarchy levels continuously iterate management and decision cycles, which are depicted in figure 5.2. The main elements of a management cycle are:

1) Obtain task from higher level.

2) Observe and/or investigate situation, obtain report from lower level.

3) Evaluate situation/resources, plan and decide.

4) Act and/or instruct lower level.

5) Check and adjust if necessary.

6) Report status to higher level.

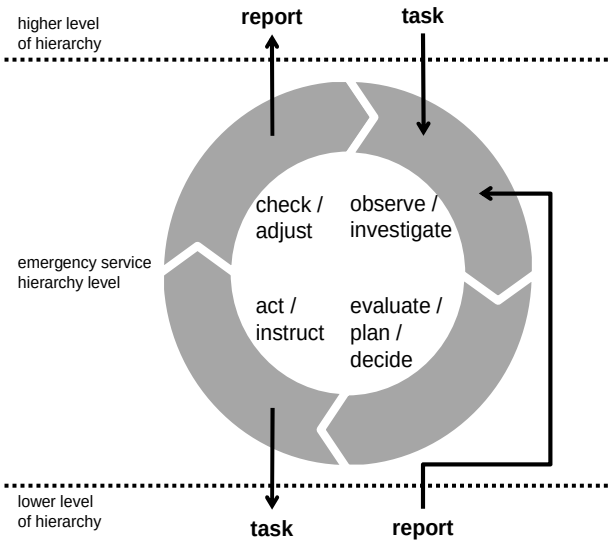

Figure 5.2: Emergency service management cycle

A key prerequisite for appropriate decision making is timely acquisition of relevant reports and distributed information via different communication channels and assembling a common operating picture (COP), which again has to be processed, distributed, and appropriately presented to involved stakeholders

The management cycle frequencies and associated information exchanges in terms of task descriptions and status reports depend on:

1) Risks to different assets: threat to human life or physical condition vs. threat to animals vs. threat to environment and properties.

2) The level of hierarchy. The closer emergency teams are deployed to the incident/hazard area, the faster the current situation has to be re-assessed.

Conversely, requirements on performance and reliability of information exchange means are partly driven by the frequency of the decision cycle.

5.3 Communication needs by action

5.3.1 Emergency management

Generic (qualitative) emergency management communication needs of the involved emergency services are listed in the following tables. Quantitative parameters will be described in clause 5.4.

Table 5.1: Emergency management within incident area

Source to destination(s)	Type of information	Main communication service	Main Requirements
Emergency teams/officers to SECC	Status reports, availability, constraints, demand notification, risks	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Emergency teams to team officer/SECC	Personal protective equipment (PPE) parameters	Data	High data integrity, good data timeliness,medium to low throughput
SECC to emergency teams/officers	Tasks, allocated resources	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
SECCs to SECCs	Task coordination, availability, constraints, demand, risks	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
SECCs to SECCs	COP	Data	High data integrity, medium data timeliness (i.e. minutes), medium to low throughput
SECC to FECC/CFECC	status report, demand, availability, constraints, risks	voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
FECC/CFECC to SECC	Tasks, decisions, deployment area, tasks, resources to be used, risks	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
SECC to FECC/CFECC	COP	Data	High data integrity, medium data timeliness (i.e. minutes), medium to low throughput
FECC/CFECC to SECC	COP	Data	High data integrity, good data timeliness, medium to low throughput

Table 5.2: Emergency management between incident area and off-site area

Source to destination(s)	Type of information	Main communications service	Main Requirements
ECC to emergency teams/ officers (before CFECC/FECC/SECC have been established)	Dispatching	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
ECC to emergency teams/ officers (before CFECC/FECC/SECC have been established)	Dispatching (computer aided dispatch)	Data	High data integrity, good data timeliness (i.e seconds), low throughput
Emergency teams/ officers to ECC (before CFECC/FECC/SECC have been established)	Status report, requests for resources	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Emergency teams/ officers to ECC (before CFECC/FECC/SECC have been established)	Status report (location/ numbers and description of casualties/pictures, etc.)	Data	High data integrity, good data timeliness (i.e seconds), low throughput
ECC to CFECC/FECCs	Tasks, allocated/available resources, constraints	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
CFECC/FECCs to ECC	Status reports, availability, constraints, demand notification, risks	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
ECC to CFECC/FECCs	COP	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
CFECC/FECCs to ECC	COP	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput

5.3.2 Risk management and damage mitigation

5.3.2.1 Road access

The communication lines used by the roads department field workers are given in table 5.3.

Table 5.3: Road access

Source to destination(s)	Type of information	Main communication service	Main Requirements
Assessment team/ site management (roads) to central authority (roads department)	Status reports/ requests	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Assessment team/ site management (roads) to central authority (roads department)	Status reports (pictures)	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Central authority (roads department) to assessment team/ site management (roads)	Tasks, allocated resources	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Central authority (roads department) to assessment team/ site management (roads)	Status reports, maps, overview resources	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Site management (roads) to road workers teams	Status reports/ allocation of tasks	Voice (1/ 1 group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Road workers teams to site management (roads)	Status reports/ requests	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Site management (roads) to emergency team (public order)	Status reports/ requests (e.g. traffic control)	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Emergency team (public order) to site management (roads)	Status reports/ requests (e.g. traffic control)	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Site management (roads) to CFECC	Status reports/ requests	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Site management (roads) to CFECC	Status reports/ requests	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
CFECC to site management (roads)	Status reports/ tasks	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
CFECC to site management (roads)	Status reports/ requests	Voice	Data integrity, data timeliness (minutes), throughput
Site management (roads) to defence engineers	Status reports/ task allocation	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Site management (roads) to defence engineers	Status reports/ site information	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Defence engineers site management (roads)	Status reports/ requests	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Defence engineers site management (roads)	Status reports/ site information	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput

5.3.2.2 Assessment and handling of specific risks

Officers summoned to the incident area to assess and handle specific risks (e.g. geologists, building surveyors) will need communication both to CFECC and to their "home bases" as shown in table 5.4.

Table 5.4: Assessment and handling of Specific Risks

Source to destination(s)	Type of information	Main communication service	Main Requirements
Geology expertise to CFECC	Status reports, requests	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Geology expertise to CFECC	Status reports, e.g. pictures	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
CFECC to geology expertise	Status reports, task allocation	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
CFECC to geology expertise	Site information, maps, pictures	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Geology expertise to central authority (geology)	Status reports, requests	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Geology expertise to central authority (geology)	Status reports, e.g. pictures	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Central authority (geology) to geology expertise	Status reports, task allocation	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Central authority (geology) to geology expertise	Site information, maps, pictures, access to Databases	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Building surveyors to CFECC	Status reports, requests	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Building surveyors to CFECC	Status reports (premade forms), pictures	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
CFECC to building surveyors	Status reports, requests	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
CFECC to building surveyors to	Status reports	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Building surveyors to LEMA	Requests (General information/ drawings, etc.)	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Building surveyors to LEMA	Requests (General information/ drawings, etc.)	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
LEMA to building surveyors	Information, requests	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
LEMA to building surveyors	Drawings/ plans/ access databases	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput

5.3.2.3 Fire-fighting

Figure 5.3 depicts the information exchanges for the fire-fighting tasks in the described earthquake.

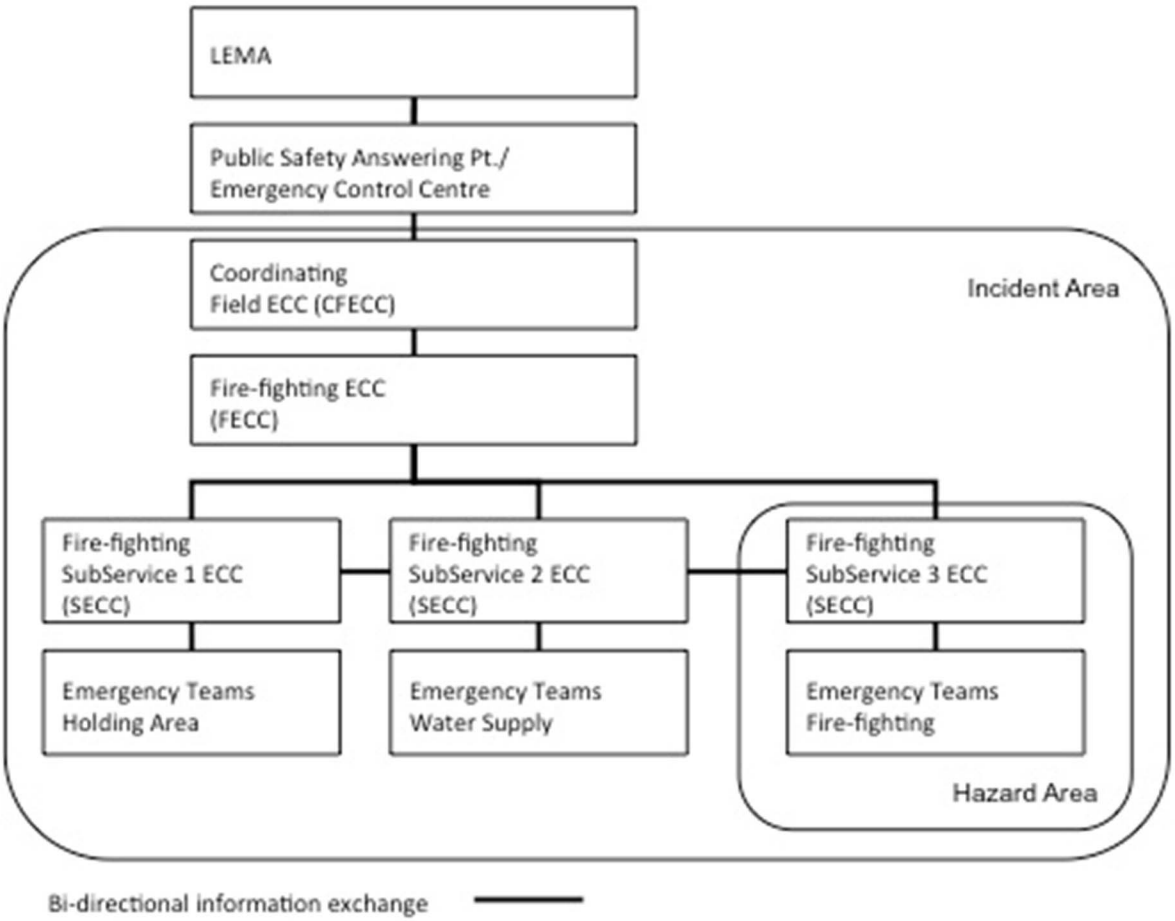

Figure 5.3: Fire-fighting information exchanges

The main information exchanges are as follows:

- Deployed teams issue continuously updated status reports and demand notification towards the higher management levels.
- In the opposite direction, higher management levels inform lower levels about tasks, risks, and available resources.
- SECCs exchange information about task coordination, availability, constraints, demand, and potential risks.

The holding area serves as buffer for arriving fire-fighting and water supply resources.

Table 5.5 describes information exchanges for fire-fighting activities in more details. A differentiation between the three SECCs introduced in figure 5.5 is not necessary since both types of information and main communications services will be nearly the same.

Table 5.5: Information exchanges fire-fighting

Source to destination(s)	Type of information	Main communication service	Main Requirements
ECC to emergency teams/ officers (before SECC has been established)	Dispatching	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
ECC to emergency teams/ officers (before SECC has been established)	Dispatching (Computer aided dispatch)	Data	High data integrity, data timeliness (i.e. seconds), medium to low throughput
Emergency teams/ officers to ECC (before SECC has been established)	Status report, requests for resources	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Emergency teams/ officers to ECC (before SECC has been established)	Status report (location/ numbers and description of casualties/pictures, etc.)	Data	High data integrity, data timeliness (i.e. seconds), medium to low throughput
SECC fire to emergency teams/ officers	Tasks, allocated resources	Voice (1/ 1 group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
SECC fire to emergency teams/ officers	Tasks, allocated resources (Pre-prepared forms)	Data	High data integrity, data timeliness (i.e. seconds), medium to low throughput
Emergency teams/ officers to SECC fire	Situation reports, requests	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Emergency teams/ officers to SECC fire	Status report (location data/ pictures etc, streaming video (smoke divers))	Data	High data integrity, data timeliness (i.e. seconds), medium to low throughput
SECCs to NGO	Status reports, allocation of tasks	Voice (1/ 1 group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
NGO to SECC	Status report, requests	Voice (1/ 1 group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Emergency teams/ officers to emergency teams/ officers	Common operational picture/ sharing of information	Voice (1/ 1 group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay

5.3.2.4 Rescue

Figure 5.6 depicts the information exchanges for the rescue tasks in the described earthquake.

