C2-SENSE – Pilot Scenario for Interoperability Testing in Command & Control Systems for Crises and Disaster Management: Apulia Example

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Abstract. Different organizations with their Command & Control (C2) and Sensing Systems have to cooperate and constantly exchange and share data and information in order to manage emergencies, crises and disasters. Although individual standards and specifications are usually adopted in C2 and Sensing Systems separately, there is no common, unified interoperability specification to be adopted in an emergency situation, which creates a crucial interoperability challenge for all the involved organizations. To address this challenge, we introduce a novel and practical profiling approach, which aims at achieving seamless interoperability of C2 and Sensing Systems in emergency management. At the end of this interoperability challenge a Pilot Application is set up and will be tested in the field to demonstrate the advantages resulting from this effort. This paper gives an overview about the involved entities in the pilot application scenario and the testing of the system functionality by using predefined micro-scenarios suitable for the pilot region in Apulia.

Keywords: Command and Control · Interoperability
Crises-, disaster- and emergency management

1 Introduction

C2-SENSE system is an environmental application for crises and disaster management. It allows alignment and cooperation between all entities involved in emergency management assuring interoperability between them. To address this challenge, C2-SENSE introduces a novel and practical profiling approach [1] that, unlike the conventional profiling approach, which addresses only the first three layers of the interoperability stack [2], involves all the layers of the communication stack in the security field. The work presented in this paper examines in particular the aspects relating to the testing of a pilot application in the region of Apulia (Italy) and the interfacing with information systems of local authorities.

2 C2-SENSE Overview

2.1 Profiling Approach for Interoperability

An innovative and technological solution to the mentioned problems is represented by profiles that allow you to improve the interoperability between the entities involved in emergency management. The C2-SENSE project develops a profile-based Interoperability Framework [1] by integrating existing standards and semantically enriched web services to expose the functionalities of Command & Control (C2) Systems and Sensing Systems involved in the prevention and management of disasters and emergency situations. In a typical C2-SENSE scenario, two main interoperability challenges need to be addressed: the vertical interoperability between Sensing and C2 Systems and the horizontal interoperability among different organizations involved in the prevention and governance of emergency situations. To address the challenge profiling is offered as a practical approach in achieving seamless interoperability by addressing all the layers of the communication stack in the security field. The profile concept aims to eliminate the need for a prior bilateral agreement between any two information exchange partners by defining a standard set of messages/documents, choreographies, business rules and constraints. The profile compliant partners are able to exchange information and services among themselves. This is in contrast to the bilateral agreements that have to be settled between partners for each new exchange partner. Considering the nature of emergency management, in which the responding organizations can change at run time (especially in an international intervention case), these generic profiles provide the needed coordination flexibility in order to deal with the unexpected circumstances and prevent chaotic response in a crisis situation.

3 Regional Involved Institutions/Organizations

In the following we will give a short overview about the most important organizations, authorities and institutions involved in the Pilot Scenario.

3.1 Prefecture

The prefecture of Foggia is the organization that represents the national government in the territory. It has the task of coordinating all the operations related to emergency management and decision-making at the highest level. During emergencies, it inter-acts with all the involved organizations, in particular with Civil Protection.

3.2 Provinces

The test takes place in the area of the Province of Foggia. In general the role of the province is critical in terms of methodological support and governance for local authorities. The improvements made by a modern information system for Civil Protection are important, as they allow local authorities in the Province of Foggia to prepare, adopt

and publish plans for Civil Protection that are fully integrated with the risk management process.

The C2-SENSE system will be able to ensure access and proper use of the functional system for all organizations involved in the province, providing all the information (static and dynamic) and visual support necessary to represent and describe the land, resources available and the population.

In summary, the information system will strengthen the operational structure of the Civil Protection of the Province of Foggia through an integrated system of information on risk scenarios to be developed and updated in "non-emergency periods". This system will be articulated according to various intervention models for the emergency management, in order to enable the timely response of the province, also in the management and coordination of resources (personnel, materials and means).