The main information exchanges are as follows:

- Deployed teams issue continuously updated status reports and demand notification towards the higher management levels.
- In the opposite direction, higher management levels inform lower levels about tasks, risks, and available resources.
- SECCs exchange information about task coordination, availability, constraints, demand, and potential risks.

The holding area serves as buffer for arriving rescue resources.

Again, a differentiation between the two SECCs is not necessary since both types of information and main communications services will be nearly the same.

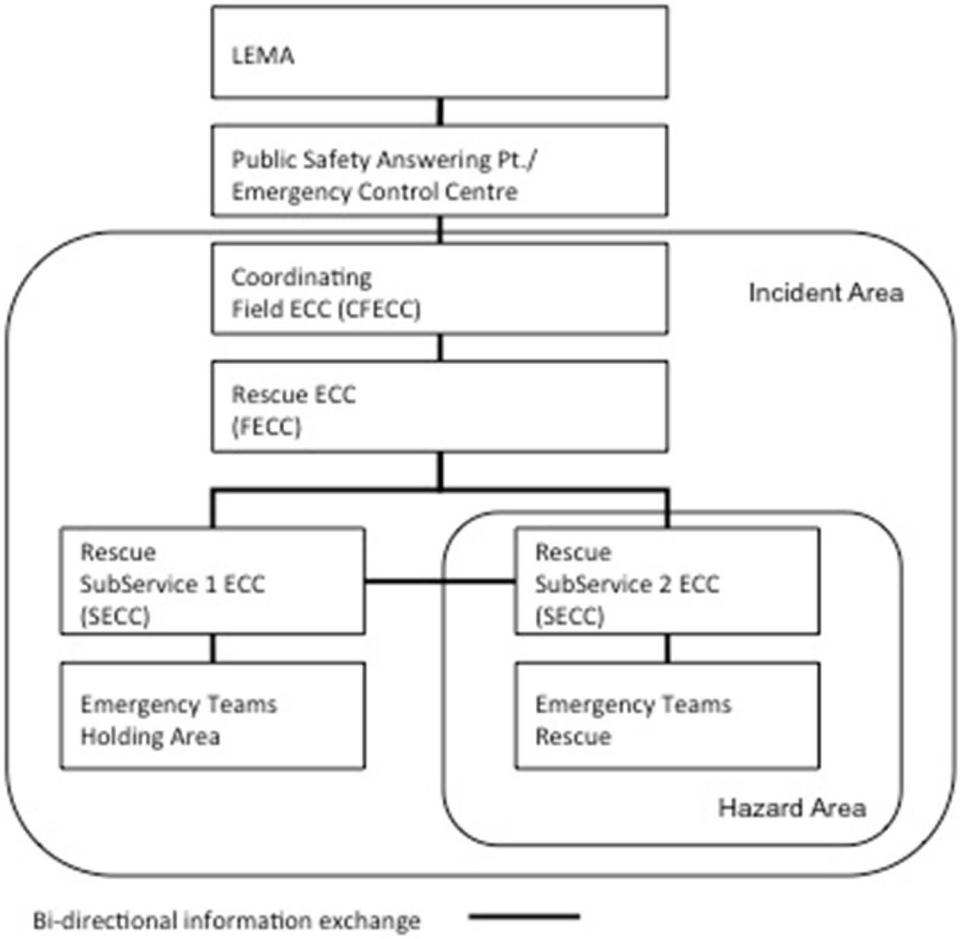

Figure 5.4: Rescue information exchanges.

The main information exchanges are as follows:

- Deployed teams issue continuously updated status reports and demand notification towards the higher management levels.
- In the opposite direction, higher management levels inform lower levels about tasks, risks, and available resources.
- SECCs exchange information about task coordination, availability, constraints, demand, and potential risks.

The holding area serves as buffer for arriving rescue resources.

Table 5.6: Rescue

Source to destination(s)	Type of information	Main communications service	Key parameters
ECC to emergency teams/ officers (before SECC has been established)	Dispatching	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
ECC to emergency teams/ officers (before SECC has been established)	Dispatching (Computer aided dispatch)	Data	High data integrity, data timeliness (i.e. seconds), medium to low throughput
Emergency teams/ officers to ECC (before SECC has been established)	Status report, requests for resources	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Emergency teams/ officers to ECC (before SECC has been established)	Status report (location/ numbers and description of casualties/pictures, etc.)	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
SECC rescue to emergency teams/ officers	Tasks, allocated resources	Voice (1/ 1 group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
SECC rescue to emergency teams/ officers	Tasks, allocated resources (Pre-prepared forms)	Data	High data integrity, data timeliness (i.e. seconds), medium to low throughput
Emergency teams/ officers to SECC rescue	Situation reports, requests	Voice	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Emergency teams/ officers to SECC rescue	Status report (location data/ pictures etc,	Data	High data integrity, data timeliness (i.e. seconds), medium to low throughput
SECCs to NGO emergency teams	Status reports, allocation of tasks	Voice (1/ 1 group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
NGO teams to SECC	Status report, requests	Voice (1/ 1 group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Emergency teams/ officers to emergency teams/ officers	Common operational picture/ sharing of information	Voice (1/ 1 group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay

5.3.2.5 Maintenance of public order

The communication needs for maintaining public order in an EQ are depicted in table 5.7

Table 5.7: Maintenance of public order

Source to destination(s)	Type of information	Main communications service	Main Requirements
ECC to emergency teams/ officers (before SECC has been established)	Dispatching	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
ECC to emergency teams/ officers (before SECC has been established)	Dispatching (Computer aided dispatch)	Data	High data integrity, data timeliness (i.e. seconds), medium to low throughput
Emergency teams/ officers to ECC (before SECC has been established)	Status report, requests for resources	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Emergency teams/ officers to ECC (before SECC has been established)	Status report (location/ numbers and description of casualties/ pictures, etc.)	Data	High data integrity, data timeliness (i.e. seconds), medium to low throughput
SECC police to emergency teams/ officers	Tasks, allocated resources/ destinations of patients	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
SECC police to emergency teams/ officers	Tasks, allocated resources (Pre-prepared forms)	Data	High data integrity, data timeliness (i.e. seconds), medium to low throughput
Emergency teams/ officers to SECC police	Situation reports, requests	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Emergency teams/ officers to SECC police	Status report (location data/ pictures, etc.)	Data	High data integrity, data timeliness (i.e. seconds), medium to low throughput

5.3.2.6 Provisions

The communication needs concerning provisions are listed in the tables 5.8 to 5.10 below.

Table 5.8: Power supply restoration

Source to destination(s)	Type of information	Main communication service	Main Requirements
Power corporation (central) to CFECC	Status reports, availability, constraints, demand notification, risks	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Power corporation (central)to CFECC	Status reports (e.g. maps), plans for restoration/ supply of generators, etc.	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
CFECC to Power corporation (central)	Status report, tasks	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
CFECC to Power corporation (central)	Status reports, tasks.	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Site management (power) to Power corporation (central)	Status reports/ requests	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Site management (power) to Power corporation (central)	Status reports (pictures)	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Power corporation (central) to site management (power)	Tasks, allocated resources	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay

Source to destination(s)	Type of information	Main communication service	Main Requirements
Power corporation (central) to site management (power)	Tasks, allocated resources, maps,	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Site management (power) to power workers teams	Status reports/ allocation of tasks	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Power workers teams to site management (power)	Status reports/ requests	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Site management (power) to CFECC	Status reports/ requests	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Site management (power) to CFECC	Status reports/ requests	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
CFECC to site management (power)	Status reports/ tasks	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
CFECC to site management (power)	Status reports/ tasks	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Site management (power) to LEMA	Status reports/ task allocation	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Site management (power) to LEMA	Status reports/ task allocation/site information	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
LEMA to site management (power)	Status reports/ requests	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
LEMA to site management (power)	Status reports/ requests/site information (maps)	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput

Table 5.9: Water, food and sanitation

Source to destination(s)	Type of information	Main communication service	Main Requirements
CFECC to LEMA	Status report, requests for resources	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
CFECC to LEMA	Status report, requests for resources, maps	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
LEMA to CFECC	Status reports, allocation of resources	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
LEMA to CFECC	Status reports, allocation of resources	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
LEMA to site management teams	Status reports, allocation of resources	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
LEMA to site management teams	Status reports, allocation of resources	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Site management teams to LEMA	Status reports, allocation of resources	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Site management teams to LEMA	Status reports, allocation of resources	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Site management teams to field workers (relevant authority/ local authority/ NGO)	Status reports, allocation of resources	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Field workers (relevant authority/ NGO) to site management teams	Status reports	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay

Table 5.10: Telecommunication

Source to destination(s)	Type of information	Main communication service	Main Requirements
Field teams to off-site management	Status report, requests for resources	Voice	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Field teams to off-site management	Status report, requests for resources, maps	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput

5.3.3 Casualty logistics

5.3.3.1 Overview

Information exchanges related to the medical evacuation of casualties (see figure 4.2) are depicted in figure 5.5. The holding area serves as buffer for arriving transport vehicles and emergency teams.

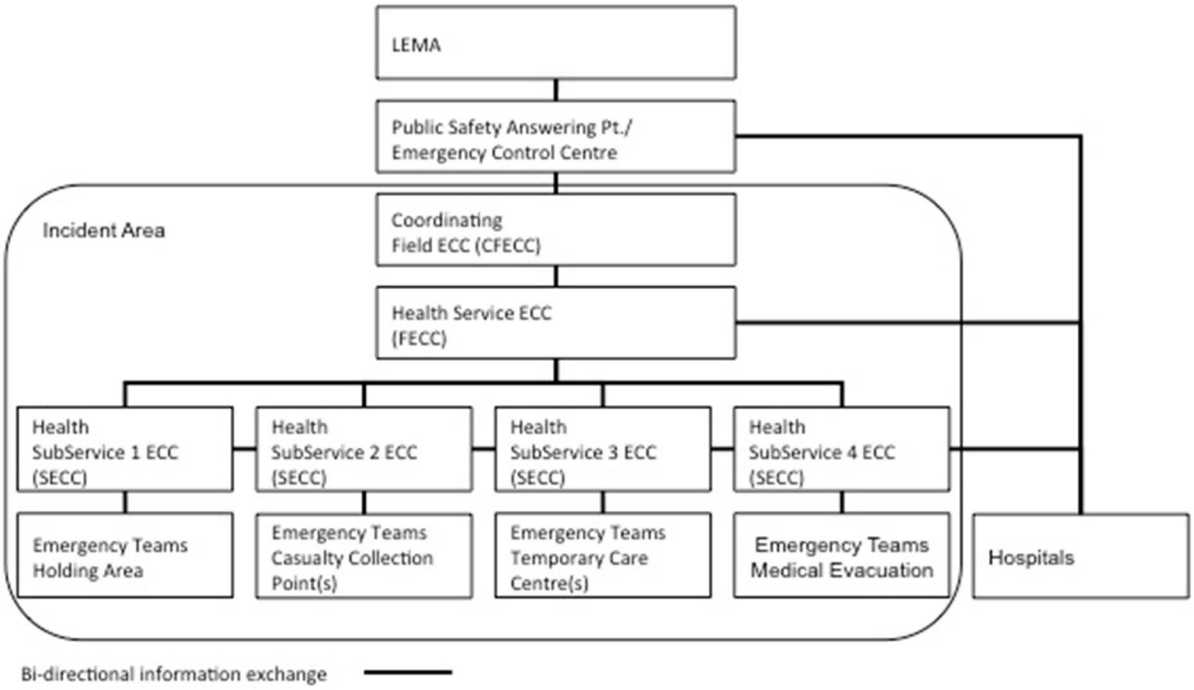

Figure 5.5: Health service information exchanges

5.3.3.2 Treatment and medical evacuation

The main objective of a mass casualty incident (MCI) logistics in the incident area and of medical evacuation logistics is keeping track of all casualties. Rough knowledge of all casualties' current locations is desirable, but detailed movement patterns are not required. An overview of remaining casualties in vicinity of the CCP(s), patients entering/leaving each TCC, and patients on their way to or arriving at receiving hospitals is the basis for all emergency management decisions.

Figure 5.6 depicts the (idealized) MCI process chain from the patient data perspective. Patient data is not static which means that all relevant status changes have to be communicated to all SubService ECCs. E.g. if one patient's triage category changes after the initial assessment, then all decisions regarding treatment and medical evacuation priority of all other patients will have to be re-evaluated. Likewise, there might be an updated diagnosis affecting medical evacuation priority and the choice of the receiving hospital.

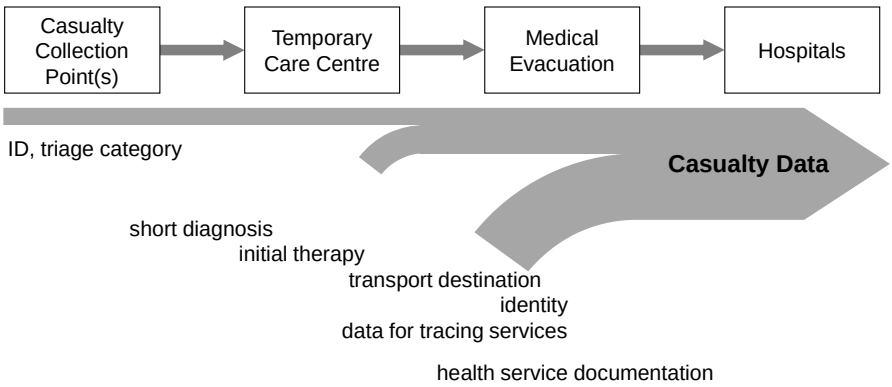

Figure 5.6: Patient data along process chain

Current approaches for MCI management are mainly based on paper tags which are attached to all individuals during the registration process. These tags have a unique identification and are marked with the patient priority and a short diagnosis as result of a brief medical examination which is typically a standardized triage algorithm checking main vital parameters. Additionally, supplementary information like date, time, or position information can also be filled in. Triage teams maintain paper lists in which they document their findings. After finishing the triage and registration tasks these lists are forwarded to the appropriate SECC. Likewise, patient logistics at the ICC and in the medical evacuation division is organized with similar paper lists supported by PMR systems.

A major improvement of this approach is to gather and exchange all data related to patient logistics electronically. This requires synchronization of data between all involved teams and management levels, both on-site and off-site.

Table 5.11: Information exchange for casualty logistics and treatment data

Source to destination(s)	Type of information	Main communications service	Main Requirements
Emergency teams CCP, TCC, medevac, holding area; SECCs CCP, TCC, medevac, holding area; FECC health service; ECC; hospitals; police/LEMA	Casualty logistic data	Data	Automatic data synchronization, data integrity, data timeliness (minutes), low throughput, capable of handling network interruptions
TCC (or other suitable location) to/from hospital or telemedicine centre	Telemedicine application data	Data	Short setup time, constant high quality and integrity, high throughput

Similar to the fire-fighting and rescue information exchanges, the information exchange for health service management has two main directions:

- Deployed teams issue continuously updated status reports and demand notification towards the higher incident management level.
- Higher management levels inform lower levels about risks, tasks, and available resources.

For clarity reasons the information exchanges for the MCI management are shown in two separate tables.

Table 5.12: Information exchange between deployed teams and assigned SECCs

from / to	CCP emergency teams	SECC CCP	TCC emergency teams	SECC TCC	Medevac emergency teams/ holding area	SECC medevac
CCP emergency teams	Task coordination, availability, constraints, demand, risks	Decisions, deployment area, tasks, available resources, risks	-	-	-	-

from / to	CCP emergency teams	SECC CCP	TCC emergency teams	SECC TCC	Medevac emergency teams/ holding area	SECC medevac
SECC CCP	Status report, demand, availability, number of casualties, triage categories, short diagnosis, date/time, casualty IDs	-	-	Status report, casualty IDs within/ entering/ leaving TCC	-	-
TCC emergency teams	-	-	Task coordination, availability, constraints, demand, risks	Decisions, deployment area, tasks, available resources, risks	-	-
SECC TCC	-	Status report, number of casualties, triage categories, short diagnosis, date/time, casualty IDs	Status report, triage categories, short diagnosis, date/time, casualty IDs within/ entering/ leaving TCC	-	-	Status report, availability, constraints, risks
Medevac emergency teams/ holding area	-	-	-	-	Task coordination, availability, constraints, demand, risks	Triage categories, short diagnosis, date/time, casualty IDs, receiving hospital
SECC medevac	-	Status report, number of casualties, triage categories, short diagnosis, date/time, casualty IDs	-	Status report, demand, triage categories, short diagnosis, date/time, casualty IDs within/ entering/ leaving TCC, receiving hospital	Status report, availability, constraints, risks	-

from / to	CCP emergency teams	SECC CCP	TCC emergency teams	SECC TCC	Medevac emergency teams/ holding area	SECC medevac
NOTE 1: One key task of all SECCs is to keep track of all casualties along the medevac process chain. NOTE 2: Individual casualty identification codes (ID)s are required for casualty tracing. The team/role issuing a report with casualty IDs to other entities implicitly reports the positions of these casualties (e.g. entering the TCC, arriving at the receiving hospital, etc.) NOTE 3: The first arriving team and depending on the size of the incident the subsequent teams are supposed to start with triage and registration of all affected persons. In most cases these teams are paramedics and emergency physicians working in the regular health service. NOTE 4: A short diagnosis can be e.g. traumatic brain injury or burn. This information is required to determine a suitable receiving hospital. Several triage algorithms specify additional data fields (e.g. child/adult and gender). NOTE 5: The SECC/FECC assigns tasks to deployed emergency teams according to availability and demand. E.g. after concluding triage and registration, these teams will preferably take care of prioritized casualties (including immediate medical evacuation). NOTE 6: Depending on the actual legal situation there may be different roles in charge of assigning patients to transport vehicles to receiving hospitals. Examples are a medical incident commander (MIC) or a chief emergency physician working at the CCP/TCC, or a transport coordinator working in the medical evacuation SECC. NOTE 7: Medical evacuation decisions require a comprehensive situation overview including overall number of patients, triage categories, short diagnosis, available transport means, transport times to receiving hospitals, hospital specialities, and hospital treatment capacities. NOTE 8: There are considerations to support staff working at the TCC with remote medical specialists by means of telemedicine applications. This requires dedicated communication links between the TCC (or vehicles with suitable equipment) and hospitals or telemedicine centres.						

Table 5.13: Information exchanges between SECCs, FECCs, and off-site entities

from / to	SECC CCP	SECC TCC	SECC medevac	FECC	CFECC	ECC	Hospitals
SECC CCP	Task coordination, availability, constraints, demand, risks	-	-	Decisions, deployment area, tasks, available resources, risks	-	-	-
SECC TCC	Status report, number of casualties, triage categories, short diagnosis, date/time, casualty IDs	Task coordination, availability, constraints, demand, risks	Availability, constraints	Decisions, deployment area, tasks, available resources, risks	-	Hospital treatment capacities	Hospital treatment capacities
SECC medevac	-	Casualty IDs, short diagnosis, receiving hospital	-	Decisions, deployment area, tasks, available resources, risks	-	Task (re-)assignment	-
FECC	Status report, demand, availability, number of casualties, triage categories, short diagnosis, date/time, casualty IDs	Status report, demand, availability, number of casualties, triage categories, short diagnosis, date/time, casualty IDs, receiving hospital	Availability, constraints	Task coordination	Decisions, deployment area, tasks, available resources, risks	Available resources, constraints, risks	Hospital treatment capacities
CFECC	-	-	Availability, constraints	Status report, demand, availability, constraints, risks	-	Available resources, constraints, risks	-
ECC	-	-	Casualty IDs, short diagnosis, receiving hospital	Status report, demand, availability, constraints, risks	Status report, demand, availability, constraints, risks	-	Hospital treatment capacities
Hospitals	-	(Direct notification)	Pre-notification	-	-	Pre-notification, demand, casualty IDs, short diagnosis	-

Information exchanges between SECCs, FECCs, and the other involved entities are described in table 5.14.

5.3.3.3 Temporary shelter and evacuation

Information exchanges related to temporary shelters and coordination of evacuation are listed in table 5.15.

Table 5.14: Temporary Shelter and Evacuation

Source to destination(s)	Type of information	Main communications service	Main Requirements
SECC relevant authority/NGO temporary shelter to emergency teams	Tasks, decisions, deployment area, resources to be used	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
SECC relevant authority/NGO temporary shelter to emergency teams	Common operating picture	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Emergency teams temporary shelter to SECC	Status report, availability, constraints, demand, risks	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Emergency teams temporary shelter to SECC	Common operating picture	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
SECC relevant authority/NGO evacuation to emergency teams	Tasks, decisions (e.g. transport plans), deployment area, tasks, resources to be used	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
SECC relevant authority/NGO evacuation to emergency teams	Common operating picture	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
Emergency teams evacuation to SECC	Status report, availability, constraints, demand, risks	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
Emergency teams evacuation to SECC	Common operating picture	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput
SECC relevant authority/NGO temporary shelter to emergency teams	Tasks, decisions, deployment area, resources to be used	Voice (group call)	Good speech intelligibility/quality, short call setup time, little end-to-end delay
SECC relevant authority/NGO temporary shelter to emergency teams	Common operating picture	Data	High data integrity, data timeliness (i.e. minutes), medium to low throughput

5.4 Characteristics of Emergency Communication Services

5.4.1 Speech services

5.4.1.1 General

Speech services are currently the most instinctive and most used communication services in emergencies, and this is likely to remain the case for years to come. For speech services several universal requirements exist, characterized by:

Speech intelligibility and quality: that received speech is capable of being understood reliably and some cases high speech quality is desirable.

Call setup-time: short call set-up times enable rapid communication of relevant information.

End to end delay: End to end delay: Regardless of the type of application, [i.4] recommendation is not to exceed 400 ms**.**

Examples of speech services are point-to-point and push-to-talk services.

5.4.1.2 PMR group call channels

The number of required voice channels depends on the number of involved emergency service disciplines and the command structure:

- 1 group call channel jointly used by ECC, CFECC, and all FECCs;
- 1 group call channel jointly used by each emergency service's FECC and all assigned SECCs;

- 1 group call channel jointly used by each SECC and all assigned emergency team officers;
- Optional: 1 group call channel used by each emergency team.

EXAMPLE: 7 involved emergency service incident commanders manage 3 sectors each, and 3 teams per sector. The total (maximal) number of required voice channels for group calls sums up to 1+7+7×3+7×3×3=86.

5.4.2 Paging (short message) services

Paging services are used by a variety of authorities in order to contact their personnel, and paging services are available from a variety of networks and technologies. The network needs to be able to identify the requested authorized emergency agent(s), and then deploy the appropriate technology to contact them. This requirement may encompass different communication network technologies, services and applications such as paging, presence, texting, instant messaging, etc.

5.4.3 Status monitoring and location services

Status monitoring includes a wide variety of parameters, e.g. breathing air tank levels, accountability monitoring, distress buttons and vital signs monitoring. Location services provide real-time information regarding the position of personnel or vehicles to an emergency team leader. This information may also include status information regarding the person or vehicle. The service may require frequent transmissions to update position; the amount of data transmitted is likely to be small when location is based on satellite-based solutions, but can be quite extensive when location is to be calculated inside buildings as other technologies may have to be used. Location reporting services may be one-way with no acknowledgement, necessitating a robust communication mechanism. Position information may be considered sensitive in some emergencies and may require security mechanisms to protect the data.