3.3   Municipalities

The municipalities involved in the tests of the pilot application (as described in Sect. 6) are belonging to the Province of Foggia which has several thousand inhabitants. According to the survey carried out at the beginning of the project, these municipalities replied that they currently do not have an electronic system for handling emergencies, thus we need to simulate these systems adequately.

3.4   Regional Civil Protection Department

The Civil Protection department has the task to be prepared and handle risk management in accordance with national guidelines.

It has a control system (SOIR) "Integrated Regional Control Room" that plays a major role in the coordination and management of emergencies, particularly for all risks affecting the Apulia region.

The SOIR is appointed to handle all the technical decisions, communications and control actions, and, as such, must ensure the continuity, activate procedures and count the occurrence of emergency situations, taking into account the received re-quests for assistance.

The CFD (Decentralized Functional Centre) monitors the area using specific pluvio-metric sensors installed in the Region.

3.5   Voluntary Associations

The high number of criticalities following an event requires a huge deployment of volunteer forces across the entire region.

The activation of voluntary associations is carried out by the SOIR. The business activities of the volunteers associations are shared with CFD (Civil Protection) and are related to sensor monitoring tasks on the territory and collaboration during emergency situation.

3.6 Fire Brigade

The Fire Brigade from 2011 adopts the CAP Profile, a simple and flexible format for the exchange of digital data, open and non-proprietary, for the collection and distribution of notifications and emergency alerts. All Entities/Organizations will be equipped with instruments for standardized data exchange with the operating rooms.

4 Stakeholders Interactions

4.1 Roles for Emergency Management

The entities and their roles involved in an emergency or crises event are different and heterogeneous. The envisaged flood emergency scenario involves multiple organizations having different roles and providing different services (e.g. police, medical care, rescue forces, fire fighters, etc.) and interacting vertically (i.e. with components of the same organization).

Figure 1 shows the institutions and actors involved in emergency situations and illustrates the role of the parties involved as described above. Analyzing this figure shows that the Prefecture has a central role. It is the party that coordinates the operations of emergency management. Furthermore, the Civil Protection plays a key role as it handles operations between SOIR and CFDs.
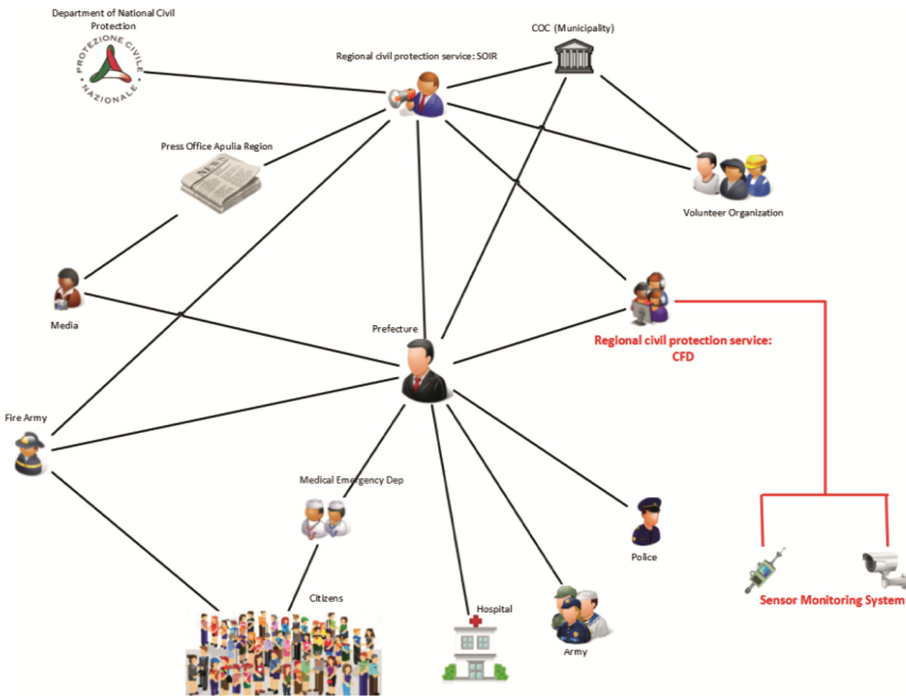

Fig. 1. Institutions and actors involved in emergency situations

A CFD in particular retrieves important information like rainfall data directly from the sensor system within the region. Finally an increasingly important role is played by citizens. In fact, they become participants in a triple role: first, an active role to inform the organizations responsible when an emergency situation occurs; second, a passive role, which allows them to be informed in real time following the occurrence of an emergency situation in their area, and third, the possibility of being easily located on the territory and therefore being properly tasked or informed in case they are needed.