5.4.4 Data services

Data services are used to provide a large number of applications which can have widely differing requirements in terms of capacity, timeliness and robustness of the data service [i.7]. Ideally, the communication networks should support the required data throughput and minimize end-to-end delay, especially for applications such as real time video. Noting the extreme circumstances that may be in force during an emergency, it may be desirable for networks to degrade gracefully when user requirements exceed the agreed levels of service.

There is a variety of data applications such as email, imaging, digital mapping, location services, video, data base access, Personnel monitoring and social networking. The data applications can be characterized by:

Throughput: data volume in a given time.

Timeliness: importance of the information arriving within an agreed timeframe.

Preservation of data integrity: how (reliable) free from bit errors the information transmission needs to be (e.g. a bitmap image with some errors is still useable); a digital image with some bit errors may be unreadable.

Data service distribution requirements are driven by the applications used by emergency service disciplines. Typical use cases for the envisaged responses from the user perspective are:

- Point-to-point data transfer (e.g. ECC sends background information to CFECC).
- Multi-point-to-point data transfer (e.g. PPE data from team members is sent to team officer, aggregation of registration and triage data).
- (Multi-) point-to-multi-point data transfer (e.g. synchronization of COP or casualty data between ECC/CFECC/FECCs/SECCs).
- Unidirectional point-to-point streaming (e.g. data generated by sensors).
- Bidirectional point-to-point streaming (e.g. real-time telemedicine applications).
- Multi-point-to-multi-point streaming (e.g. audio/video conference calls).

6 Topology model

6.1 General

Topology modelling is generally used to represent a network's layout and dynamics mathematically in terms of the topology of the network nodes, represented here by the scenario actors. Algorithms may be chosen to depict properties such as the location and motion of the nodes, and whether nodes switch on/off during the lifetime of the network.

This clause defines a set of model parameters which may be used as a basis for topology simulation of emergency teams or "actors" in the defined scenario.

The Topology Model parameters define primarily how actors are deployed and move in the Incident Area. This specification is based on topology modelling concepts in [i.7] and [i.8]. The mobility model described in [i.9], [i.10] and [i.11] serve as references for the movements of the actors.

Casualties are part of the model, even though they are not "actors". They indicate the geographical location where the response teams are acting. For the modelling, they are classified according to the following types:

1 = requiring treatment and medevac

2 = requiring minor treatment and evacuation

3 = requiring no treatment but evacuation

4 = deceased Because this scenario involves numerous response actions, actors (see clause 4.3) are modelled as teams rather than individuals.

6.2 Model graphics

Figure 4.1 in clause 4.2.1 shows the physical layout of the incident area (i.e. the future incident area) before the EQ takes place. It illustrates the places that will be affected and the associated actors.

Figure 6.1 illustrates a snapshot of the ramp-up of the scenario, including the first response actions, but excluding the main command and coordination centres.

Figure 6.2 shows a snapshot of the incident area at the highest point of activity, complying with the requirements defined in clause 6.3 regarding the positions in the incident area and the mobility of the actors.

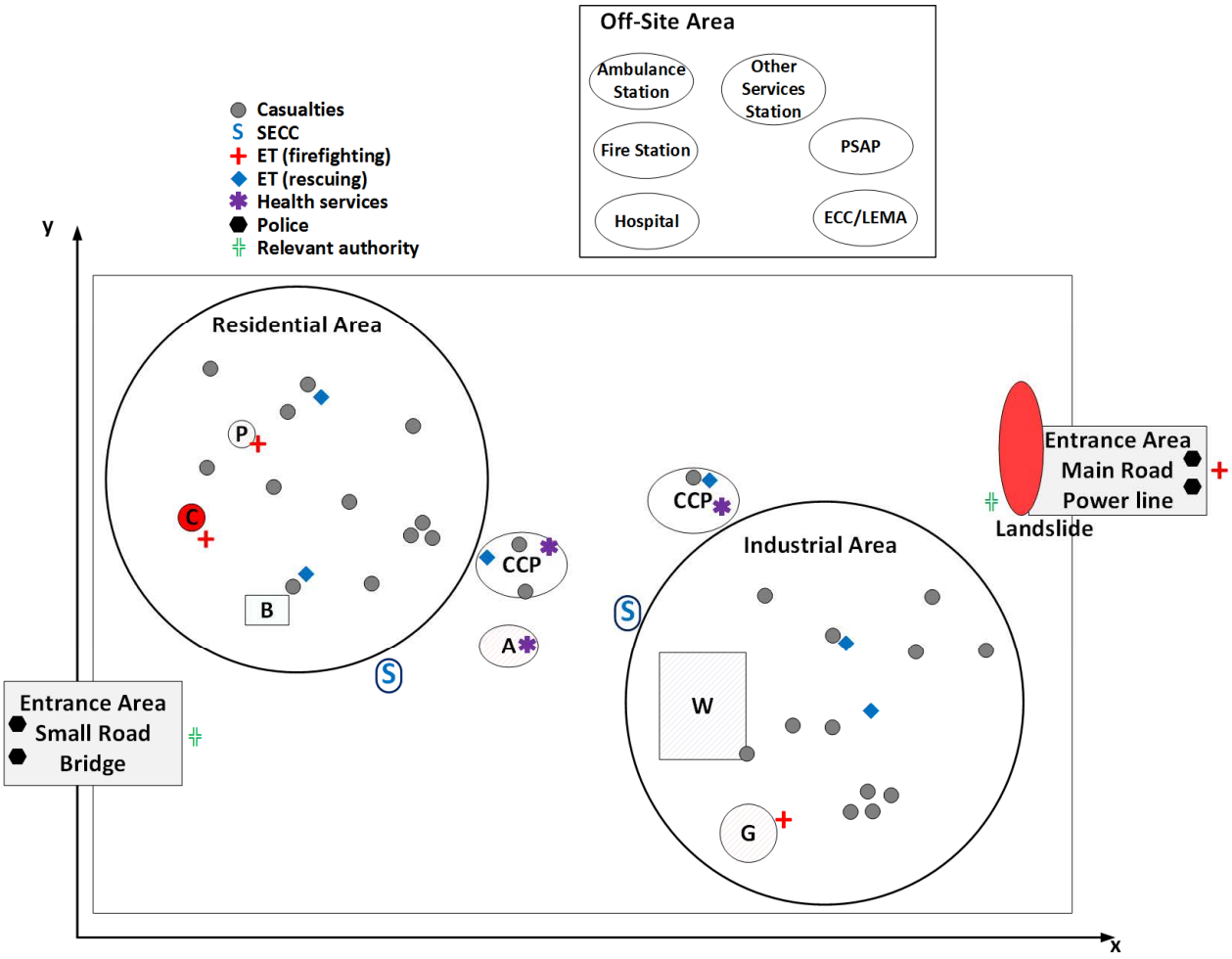

Figure 6.1: Snapshot of the EQ incident area (ramp-up condition, before CFECC)

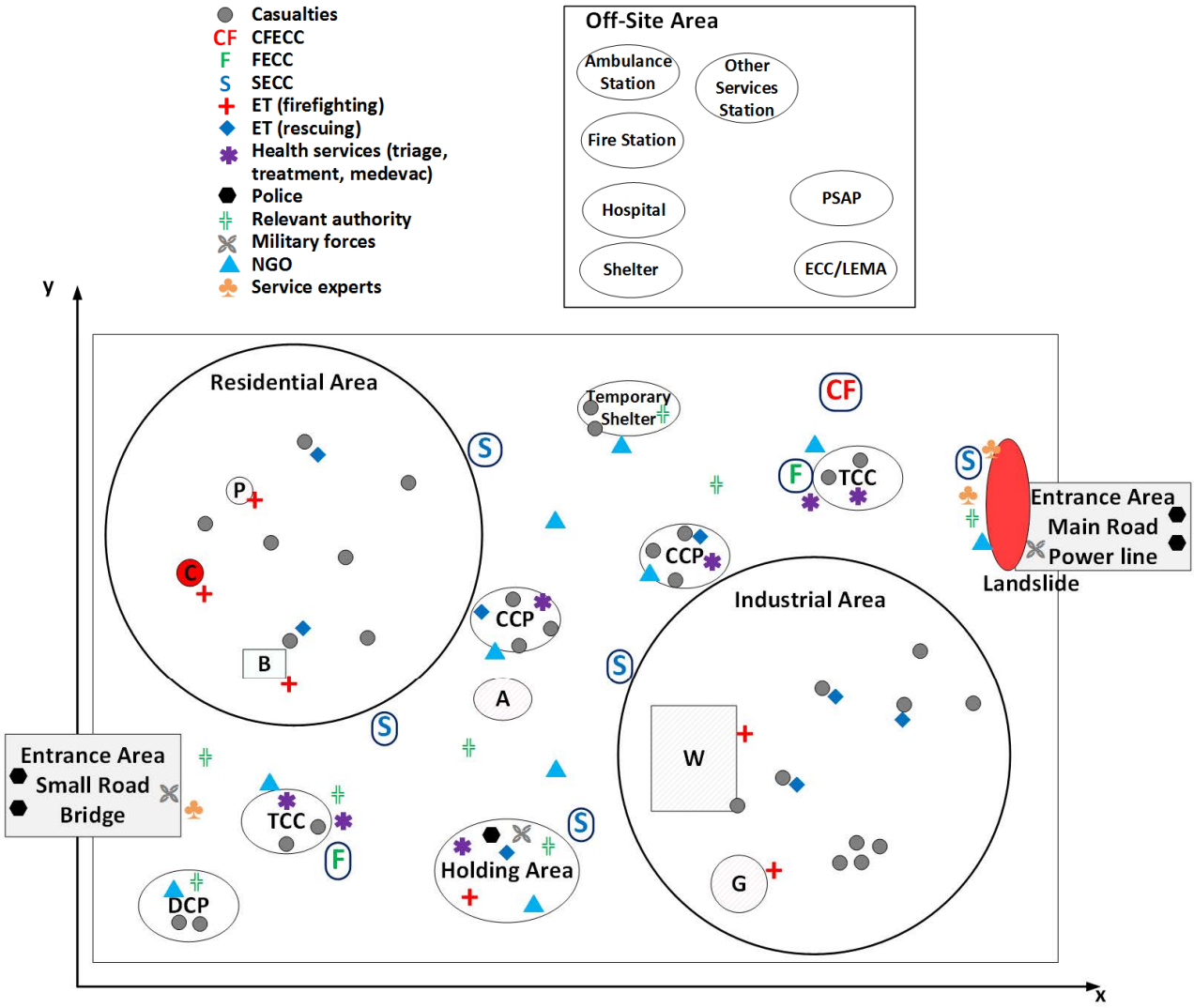

Figure 6.2: Snapshot of the EQ incident area (mid-term)

6.3 Model specification

6.3.1 Scenario quantities

This clause specifies the topology of the actors and physical locations involved, together with their properties and parameters.

An implementation of the reference topology of this type of event shall conform to the following model, made of a set of tables and illustrations. It is specified here in a top down approach, focussing first on the scenario quantities, which are expressed as mean values and define the size of the event in table 6.1. Tables 6.2 and 6.3 specify the different locations associated with the event and, when applicable, the requirements of their position, while table 6.4 provides the global properties of the actors involved, based on the list in clause 4.3, associated as well to the requirements on their position and mobility.

Table 6.1: Scenario quantities

Parameter	Value
Size of incident area	12 km x 15 km
Modelling geometry (distances, etc.)	See figure 4.1 in clause 4.2.1
Total number of casualties	Sector A: 1 750 individuals unaccounted Sector B: 1 500 individuals unaccounted
Casualties in need of treatment and medical evacuation	Sector A: 192 Sector B: 280
Casualties in need of on-site treatment and (nonmedical) evacuation	Sector A: 389 Sector B 513
Casualties in need of (nonmedical) evacuation	Sector A: 1 110 Sector B: 661
Casualties deceased	Sector A: 59 Sector B: 31
Number of fire-fighting teams (including NGOs)	300
Number of rescue teams (including NGOs)	150
Number of health services teams (including NGOs)	200
Number of medical evacuation transport vehicles (including NGOs)	98
Number of relevant authority teams	360
Number of NGO teams	81
Number of NGO evacuation transport vehicles	65
Number of police teams	100
Number of CFECCs	1
Number of FECCs	5
Number of SECCs	50
Number of military forces teams	360
Number of Utilities (power, water, telecom) teams	130
Number of Roads departments and experts teams	135

6.3.2 Locations

6.3.2.1 On-site

Table 6.2: On-site locations

Location	Requirements on position	Time-variant parameters	Time-invariant parameters
Hazard area(s)	Inside incident area. made of residential and industrial areas. For simplicity, stationary hazard areas are considered only	n/a	Centre coordinates, size
CCP	Outside hazard area, inside incident area	Number, centre coordinates	Size
TCC	Outside hazard area, inside incident area. May be merged with CCP. Location typically between CCP and exit road	Number, capacity	Centre coordinates, size
Temporary Shelter(s)	Outside hazard area, inside incident area.	Number, capacity	Centre coordinates, size
Holding area(s)	Outside hazard area, inside incident area	Number, capacity	Centre coordinates
Disrupted infrastructure(s)	Inside incident area E.g. roads, bridges, power, water supply, sanitation, telecom networks, etc.	Number	Coordinates, time needed to recover
Deceased Collection Point(s)	Outside hazard area, inside incident area	Number, capacity	Coordinates, size
Fire	Inside hazard area	Number	Coordinates, size

6.3.2.2 Off-site

Table 6.3: Off-site locations

Location	Notes	Time-variant parameters	Time-invariant parameters
Ambulance station(s)	There is an ambulance station on-site (partially destroyed)	Journey time to incident area (CCP, TCC, holding area)	Capacity (number of teams / ambulances available)
Fire station(s)		Journey time to incident area (hazard area, holding area(s))	Capacity (number of teams / fire engines available)
Hospital(s)		Journey time from/to incident area (CCP, TCC, holding area), capacity	Number
Shelter(s)		Journey time from/to incident area (interim shelter, holding area), capacity	Number
LEMA/ECC	For communication only	n/a	n/a
Other services stations (e.g. NGOs, military, infrastructure, companies, etc.)		Journey time from/to incident area (holding area(s), disrupted infrastructure(s))	Number

6.3.3 On-site actors

On-site actors and their properties are listed in table 6.4. The notation for the topology properties are as follows:

/P: Position

/M: Mobility

/B: Start condition

/MT: Mid-term step

/E: Stop condition

Table 6.4: On-site actors

Actor	Requirements on position and mobility	Requirements on behaviour and presence on site (start / mid-term, stop)	Other parameters - Additional description - Number (size of the group)
Casualties	/P: In hazard area initially. /M: Mobility from hazard area only with an emergency team (ET). Then mobility out of incident area only with an evacuation team.	/B: in hazard area /MT: arrival of first rescue team /E: When transported to hospital or shelter	Do not take part in the response actions - Number - Rescue Time
Site management (CFECC)	/P: In incident area /M: Static	/B: 1st alert to PSAP /MT: Set-up completed /E: End of disaster handling	Size of the group
Service Management (FECC)	/P: in incident area (CCP and TCC) /M: Static	/B: Arrival on site /MT: Set-up completed /E: Supported action completed	Number of teams
SubService Management (SECC)	/P: in incident are (close to Hazard area) /M: Static	/B: Arrival on site /MT: Set-up completed /E: Supported action completed	Number of teams
Fire-fighting team	/P: In hazard area /M: Moving in vicinity of fires	/B: Arrival on site /MT: reporting from fire and rescue actions /E: All fires stopped	Number of teams, size of the group (may be transferred to other tasks after completing fire and rescue actions)

Actor	Requirements on position and mobility	Requirements on behaviour and presence on site (start / mid-term, stop)	Other parameters - Additional description - Number (size of the group)
Rescue team	/P: In hazard area /M: Moving in a grid pattern in hazard area /M: Moving between hazard area and CCP	/B: Arrival on site /MT: reporting from fire and rescue actions /E: All individuals rescued from hazard area	Number of teams, size of the group (may be transferred to other tasks after completing fire and rescue actions)
Triage at CCP (part of health services)	/P: In incident area: CCP /M: static	/B: Arrival on site /MT: reception of 1st casualty from ET Rescue /E: all casualties assessed and registered	Number of groups / teams, Size of groups
Treatment at TCC (part of health services)	/P: In incident area /M: between CCP and TCC	/B: Arrival on site /MT: reception of 1st casualty from CCP /E: all casualties treated and evacuated	Number of groups / teams, Size of groups
Medical evacuation	/P: Inside and outside incident area /M: between TCC and hospital	/B: Arrival on site /MT: reception of 1st casualty to transport /E: all casualties medically evacuated	Number of medevac vehicles Transport capacity per vehicle Type of vehicle (land-based vs. air-borne)
Temporary shelter personnel (including NGOs)	/P: In incident area /M: between CCP and temporary shelter for taking care of casualties type 2 and 3	/B: Arrival on site /MT: reception of 1st casualty from CCP /E: all casualties evacuated	Number of groups / teams, Size of groups
Evacuation	/P: Inside and outside incident area /M: between temporary shelter and off-site shelter	/B: Arrival on site /MT: 1st group of casualties ready to be evacuated /E: all casualties evacuated	Number of transport vehicles Transport capacity per vehicle
Police	/P: In incident area /M: Mobility independent of victims	/B: 1st alert to PSAP /E: End of disaster handling	
Utilities (power, water, telecom)	/P: in incident area /M: Mobility independent of casualties	/B: arrival on site /E: temporary repair completed	Number of groups, size of groups
Relevant authority/ NGO	/P: in incident area /M: Movement same as the actor they support, including in FECC and SECC during ramp-up for helping at their installation	/B: arrival on site /E: All assistance actions completed (water & food, power, temporary shelters)	Number of groups, size of groups, supported actor when relevant
Military forces	Idem Police	Idem Police	Idem Police
Provision providers (including NGOs)	/P: in incident area /M: Mobility independent of casualties	/B: arrival on site /E: End of disaster handling	Number of groups, size of groups
Non-emergency service experts and professionals	/P: in incident area, close to disrupted infrastructure: EQ: landslide, small bridge /M: Static	/B: When problems are reported by site management /E: When reparative actions are initiated	Number of groups, size of groups
		/B: Assessment completed /E: temporary repair completed	

Annex E contains a more detailed description of each actor, together with the mathematical parameters and pseudo-code required to implement the model.

Annex A (informative): Major recent earthquakes

Table A.1: Data for Major Recent Earthquakes

Date	Country	Place	Mag	People				Buildings		Cost
				Killed	Injured	Affected ('000s)	Homeless ('000s)	Demo-lished	damaged	MEuro
Europe										
20/05/2012	Italy	Emilia	6	24	350	25	20			15 800+
11/05/2011	Spain	Lorca	5,3	10	167	15				200
06/04/2009	Italy	L'Aquila	6,3	295	1 600	56	50		10 000	2 500
07/09/1999	Greece	Athens	5,9	143		115		2 700	35 000	4 200
Outside Europe										
11/03/2011	Japan	Honshu	9	20 000		370				210 000
12/01/2010	Haiti	Haiti	7	222 500		3 700		105 000	188 383	8 000
30/09/2009	Indonesia	Padang	7,5	1 200		2 500				2 200
12/05/2008	China	Eastern Sichuan	7,9	87 500		4 600				85 000

Sources: EMDAT, USGS.

Annex B (informative): Detailed scenario definition

This annex provides a detailed description of the scenario, which forms the basis for the modelling, described in clause 6.

The incident area is shown in figure 4.1.

Incident area: An area of 12 km x 15 km in a city of 350 000 inhabitants. The area is isolated; the main road access is damaged by a landslide (see sector C below). In addition to the main road, there is a smaller road crossing a bridge (see sector D below).

There is one high voltage cable to the area; water supply is via underground pipes from a lake outside the incident area.

None of the emergency services have ECCs within the incident area, but there is an ambulance station based at D.

Sector A (domestic/ shopping area):

- In the north-western part of the incident area.
- Totally or partly collapsed buildings:
  - School, enrolment 350, staff 100.
  - 7 blocks of flats, totally 140 flats, approximately 480 persons live there. Not known how many who were at home at the time of the EQ.
  - 45 bungalows, approximately 240 persons live there.
  - Shopping centre consisting of 15 small and large enterprises, total staff 240, number of customers present not known but estimated to around 500. Three is a fire covering an area of 1 department store.
- Specific risks:
  - 1 petrol station is partly damaged, it has tanks of diesel, petrol and LPG.

Sector B (industrial area):

- In the south eastern part of the city
- Totally or partly collapsed buildings:
  - 3 factory buildings (meat processing, clothes manufacturing, mechanical enterprise), totally 600 employees.
  - Bus garage/ workshop on fire. 45 employees, 25 buses with diesel tanks.
- Specific risks
  - Tanks containing gas. The status concerning leakage, etc. is not known.

Sector C: (Hillside, mainly farming area)

- The EQ has led to a landslide which has broken the power line supplying the incident area, and closed the main road leading into the incident area.

Sector D: (Secondary road, crossing a bridge)

- The EQ has led to structural damages on the bridge; it is initially unclear to what extent that has reduced the load carrying capacity. Landslide breaking the power-line and covering the road. No cars hit by the landslide, but the road is blocked.
- The bridge has minor damages from the EQ, uncertainty as to how this affects its load capacity.

Annex C (informative): Disaster response actions - timelines

C.1 Emergency management

0 min: Although located outside the affected area, the personnel on duty at the ECCs note the earthquake EQ. Operational staff is notified via pre-set procedures that they should be on the alert, and routine tasks (e.g. non-critical patient transports) be postponed till further notice.

3 min++: PSAP receives a high number of calls from the affected areas, the overall picture is unclear but information as it comes is continuously forwarded to the ECCs of the individual services.

20 min: SECC (health) consisting of 1 ambulance officer is established.

30 min: SECC (Fire) is established.

30 min: SECC (Police) is established.

30 min: SECC (Rescue) is established.

45 min: CFECC established.

55 min: A preliminary situation report (V) is submitted to authorities; procedures and links for communication to SECC are established. Updates and requests are made to authorities continuously for the next two hours.

60 min: Written situation report in accordance with premade plans is submitted to authorities, updated every hour for the first 24 hours.

90 min: Videoconference with authorities, pictures from scene submitted. Videoconference between members of CFECC and authorities planned for every 2 hours.

100 minutes: Preliminary report on needs for water/ sanitation/ food/ shelter is submitted to authorities.

115 minutes: Local "air traffic control" established, landing area for helicopter appointed. Ambulance helicopters are now arriving every 15 minutes, airlifting patients out of incident scene.

120 min: Generators and tents are brought in, are distributed between services and set up.

150 min: Plans for evacuation of non-injured casualties are set up, transport resources asked for.

3 hours: Situation report: No/ minor injuries: Not known, local treatment only 127, need for hospital treatment 235, dead 15.

4 hours: Food and water is brought in and distributed to the rescued and to the rescue teams. Supplies are to arrive every 3 hours, following specified requests from CFECC.

6 hours: Lists prepared on staff rotation, the responsibility for ensuring that so happens lies with the service EECs, but reports are made to CFECC.

9 hours: Situation report: No/ minor injuries approximately 600, local treatment 200, need for hospital treatment 300, not accounted for: not known.

10 hours: Re-enforcement from NGOs from outside the city, assisting in supplying water/ food.

C.2 Risk management and damage mitigation

C.2.1 Road access

25 min: Fire team reports on blocked main road, only light vehicles to be dispatched till further notice.

30 min: Request from Central Authorities to Roads Department to assess the capacity of the remaining bridge.

50 min: Assessment team on site, taking photos and submitting them to central roads department.

65 min: Conclusion: The weight limit raised to 12 tons, subject to traffic regulation (only one car at the time).

135 min: Reparative work on landslide initiated, but made difficult by risks of further landslides.

3 hours: 4 different areas identified as suited for landing for the helicopters involved.

8 hours: Work on landslide stopped as it gets dark and it is no longer possible to continuously assess the risk for further landslides.

19 hours: Work on landslide is started again. Assistance from defence forces engineers.

23 hours: Main road opened for limited traffic.