Actually most of the communication is done by phone or fax which of course is highly error prone in crisis situations and not state of the art anymore. Existing plans or organizational information is outdated or invalid this can quickly lead to confusion and wrong decisions. C2-SENSE system intends to overcome this unsatisfying situation and provide interoperable means (e.g. tools, adapters, applications) to the stakeholders involved in the Pilot Scenario.

Interoperability is important because it enables different components to work together across organizational and system boundaries. The ability representing the system as a set of components and to combine the various components is essential for the construction of complex systems. Without interoperability this becomes almost impossible - as in the myth of the Tower of Babel, where the inability to communicate (and interoperate) results in a systemic failure in the construction of the tower.

Thus, there is an urgent need to improve mechanisms for crisis management information and communication technologies that can keep track of the many details involved in all phases of disaster management. ICT enabled collaboration and related tools that support interoperability have become a must today for all task involved in emergency management.

The purpose of the C2-SENSE project is to ensure a proper management and coordination of all activities and tasks supported by a set of components and tools [4]. The envisaged organizational structure for the scenario allows a seamless coordination of all technical and administrative activities respecting all the interest of the involved stakeholders (e.g. authorities, organizations, institutes, project partners, and external environments) in the project.

4.2 Criticalities

As a result of a survey done at the beginning of the project several critical issues have been identified in relation to activities carried out by the Regional Civil Protection Department. They are mainly related to notification and communication management as well as to data and information sharing. This also relates to activities and processes of the alert management, situation monitoring and/or management of emergency meteorological, hydrological and hydraulic risks.

As already mentioned before, during an emergency situation, currently all information are managed through telephone communications (mainly), email, radio and fax machines that are simultaneously collected by involved stakeholders; which leads to huge challenge and considerable difficulties in managing all the diverse and heterogeneous information.

Therefore we put our focus in the pilot application respectively scenario on these issues and challenges in order to provide a better understanding of IT supported emergency management solutions.

5   Pilot Application

5.1   Functions

The Pilot Application respectively the Scenario has three main features to be tested: data sharing, notification management and communication management.

Data Sharing as one of the important aspects to be tested. Key is the capability to share data and information about the actual situation but also about available resources with multiple applications and/or users.

In fact, to deal successfully with critical (crises/emergency) situations, it is crucial for all the involved systems (of different organization) to have all necessary information at their disposal. C2-SENSE has to guarantee to operate on an actual dataset that is coherent with the data provided by the involved organization. Thus, mutual interactions between organizations will imply information sharing between different systems. Consequently C2-SENSE will provide necessary data integration between different datasets in a transparent way with respect to the underlying technical systems and to their input specific sources.

Notification management, in any emergency situation, is one of the most important critical factors. Independent of the event (e.g. natural hazards, such as floods, tsunamis, etc. or from man-made accidents and threats) it is essential to be notified as fast as possible.

C2-SENSE shall provide a timely communication that is able to supply detailed and meaningful information, about an evolving emergency, to be exchanged among the involved institutional and non-institutional actors.

Communication management is one of the fundamental activities of emergency management. It becomes crucial when there are different subjects responding to an emergency and even more complex when we have to deal with different public information channels. Social media, especially Facebook and Twitter, but also WhatsApp, Telegram, YouTube, Instagram and Google Plus, are taking a very important part in the emergency response today. During emergencies, they are used by disaster responders, governments and non-governmental organizations, as an integrative information tool for crisis management.

The involved stakeholders can be grouped into three categories: control base, on field points and command stations.