C.2.2 Assessment and handling of specific risks

30 min: Geologic Expertise requested.

90 min: Geologists arriving on scene, pictures to be submitted.

120 min: Conclusion, advise for reparative landslide work provided.

120 min: Specialist team (building surveyors, 12 officers) arrive on scene. They are distributed to sectors A and B to control and if necessary, take steps to make areas safe for rescue work. They communicate to central authorities (via CFECC) sending and receiving building plans and pictures.

5 hours: Surveyors have checked collapsed buildings, cleared 10 but decided that 4 blocks of flat and the primary school needs further work to be declared safe. Specialist workforce is requested via CFECC

C.2.3 Fire fighting

30 min: First team (4 persons) arrive on scene, reports to ECC, starts surveying the scene and reports continuously to ECC for the next hour. Pictures of the scene are sent to the ECC.

35 min: Fire trucks are dispatched to scene, but awaiting permission to cross the bridge.

40 min: Additional 8 officers arrive on scene; SECC is established and reported to ECC.

50 min: SECC is overloaded by survivors, police summoned to keep order.

65 min: 8 fire trucks with personnel (5 officers each) and equipment arrive on scene. 4 are deployed to sector A, the other 4 to sector B, where they start fire fighting.

70 min: A team of smoke divers (4 officers) arrive at sector A where they prepare for action, 2 of them have helmet cameras able to submit streaming video.

75 min: Part of the stricken area is declared safe. Reported to CFECC who reports to authorities.

80 min: A team of smoke divers (4 officers) is deployed to Sector B, 2 of them able to submit streaming video from helmet cameras.

80 min: Building plans for collapsed buildings are requested from central authorities.

6 hours: 12 fire trucks (5 officers each) from other services arrive and assist.

7 hours: Fires at sector A is terminated, all efforts now on search and rescue.

9 hours: Fire at sector B is terminated.

7 - 20 hours: Search and rescue activities continue throughout the night, but at a lower rate due to darkness.

23 hours: With the opening of the road, heavy equipment is brought in for securing buildings, etc.

C.2.4 Rescue

95 min: 10 SAR teams, each of 2 officers, are established and search is starting, 6 teams at sector A, 4 at sector B.

105 min: 15 casualties are evacuated and taken over by medical services.

120 min: Dead people are located.

2 hours 30 min: 80 volunteers from Red Cross arrive, and are set to work on SAR in sectors A and B.

3 hours: 6 teams (1 person and dog in each team) NGO) with rescue dogs arrive on scene and start their work in the areas so far declared safe.

C.2.5 Maintenance of public order

30 min: 2 officers arrive on scene; establish SECC, reports to ECC, requesting more resources.

45 min: Reports to CFECC.

50 min: Summoned to SECC F&R where a large group of people have gathered demanding assistance and information. Information is submitted continuously to CFEEC who submits the reports to the authorities every 30 minutes.

55 min: 10 more officers arrive on scene. SECC is established, teams of 2 officers start securing and patrolling the area. All officers connected by PMR. For the first 12 hours each officer is on the radio with the SECC at an average of 2 minutes per hour.

60 min: System for registration of casualties able to walk and report is set up.

75 min: 16 more officers arrive on scene. The area is cordoned off and patrolled. System for access control, registering who enters and leaves the area is established, information conveyed continuously to authorities via CFECC. Traffic control at bridge is established.

90 min+++: Congestion at the bridge (entry point), police make a priority list and officers are there to guide the traffic.

5 hours: Additionally 30 officers from neighbouring services arrive on scene.

7 hours: 120 officers from national services arrive on scene.

C.2.6 Provisions

C.2.6.1 Power supply restoration

120 min: First generators are brought in, more are requested for. Generators are supplied by the power corporation.

180 min: System for regular supply of fuel for generators established, dedicated personnel responsible for maintaining control and ensuring that they are in working order.

4 hours: More generators and lighting equipment arrives from outside the city.

5 hours: Mapping of damages completed and reported via CFECC to power provider.

24 hours: Staff and equipment in place, start working on emergency supply to most critical areas.

27 hours: Limited power supply available.

C.2.6.2 Water, food and sanitation

To provide safe water supply and food is a priority.

90 min: Request made as part of the regular videoconference between CFECC and authorities.

4 hours: The first truck loaded with the equipment arrives at the bridge, and receives a description from CFECC as to where the supplies are to be unloaded.

7 hours +++: Continuous supplies and emptying of latrines is on-going, continuous reporting to CFECC.

C.2.6.3 Telecommunication

120 minutes: Repair teams from Telecom providers arrive in the incident area, temporary repair initiated.

32 hours: Public telephone systems restored.

C.3 Casualty logistics

C.3.1 Treatment and medical evacuation

0 min: Ambulance station hit by EQ. Garage broken down, 1 out of 2 vehicles rendered inoperative.

13 min: Preliminary assessment made, officer reports to ECC, requesting resources.

15 min: ECC health notifies other ECCs, emergency services resources dispatched to incident scene.

30 min: Ambulance helicopter arrives on scene. Before landing it surveys the stricken area, submitting streaming video to ECC health.

40 min: 3 more ambulances (6 officers) arrive on scene and are distributed to sectors A and B.

45 min: 4 Trailers with emergency medical equipment dispatched, waiting at bridge.

45 min: Reports to CFECC, locations for triage/ treatment are established, and treatment started. Medical services overloaded, repeat request for more resources.

60 min: Continuous reporting to CFECC (Numbers and names of patients).

70 min: 2 hospital teams (8 officers each) and leader SECC are brought in by ambulance helicopter, starts working with the injured.

75 min: Ambulance manager and First aid manager are appointed, report continuously to SECC.

90 min: Another 4 helicopters are brought in and continue airlifting patients to hospital.

120 min: Direct communication link between treatment area and hospital is set up (V+D). The local hospital is overloaded; plans for further evacuation are made, and system for reporting of patients from the Incident Scene is established in collaboration with CFECC.

3 -5 hours: 10 ambulance teams from other hospitals arrive on scene, medical evacuation continues by road and by air.

7 - 20 hours: Patients continue to be brought in.

22 hours: The number of patients being brought in is now lower than the day before, but the patients who do come, tend to have more serious injuries. Consultations with hospitals, both local and specialized, are done via Video conferencing.

C.3.2 Temporary shelter and evacuation

65 min: Team from coordination entity (Relevant authority/ NGO) arrives and sets up centre for registration of casualties.

65 min: Request for transport is forward via CFECC to authorities.

90 min: Need for shelters is discussed in videoconference, supplied by written report. LEMA forward the request to defence force and NGOs.

2 hours+++: Registration and evacuation is on-going, continuous reporting made to CFECC who forward the reports to LEMA.

150 min: Small vehicles arrive and start evacuation.

3 hours: An inventory of available tents/ personnel to set them up and possible times of arrival are received by CFECC, plans made for deployment within incident area.

5-18 hours: Tents, supplied by Relevant Authority/ NGO arrive and are set up by officers from the two entities.

Annex D (informative): Modelling specification of objects, parameters and behaviour

D.1 Modelling assumptions

In order to model the complex disaster scenarios several assumptions and simplifications have to be made. Especially details that concern the response of the emergency teams are simplified in order to limit the complexity.

Several remarks on the modelling specification:

1) Details on scenario quantities (SQ) and locations can be found in clause 6 "Topology Model".

2) The CCPs are assumed to be static even though in reality CCPs might appear/be cleared/move over time.

3) The emergency services are split into divisions consisting of emergency teams (ET) that fulfil specific tasks even though in a real life scenario the same teams might be able to fulfil different tasks. The latter can be modelled by transforming an ET that fulfilled its task into another ET.

4) The casualties are of static type, even though in reality casualties' conditions might change over time. The types are as described in clause 6.1.

5) The rescue and treatment of casualties is in random order, not prioritized as it would be in reality to provide quick help to the ones who need it the most urgent.

6) Fires that are not taken care of will not grow bigger as they would in reality.

7) Everything that leaves the incident area can be considered at an off-site location. Distances between off-site and on-site as well as between off-site and off-site locations only reflected in time variables.

8) For all parameters default values and ranges are provided that can also depend on the scenario. For other scenario settings they should be adjusted accordingly.

9) The emergency teams for temporary shelter, provisions and evacuation are staffed by personnel from the relevant authority and NGOs, even though in some countries they will be staffed by health services personnel or military forces.

In the following paragraphs, clause D.2 describes the behaviour of the model during the execution of the scenario, including its initialization and the ramp-down towards the end of incident handling. Details on the different timers can be found in clause D.3, and on the different locations and actors in clause D.4.

D.2 Pseudo-code describing the model behaviour

D.2.1 Pseudo-code describing the initialization of the model including placement of locations

1) Instantiate incident area according to size in Scenario Quantities (SQ).

2) Instantiate location(s) of the hazard areas according to SQ.

3) According to SQ place fires inside the hazard area(s).

4) According to SQ place disrupted infrastructure at the border of incident area.

5) According to SQ place casualties inside the hazard/incident area(s). For the EQ scenario, the local distributions e used is a 2-dimensional Gaussian distribution with mean at the centre of the hazard area and standard deviation of 0,5 average radiuses of the hazard area (that means that about 95 % of casualties end up inside the hazard area).

6) Place CCP(s).

7) Place (one or multiple) TCC(s) close to the hazard area(s).

8) Place (one or multiple) TS(s) close to the hazard area(s).

9) Place holding area.

10) Place DCP.

D.2.2 Pseudo code describing the mobility and sequential actions of the respective actors

Casualties

1) (Casualties are instantiated and positioned in step 5 of initialization, mainly inside the hazard area)

2) Cooperate with emergency teams (passive role)

CFECC

1) When receiving alert, wait CFECC.responseTime, enter the incident area.

2) Take position in incident area (outside hazard area).

Further behaviour is not modelled. Usually the FECC is a central communication source and sink with SECCs, FECCs and all other emergency teams as well as individual experts (e.g. site incident officers) as partners.

FECC

1) When receiving alert, wait FECC.responseTime, enter the incident area.

2) Take position in incident area (outside hazard area).

Further behaviour is not modelled. Usually the FECC is a central communication source and sink with SECCs, CFECC and possibly individual teams as partners.

SECC

1) When receiving alert, wait SECC.responseTime, enter the incident area.

2) Take position in incident area (outside hazard area).

Further behaviour is not modelled. Usually the SECC is a central communication source and sink with FECC and possibly individual teams as partners.

Firefighting

1) When receiving alert, wait Firefighting.responseTime, enter the incident area.

2) If SECC/FECC/CFECC is not in place, go to point 4, else move to holding area.

3) Wait Firefighting.dispatchingTime until dispatched.

4) Enter hazard area (position defined by a random mathematical statistical formula, close to fire).

5) Wait Firefighting.fireTime until fire is extinguished (represents the fire-fighting action).

6) Move to holding area.

7) Wait Firefighting.reportingTime until report finished.

8) Transform into another type of actor (e.g. Rescuing).

Rescuing

1) When receiving alert, wait Rescuing.responseTime, enter the incident area.

2) If SECC/FECC/CFECC is not in place, go to point 4, else move to holding area.

3) Wait Rescuing.dispatchingTime until dispatched.

4) Enter hazard area and move to casualty (random choice).

5) Wait Rescuing.rescuingTime until a casualty is ready to be transported (representing the search and rescue time).

6) Bring casualty to closest CCP.

7) Wait Rescuing.handoverTime + Rescuing.reportingTime until report finished (same time parameter as for Firefighting, defined as a random function).

8) If still casualties in hazard area, go back to point 4, else move to holding area and transform into another type of actor.

Triaging

1) When receiving alert, wait Triaging.responseTime, enter the incident area.

2) If SECC/FECC/CFECC is not in place, go to point 4, else move to holding area.

3) Wait Triaging.dispatchingTime until dispatched.

4) Move to selected CCP (i.e., with the smallest number of teams; if multiple ones with smallest number of teams, choose randomly between them).

5) If casualty is available, wait Triaging.triageTime until casualty has passed triage (=waiting time representing the triage and basic treatment, defined as random function).

6) Move casualty according to its type and wait Triaging.handoverTime.

   if casualty.type=1 or 2, bring casualty to closest TCC.

   if casualty.type=3, bring casualty to closest TS with TS.numberCasualties<TS.capacity.

   if casualty.type=4, bring casualty to DCP.

7) Return to CCP.

8) Wait Triaging.reportingTime until report finished, go to 5.

9) When no more casualties available, move to holding area and transform into another type of actor.

Treatment

1) When receiving alert, wait Treatment.responseTime, enter the incident area.

2) If SECC/FECC/CFECC is not in place, go to point 4, else move to holding area.

3) Wait Treatment.dispatchingTime until dispatched.

4) Move to selected TCC (i.e. with the smallest number of teams; if multiple ones with smallest number of teams, choose randomly between them).

5) If casualty is available, wait Treatment.treatmentTime (representing the treatment and documentation).

6) Move casualty according to its type and wait Treatment.handoverTime.

   if casualty.type=1, request medevac at holding area, wait for pick-up by Medevac.

   if casualty.type=2, bring casualty to closest TS with TS.numberCasualties<TS.capacity, return to TCC.

7) Wait Treatment.reportingTime until report finished, go back to point 5.

Medevac

1) When receiving alert, wait Medevac.responseTime, enter the incident area.
2) Move to holding area.
3) Wait until request for medevac from a TCC is available, then go to 4.
4) Move to TCC to pick up a casualty.
5) Wait Medevac.handoverTime.
6) Bring casualty to hospital (off-site).
7) If Hospitals.numberCasualties<Hospitals.capacity.

   Wait Medevac.medevacTime until back from hospital.

   Else.

   Wait Medevac.medevacTimeRemote until back from hospital.

   (accounting for the driving time of return trip according to TCC's time to hospital + handover time at hospital).
8) Wait Medevac.reportingTime until report finished, go back to point 2.

TempShelter

1) When receiving alert, wait TempShelter.responseTime, enter the incident area.
2) If SECC/FECC/CFECC is not in place, go to point 4, else move to holding area.
3) Wait TempShelter.dispatchingTime until dispatched.
4) Move to selected TS (i.e., with the smallest number of teams; if multiple ones with smallest number of teams, choose randomly between them).
5) Wait until sufficient number of casualties for transport is reached (TS.numberCasualties > Evacuation.capacity.
6) Request Evacuation at holding area.
7) When Evacuation arrived, wait (TempShelter.handoverTime x number of casualties evacuated) until task is finished.
8) Wait TempShelter.reportingTime until report finished.
9) Go back to point 5.

Evacuation

1) When receiving alert, wait Evacuation.responseTime, enter the incident area.
2) Move to holding area.
3) Wait until request for Evacuation from a TS is available, then go to 4.
4) Move to TS to pick up casualties.
5) Wait Evacuation.handoverTime x number of casualties evacuated.
6) Bring casualties to shelter (off-site).
7) If Shelters.numberCasualties<Shelters.capacity.

   Wait Evacuation.evacuationTime until back from shelter.

   Else.

Wait Evacuation.evacuationTimeRemote until back from shelter.

(accounting for the driving time of return trip according to TS's time to shelter + handover time at shelter).

8) Wait Evacuation.reportingTime until report finished.

9) Go back to point 2.

NOTE: The evacuation is not necessarily carried out by emergency relief personnel, this is just an assumption. Also it is safe to assume that most if not all of the evacuation teams will consist of teams that originate from "relevant authority/NGO", see below.

Provisions

1) When receiving alert, wait Provisions.responseTime, enter the incident area.

2) If SECC/FECC/CFECC is not in place, go to point 4, else move to holding area.

3) Wait Provisions.dispatchingTime until dispatched.

4) Move around randomly in the incident area, outside of hazard area (this accounts for handing out provisions at different places).

Police

1) When receiving alert, wait Police.responseTime, enter the incident area.

2) If SECC/FECC/CFECC is not in place, go to point 4, else move to holding area.

3) Wait Police.dispatchingTime until dispatched.

4) Move around randomly in the incident area (outside of hazard area).

Utilities/Experts

The modeling of the utilities depends highly on the level of detail that is to be achieved. Basically the same structure of response can be assumed (shown here for a Utilities team):

1) When receiving alert, wait Utilities.responseTime, enter the incident area.

2) Go to location where technical work or expertise is required.

3) Wait Utilities.repairTime (accounting for the time that is needed to carry out the assessment or to repair the specific problem).

4) Wait Utilities.reportingTime reporting time.

5) If another problem persists, go to next problem.

When no specific problems exist, Utilities/Experts move around within the incident area in an arbitrary way to account for support they provide, that is not specifically modelled.

Relevant authority/NGO and Military

As different countries have different structures for disaster relief it is impossible to model the relevant authority personnel as well as the NGOs and the military in a correct manner, however it is safe to assume that the teams will support the other emergency teams. The NGOs that support the emergency teams are already included in their respective values in the SQ. The rest of the NGO teams is assumed to take care of the temporary shelters and evacuations. It is advised to model the relevant authority /military teams by splitting them up and treat them as emergency teams or to let them move in the incident area in an arbitrary way to account for unspecified support they provide.

D.2.3 Pseudo code describing the end of the incident and "ramp down"

For every actor an "end of mission" has been defined in clause 6.

After the end of mission of an actor has been reached (e.g. no fires in hazard area for Firefighting) the teams can go on and help other teams (e.g. Firefighting goes to next hazard area with active fires or becomes Rescuing and helps the other teams, etc.).

Details of this behaviour are left open as a degree of freedom for the implementation.

Generally, the scenario simulation is considered finished when all casualties have been transported off-site as the main focus is on the immediate disaster relief. Optionally the "end of mission" for every single actor can be considered and thus the simulation end can be prolonged.

D.3 Modelling action/time parameters

The topology model describes the movement of the different response actors inside the incident area and off-site.

To model actions that do not imply any movement, waiting timers are used. The next table describes the different actions / timers introduced in the modelling of the scenarios. When such an action occur, the value is calculated using a Gaussian process (also called normal distribution) with mean and standard deviation values as defined in the table. It is re-evaluated when the next iteration of a task starts.

Table D.1

Action/ Timer	Description	Typical mean value	Typical standard deviation
Toff	Time that is needed to reach one of the off-site locations in the vicinity of the incident area access. For simplification of the model, the same timer is used for both hospitals and off-site shelters	μToff (before access cleared) = 30 min (after access cleared) = 20 min	σToff (before access cleared) = 10 min (after access cleared) = 5 min
ToffRemote	Time that is needed to reach one of the remote off-site locations from the incident area access. For simplification of the model, the same timer is used for both remote hospitals and remote off-site shelters	μToffRemote (before access cleared) = 75 min (after access cleared) = 60 min	σToffRemote (before access cleared) = 30 min (after access cleared) = 20 min
Thold	Time that is needed between one of the neighbour off-site locations (fire station, ambulance station, other service station, hospital, shelter) and the holding area	μThold (before access cleared) = 30 min (after access cleared) = 20 min	σThold (before access cleared) = 10 min (after access cleared) = 5 min
TholdRemote	Time that is needed between one of the remote off-site locations (remote: fire station, ambulance station, other service station, hospital, shelter) and the holding area	μTholdRemote (before access cleared) = 65 min (after access cleared) = 55 min	σTholdRemote (before access cleared) = 30 min (after access cleared) = 20 min
Tresp	Time that is needed after the alerting until the team arrives at the incident area	See table D.2	See table D.2
Tdispatch	Time that is needed to be dispatched from the holding area	μTdispatch = 15 min	σTdispatch = 5 min
Tfire	Time that is needed to extinguish the fire by one team	μTfire = 5h	σTfire = 1 h
Trescue	Time that is needed to rescue a trapped casualty	μTrescue = 30 min	σTrescue = 10 min
Ttriage	Time that is needed for triage of a casualty as well as immediate first aid	μTtriage = 2 min	σTtriage = 1 min
Ttreat	Time that is needed for health treatment of a casualty at the TCC	μTtreat = 15 min	σTtreat = 5 min
Thandover	Time that is needed for handing over a casualty	μThandover = 1min	σThandover = 0.5 min
Treport	Time that is needed for reporting after a task has finished	μTreport = 1min	σTreport = 0.5 min
Tdisrupt	Time that is needed to carry out the assessment of a disruption in infrastructure or to repair the specific problem	μTdisrupt = individual value per disruption, from min to hours	σTdisrupt = individual value per disruption, from min to hours

The modelling of the response time requires however further refinements according to the related actors, as described in table D.2.

Table D.2

Team	Typical mean value	Typical standard deviation
Emergency control structures (CFECC, FECC, SECC)	μTresp = 30 min	σTresp = 15 min
Fire-fighting and Rescue: sum of three Gaussian processes representing the different waves of arrivals, i.e. early stage, local region, neighbouring or remote regions (for EQ only)	μTresp (1) = 15 min (2) = 180 min (3) = 4 h	σTresp (1) = 10 min (2) = 30 min (3) = 60 min
Health services (triage, treatment, medevac): sum of three Gaussian processes representing the different waves of arrivals, i.e. early stage, local region, neighbouring or remote regions (for EQ only)	μTresp (1) = 15 min (2) = 70 min (3) = 4 h	σTresp (1) = 10 min (2) = 30 min (3) = 60 min
Police	μTresp = 30 min	σTresp = 10 min
Utilities	μTresp = 3 h	σTresp = 30 min
Relevant authority, Military forces, Non-emergency service experts and professionals	μTresp = 3 h	σTresp = 60 min

D.4 Objects and their parameters

D.4.1 Locations on-site

Table D.3

Object Name/ Parameter Name	Description	Default Value/ Range/ Dependencies
HazardArea	**Hazard Area**	**Number defined by SQ**
x_Pos	Centre position in X direction	Incident area, defined by SQ
y_Pos	Centre position in Y direction	Incident area, defined by SQ
shape	Approximate shape of the hazard area	Rectangular or circular, defined by SQ
radius	Radius of the hazard area (circular shape)	Initialization parameter, defined by SQ
length	Length of the hazard area (rectangular shape)	Initialization parameter, defined by SQ
width	Width of the hazard area (rectangular shape)	Initialization parameter, defined by SQ
rotation	Rotation of the hazard area in degrees (rectangular shape)	0-360, defined by SQ
numberCasualties	Number of casualties (all four types)	Decreasing from initial value to 0, defined by SQ
CCP	**Casualty Collection Point**	**At least one per hazard area**
x_Pos	Centre position in X direction	Incident area not in but close to hazard area, defined by SQ
y_Pos	Centre position in Y direction	Incident area not in but close to hazard area, defined by SQ
numberCasualties	Number of casualties currently at the CCP	Varying along the scenario initial and final values = 0, in between, value <= capacity
TCC	**Temporary Care Centre**	**At least one per hazard area**
x_Pos	Centre position in X direction	Incident area not hazard area, defined by SQ
y_Pos	Centre position in Y direction	Incident area not hazard area, defined by SQ
numberCasualties	Number of casualties being treated or waiting for treatment in the TCC	Varying along the scenario initial and final values = 0, in between, value <= capacity
capacity	Maximum number of casualties that can be accepted in the TCC at the same time	4-50, default 8
TS	**Temporary Shelter**	**At least one per incident area**
x_Pos	Centre position in X direction	Incident area not hazard area, defined by SQ
y_Pos	Centre position in Y direction	Incident area not hazard area, defined by SQ

Object Name/ Parameter Name	Description	Default Value/ Range/ Dependencies
numberCasualties	Number of casualties (type 2 and 3) in the TS	Varying along the scenario initial and final values = 0, in between, value <= capacity
capacity	Maximum number of casualties (type 2 and 3) that can be accepted in the TS at the same time	E.g. 200
HoldingArea	**Holding Area**	**One per scenario**
x_Pos	Centre position in X direction	Incident area not hazard area, defined by SQ
y_Pos	Centre position in Y direction	Incident area not hazard area, defined by SQ
DisruptInfrastructure	**Disrupted Infrastructure**	**Number defined by SQ**
x_Pos	Centre position in X direction	Border of incident area, defined by SQ
y_Pos	Centre position in Y direction	Border of incident area, defined by SQ
DCP	**Deceased Collection Point**	**One per scenario**
x_Pos	Centre position in X direction	Incident area not hazard area, defined by SQ
y_Pos	Centre position in Y direction	Incident area not hazard area, defined by SQ
numberDeceased	Number of deceased, that have been brought to the DCP	Varying along the scenario initial value = 0 final value (total of all DCPs) = number of casualties deceased
Fire	**Fire**	**Number defined by SQ**
x_Pos	Centre position in X direction	Hazard area, defined by SQ
y_Pos	Centre position in Y Direction	Hazard area, defined by SQ