The *control base* is made up of civil protection systems which are considered the main user of the C2-SENSE system. As described in the previous paragraphs, it is divided into a Functional Center and a Control Room.

For *field points* we can find actuators such as alarms or automatic barrier systems, voluntary organizations occurring in the territory to meet the most varied events and

emergencies, and citizens that can interact with the C2-SENSE system either to communicate an emergency situation or to receive information related to the evolution of the event and risk situations.

Command stations are command and control points such as prefectures and municipalities, but also others like the fire brigade and the medical centers involved in the territory where the emergency occurs.

Finally Fig. 2 shows the data inputs that enrich the system with information needed to manage the emergency. This information is introduced by sensors installed in the region, or is information shared by systems that are involved in emergency management.
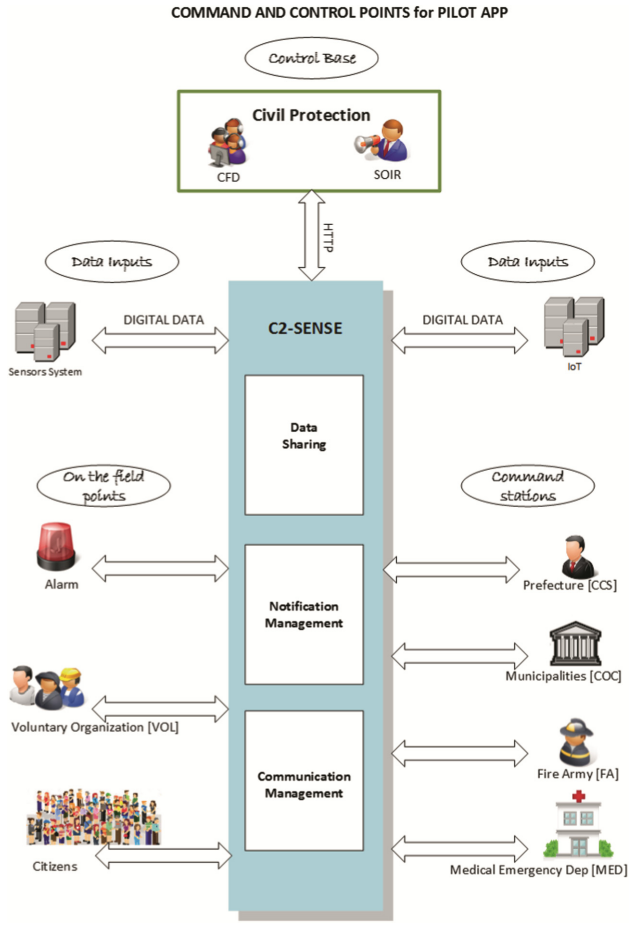

Fig. 2. Pilot application functions

5.2   C2-SENSE Pilot Application Environment

In Fig. 3 the pilot environment is shown. It is divided into two different logical ecosystems: C2-SENSE test environment (on the top) and end-users systems (second half).
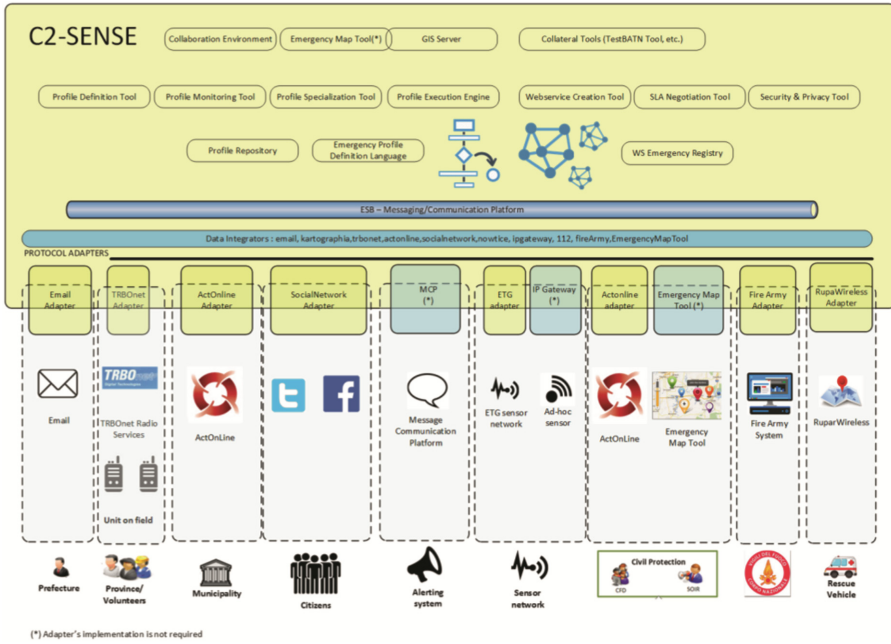