D.4.2 Locations off-site

Table D.4

Object Name/ Parameter Name	Description	Default Value/ Range/ Dependencies
AmbulanceStation	**Ambulance Station**	**No specific number modelled**
	No special parameters, here for completeness, relevant for communications (not modelled)	
FireStation	**Fire Station**	**No specific number modelled**
	No special parameters, here for completeness, relevant for communications (not modelled)	
LocalHospitals	**Hospitals that are situated close to the incident site**	**No specific number modelled**
numberCasualties	Number of casualties at the hospital	Changes during disaster response
treatmentCapacity	Maximum capacity of the local hospitals for casualties	80
RemoteHospitals	**Hospitals that are situated further away from the incident site**	**No specific number modelled**
numberCasualties	Number of casualties at the hospital	Changes during disaster response
LocalShelter	**Shelters that are situated close to the incident site**	**no specific number modelled**
numberCasualties	Number of casualties at the shelter	Changes during disaster response
capacity	Maximum capacity of the local shelters for casualties	500
RemoteShelters	**Shelter that are situated further away from the incident site**	**No specific number modelled**
numberCasualties	Number of casualties at the shelter	Changes during disaster response
LEMA	**LEMA/ECC**	**No specific number modelled**
	No special parameters, here for completeness, relevant for communications (not modelled)	

D.4.3 Actors

Table D.5

Object Name/ Parameter Name	Description	Default Value/ Range/ Dependencies
casualties	**Casualties**	Number defined by SQ
x_Pos	Position in X direction	Hazard area and incident area, defined by SQ
y_Pos	Position in Y direction	Hazard area and incident area, defined by SQ
type	1= requiring treatment and medevac 2= requiring minor treatment and evacuation 3= requiring no treatment but evacuation 4= deceased	Numbers provided according to SQ
CFECC	**Site Management CFECC**	Number defined by SQ
x_Pos	Position in X direction	Incident area not hazard area
y_Pos	Position in Y direction	Incident area not hazard area
responseTime	Instantiation of Tresp for the CFECC establishment	Result of the Gaussian process
FECC	**Service Management**	Number defined by SQ
x_Pos	Position in X direction	Incident area not hazard area
y_Pos	Position in Y direction	Incident area not hazard area
responseTime	Instantiation of Tresp for the FECC establishment	Result of the Gaussian process
SECC	**SubService Management**	Number defined by SQ
x_Pos	Position in X direction	Incident area not hazard area
y_Pos	Position in Y direction	Incident area not hazard area
responseTime	Instantiation of Tresp for the SECC establishment	Result of the Gaussian process
Firefighting	**ET fire-fighting**	Number obtained from SQ
x_Pos	Position in X direction	Incident area
y_Pos	Position in Y direction	Incident area
responseTime	Instantiation of Tresp for the ET fire-fighting arrival	Result of the sum of three Gaussian processes (see table D.2)
dispatchingTime	Instantiation of Tdispatch for the ET fire-fighting arrival	Result of the Gaussian process
fireTime	Instantiation of Tfire for the ET fire-fighting at the target fire	Result of the Gaussian process
reportingTime	Instantiation of Treport for the ET fire-fighting	Result of the Gaussian process
speed	Movement speed	4km/h
Rescuing	**ET rescue**	Number obtained from SQ
x_Pos	Position in X direction	Incident area
y_Pos	Position in Y direction	Incident area
responseTime	Instantiation of Tresp for the ET rescue arrival	Result of the sum of three Gaussian processes (see table D.2)
dispatchingTime	Instantiation of Tdispatch for the ET rescue	Result of the Gaussian process
rescuingTime	Instantiation of Trescue for the ET rescue and one target casualty	Result of the Gaussian process
handoverTime	Instantiation of Thandover for the ET rescue and one target casualty	Result of the Gaussian process
reportingTime	Instantiation of Treport for the ET rescue and one target casualty	Result of the Gaussian process
speedCasualty	Movement speed with casualty	E.g. 3 km/h
speed	Movement speed without casualty	E.g. 5 km/h
Triaging	**ET taking care of triage**	Number obtained from SQ (25 % of health services teams)
x_Pos	Position in X direction	Incident area not hazard area
y_Pos	Position in Y direction	Incident area not hazard area
responseTime	instantiation of Tresp for the ET triage arrival	result of the sum of three Gaussian processes (see table D.2)
dispatchingTime	instantiation of Tdispatch for the ET triage	result of the Gaussian process

Object Name/ Parameter Name	Description	Default Value/ Range/ Dependencies
triageTime	instantiation of Ttriage for the ET triage and one target casualty	result of the Gaussian process
handoverTime	instantiation of Thandover for the ET triage and one target casualty	result of the Gaussian process
reportingTime	instantiation of Treport for the ET triage and one target casualty	result of the Gaussian process
speedCasualty	Movement speed with casualty	e.g. 3 km/h
speed	Movement speed without casualty	e.g. 5 km/h
Treatment	**ET taking care of treatment**	Number obtained from SQ (75 % of health services teams)
x_Pos	Position in X direction	Incident area not hazard area
y_Pos	Position in Y direction	Incident area not hazard area
meanResponseTime	Mean of the Gaussian process that specifies the time that is needed after the alerting until the unit arrives at the incident area	
responseTime	instantiation of Tresp for the ET treatment arrival	result of the sum of three Gaussian processes (see table D.2)
dispatchingTime	instantiation of Tdispatch for the ET treatment	result of the Gaussian process
treatmentTime	instantiation of Ttreat for the ET treatment and one target casualty	result of the Gaussian process
handoverTime	instantiation of Thandover for the ET treatment and one target casualty	result of the Gaussian process
reportingTime	instantiation of Treport for the ET treatment and one target casualty	result of the Gaussian process
speedCasualty	Movement speed with casualty	e.g. 3 km/h
speed	Movement speed without casualty	e.g. 5 km/h
Medevac	**ET medical evacuation / Medical evacuation transport vehicles**	Number obtained from SQ (medevac vehicles)
x_Pos	Position in X direction	Incident area not hazard area
y_Pos	Position in Y direction	Incident area not hazard area
responseTime	instantiation of Tresp for the ET medevac arrival	result of the sum of three Gaussian processes (see table D.2)
handoverTime	instantiation of Thandover for the ET medevac and one target casualty	result of the Gaussian process
medevacTime	sum of: instantiation of Toff for the ET medevac and one target casualty + instantiation of Thandover for the ET medevac at the hospital + instantiation of Thold for the ET medevac to return to holding area	sum of the results of the Gaussian process
medevacTimeRemote	sum of: instantiation of ToffRemote for the ET medevac and one target casualty + instantiation of Thandover for the ET medevac at the hospital + instantiation of TholdRemote for the ET medevac to return to holding area	sum of the results of the Gaussian process
reportingTime	instantiation of Treport for the ET medevac	result of the Gaussian process
speed	Movement speed	e.g. 60 km/h
TempShelter	**Personnel operating the temporary shelter**	Number obtained from SQ (50 % of NGO teams)
x_Pos	Position in X direction	Incident area not hazard area
y_Pos	Position in Y direction	Incident area not hazard area
responseTime	instantiation of Tresp for the ET temporary shelter arrival	result of the Gaussian process
dispatchingTime	instantiation of Tdispatch for the ET temporary shelter	result of the Gaussian process
handoverTime	instantiation of Thandover for the ET temporary shelter and one target casualty	result of the Gaussian process
reportingTime	instantiation of Treport for the ET temporary shelter	result of the Gaussian process
speed	Movement speed	e.g. 4 km/h

Object Name/ Parameter Name	Description	Default Value/ Range/ Dependencies
Evacuation	**Vehicles including personnel taking care of evacuation**	Number obtained from SQ (evacuation vehicles)
x_Pos	Position in X direction	Incident area not hazard area
y_Pos	Position in Y direction	Incident area not hazard area
responseTime	instantiation of Tresp for the evacuation vehicles arrival	result of the Gaussian process
handoverTime	instantiation of Thandover for the evacuation of one target casualty	result of the Gaussian process
evacuationTime	sum of: instantiation of Toff for the evacuation of one group of target casualties + instantiation of Thandover (x number of casualties) for the evacuation at the shelter + instantiation of Thold for the evacuation vehicle to return to holding area	sum of the results of the Gaussian process
evacuationTimeRemote	sum of: instantiation of ToffRemote for the evacuation of one group of target casualties + instantiation of Thandover (x number of casualties) for the evacuation at the shelter + instantiation of TholdRemote for the evacuation vehicle to return to holding area	sum of the results of the Gaussian process
reportingTime	instantiation of Treport for the evacuation personnel after evacuating one group of casualties	result of the Gaussian process
speed	Movement speed	e.g. 30 km/h
capacity	Number of casualties that can be transported	8 - 50, default: 30
Provisions	**Personnel taking care of handing out provisions**	Number obtained from SQ (50 % of NGO teams)
x_Pos	Position in X direction	Incident area not hazard area
y_Pos	Position in Y direction	Incident area not hazard area
responseTime	instantiation of Tresp for the Provisions arrival	result of the Gaussian process
dispatchingTime	instantiation of Tdispatch for the Provisions	result of the Gaussian process
speed	Movement speed	e.g. 4 km/h
Police	**Police**	Number obtained from SQ
x_Pos	Position in X direction	Incident area not hazard area
y_Pos	Position in Y direction	Incident area not hazard area
responseTime	instantiation of Tresp for the police arrival	result of the Gaussian process
dispatchingTime	instantiation of Tdispatch for the police	result of the Gaussian process
speed	Movement speed	e.g. 4 km/h
Utilities	**Utilities**	Number obtained from SQ
x_Pos	Position in X direction	Incident area not hazard area
y_Pos	Position in Y direction	Incident area not hazard area
responseTime	instantiation of Tresp for the utilities team arrival	result of the Gaussian process
repairTime	instantiation of Tdisrupt for the utilities team on one disruption event	result of the Gaussian process
reportingTime	instantiation of Treport for the utilities team after completing one task	result of the Gaussian process
speed	Movement speed	e.g. 4 km/h
RelevantAuthority	**Relevant authority personnel**	Number defined by SQ
x_Pos	Position in X direction	Incident area not hazard area
y_Pos	Position in Y direction	Incident area not hazard area
responseTime	instantiation of Tresp for the relevant authority personnel / NGO team arrival	result of the Gaussian process
dispatchingTime	instantiation of Tdispatch for the relevant authority personnel / NGO team	result of the Gaussian process
reportingTime	instantiation of Treport for the relevant authority personnel / NGO team	result of the Gaussian process
Military	**Military Forces**	Number obtained from SQ
x_Pos	Position in X direction	Incident Area
y_Pos	Position in Y direction	Incident Area
responseTime	instantiation of Tresp for the military forces arrival	result of the Gaussian process
dispatchingTime	instantiation of Tdispatch for the military forces	result of the Gaussian process
reportingTime	instantiation of Treport for the military forces	result of the Gaussian process

Object Name/ Parameter Name	Description	Default Value/ Range/ Dependencies
Expert	**Non-Emergency service expert/professional or roads department**	Number obtained from SQ
x_Pos	Position in X direction	Incident area
y_Pos	Position in Y direction	Incident area
responseTime	instantiation of Tresp for the expert team arrival	result of the Gaussian process
repairTime	instantiation of Tdisrupt for the expert team on one disruption event	result of the Gaussian process
reportingTime	instantiation of Treport for the expert team after completing one task	result of the Gaussian process
speed	Movement speed	e.g. 4 km/h

History

Document history		
V1.1.1	May 2015	Publication