Fig. 3.   Pilot application environment

C2-SENSE test environment is a digital ecosystem composed of various C2-SENSE tools having specific tasks: tools for definition and specialization of integration profiles, tools for communications management between the different C2-SENSE systems, and tools for performance monitoring. This ecosystem interacts with another ecosystem consisting of all systems of the local end users involved in emergency management and taking part in the pilot application testing. The interaction between the two ecosystems is done via different interfacing modules, called adapters, implemented between end-user's system and the C2-SENSE tools. Data used by the *end-user system* is translated by the adapter to make it C2-SENSE compliant; then, this information is processed and transmitted to the end-user recipient according to his local understanding or standards. The integration profiles define the way in which such integration has to be done.

5.3   Pilot Scenario

C2-SENSE will assess its outcomes in a realistic pilot "Flood Scenario in Italy" to ensure that the developed profiling approach is generic enough but also applicable in real life situations [3]. The pilot territory chosen is located in the north of Apulia, and in particular

in the Province of Foggia, forming the border with the region of Molise. The Pilot Scenario covers a period of two days and describes step by step what could happen, before and during a flooding along the Fortore River as well as the evolution of the event.

This area (Fig. 4) is characterized by the terrain of the Gargano promontory, and the flat plains of Tavoliere.

Fig. 4. Test area

In this area, there are many rivers present, and for the trial river Fortore (Fig. 5) was selected. It crosses the territory from south to north, and collects the waters of four other rivers; The Occhito dam meets along the way, and flows into the Adriatic Sea, not far from Lake Lesina.

Fig. 5. Fortore river

During the first day, the Pilot Scenario describes what are the institutions involved in the "Forecasting Phase" and what are the documents produced. In particular:

- The National Weather Service (CFN) announces bad weather conditions for the next 24–36 h;
- The Regional Functional Center (CFD) issues a Bulletin about the regional criticality.

- The manager of the Regional Civil Protection publishes and sends an alert message to Prefectures, Municipalities, and other organization as far as they are concerned.

For the second day, the Pilot Scenario describes what happens during the flooding along the Fortore River, and the institutions and organizations involved including their roles and responsibilities. In particular:

- CFD (Regional Functional Center) follows the evolution of the situation through the regional monitoring network installed in the territory (monitoring and surveillance activities).
- SOIR ensures emergency operations and H24 service to update the information related to the activities carried out, the type and amount of resources needed.
- The Prefecture opens its Assistance Coordination Center (CCS) at the provincial level with the presence of Healthcare Service, Police Department, Fire Brigade, Red Cross, etc.

Municipalities, the responsible body in their territory, activate its own emergency procedures and keep in contact with the voluntary organizations and other involved organizations.

The events described in the Pilot Scenario are grouped into micro-scenarios (MS 1–10 in following tables). They are used to describe in detail the interactions between two or more involved end-users. In particular: what is the event, which are the triggering systems, which are the target systems, what has to be tested, and what the positive/ negative evaluation criteria are. In the following there is an overview about the proposed micro-scenarios used for the pilot:

Official Sensor Value Display

Decentralized Functional Centre (CFD) wants to show all the regional official sensors connected. They activate 'Emergency Map Tool (EMT)' [4] and start the sensor data acquisition. The Emergency Map Tool acquires sensor data using the C2-SENSE system and displays them on the map. In this case all existing sensor networks are connected directly to C2-SENSE (Fig. 6).

MS01 – Sensor values display			
Interaction Step	Initiator	Target	Test Modality
1	Sensor network (ETG sensors)	CFD (EMT)	Activate the function (or the layer) on the emergency Map Tool.

Fig. 6. Official sensor value display: pilot steps

AdHoc Sensor Adding

Decentralized Functional Centre (CFD) decides to put additional sensor(s) in the field. They use the ActOnline[1] (AOL) application to ask a volunteer organization to install (an) ad-hoc sensor(s) and activate them. ActOnline adapter catches this request and forwards it to the Enterprise Service Bus (ESB), further on another service catches it on

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[1] ActOnline is a tool used for events and communications management during an emergency event. It is used by Civil Protection and municipalities.

ESB and forwards it to volunteers using TRBOnet[2] application. Sensors are connected to the IP based gateway. They communicate with C2-SENSE using mobile phone network. Once activated, the sensor(s) immediately start sending data, and the data becomes visible in Emergency Map Tool (Fig. 7).

MS02 – AdHoc sensor adding			
Interaction Step	Initiator	Target	Test Modality
1	CFD (AOL)	Volunteers (TRBOnet devices)	Insert a new request about ad-hoc sensor to Volunteers of Foggia.
2	Ad-hoc sensor (new sensor)	CFD (EMT)	New values are displayed on Map Tool.

Fig. 7. AdHoc sensor adding: pilot steps

COC Opening

Operating Room of Civil Protection (SOIR) asks to the involved municipality to apply their Emergency Plan. This request will be performed using ActOnLine. The Message Communication Platform (MCP) will distribute the messages to the alert responsible persons in the municipality. At the same time the message will arrive via ActOnLine in the Municipality Emergency Control Room (COC) system. COC reads the message from ActOnLine and send a 'read notification' to SOIR using the C2-SENSE environment in order to acknowledge that the message was read by the COC (Fig. 8).

MS03 – COC opening			
Interaction Step	Initiator	Target	Test Modality
1	SOIR (AOL)	Alerting system (MCP), COC (AOL)	SOIR operator sends a specific message to 'municipality of province of Foggia' in order to apply their emergency plan.
2	COC (AOL)	SOIR (AOL)	COC operator reads the message and marks it as read.

Fig. 8. COC opening: pilot steps

Volunteers' Involvement

The volunteers of Foggia start the operation and activate their radio terminal. Then the radio terminal starts to send its GPS position using a specific TRBOnet function. The position is displayed on the Emergency Map Tool used in the Regional Civil Protection Operating Room (SOIR) (Fig. 9).

The Municipality Emergency Control Room (COC) requests the volunteer organization in order to start the foreseen operation as defined in the plan. The COC gives feedback to the Regional Civil Protection Operating Room (SOIR). SOIR reads the message and the notification of having read the message is sent to the COC.

The Regional Civil Protection Operating Room (SOIR) sends a message to a voluntary group and the Municipality Emergency Control Room (COC) in order to 'follow the situation on field' taking care about certain specific river points. The message is something like 'Attention, it is very important to follow the river 'abc' near the point 'xyz'. COC reads the message using ActOnLine which sends a 'read notification' to

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[2] TRBOnet is a tool installed on radio device used by volunteers in the Province of Foggia.

MS04 – Volunteers Involvement			
Interaction Step	Initiator	Target	Test Modality
1	Volunteers (TRBOnet)	SOIR (EMT)	Volunteers' position is geo-localized on Map Tool.
2	COC (AOL)	SOIR (AOL)	COC sends an update message to SOIR about involved volunteers.
3	SOIR (AOL)	COC (AOL)	SOIR operator reads the message and marks it as read.
4	SOIR (AOL)	COC (AOL), Volunteers (TRBOnet devices)	SOIR sends a message to COC and volunteers to follow situation on field.
5	COC (AOL)	SOIR (AOL)	COC operator reads the message and mark it as read.

Fig. 9. Volunteers' involvement: pilot steps

SOIR using the C2-SENSE environment. And also the volunteers' group receives the message directly on their radio device.

Risk Detection

Volunteers of Foggia report a dangerous flooding situation to the Municipality Emergency Operating Room (COC) using TRBOnet radio devices. The COC informs the SOIR (Regional Civil Protection Operating Room about the evolving situation (ActOnLine of COC sends a reply message to SOIR). SOIR reads the message and using its ActOnLine (AOL) that sends a 'read notification' to the COC (Fig. 10).

MS05 - Risk detection			
Interaction Step	Initiator	Target	Test Modality
1	Volunteers (TRBOnet devices)	COC (AOL)	Volunteers send a message to COC.
2	COC (AOL)	SOIR (AOL)	COC operator sends message to SOIR to communicate the risk.
3	SOIR (AOL)	COC (AOL)	SOIR operator reads the message and mark it as read.

Fig. 10. Risk detection: pilot steps

Internal Civil Protection Communication

See Fig. 11.

MS06 – Internal civil protection communication			
Interaction Step	Initiator	Target	Test Modality
1	SOIR (AOL)	CFD (AOL)	SOIR sends information about flood situation
2	CFD (AOL)	SOIR (AOL)	CFD operator reads the message and mark it as read.

Fig. 11. Internal civil protection communication: pilot steps

Closure of Main Roads

Province of Foggia closes some main roads. They use the Message Communication Platform (MCP) to perform this step. A new updated ' road map' will be displayed in the Emergency Map Tool (EMT) at the Regional Civil Protection Operating Room (SOIR) (Fig. 12).

MS07 – Closure of main roads			
Interaction Step	Initiator	Target	Test Modality
1	SOIR (EMT)	COC (AOL)	Closed provincial road is displayed on Map Tool

Fig. 12. Closure of main roads: pilot steps

Alert Messages

Under the responsibility of the Regional President of Regione Puglia the SOIR (Regional Civil Protection Operating Room) needs to alert the population via different channels using the Message Communication Platform (MCP): SMS, email, Twitter, Facebook (municipality page). SOIR prepares a message on ActOnLine (AOL) and the C2-SENSE system pushes the messages through the different channels, using a combination of the MCP, twitter and Facebook. The Social Network Adapters produce a reply message to inform the SOIR that the message was correctly delivered to Facebook and/or twitter (Fig. 13).

MS8 – Alert message			
Interaction Step	Initiator	Target	Test Modality
1	SOIR (AOL)	Message Communication Platform	SOIR sends an alert message to all alerting system users.
2	SOIR (AOL)	Citizens (SocialNetworks)	SOIR posts a message on its own social network page.
3	Citizens (SocialNetwork)	SOIR (AOL)	Social network sends a reply message to confirm operation.

Fig. 13. Closure of main roads: pilot steps

Unique Emergency Number Involvement

The Municipality Emergency Control Room (COC) requests healthcare services and equipment to provide first aid to the citizen. They ask this request to CSS (prefecture) and SOIR (Regional Civil Protection Operating Room) using its ActOnLine (AOL). C2-SENSE delivers the request to CSS by email (read notify is required) and to SOIR with ActOnLine. SOIR takes the request into account and sends 'mobile column' to the municipality. When COC receives the equipment it communicates the delivery of the 'mobile column' using ActOnLine (the message will be delivered to the SOIR and the Prefecture hat use ActOnLine and email) (Fig. 14).

MS09 – Unique emergency number involvement			
Interaction Step	Initiator	Target	Test Modality
1	COC (AOL)	SOIR (AOL), Prefecture (Email)	COC sends a request for means to SOIR and Prefecture
2	SOIR (AOL), Prefecture (Email)	COC (AOL)	SOIR and Prefecture mark the message as read.
3	SOIR (AOL)	COC (AOL), Prefecture (Email)	SOIR takes the request into account and informs COC and prefecture
4	COC (AOL), Prefecture (Email)	SOIR (AOL)	COC and Prefecture mark the message as read.
5	SOIR (EMT)	Rescue Vehicle (RuparWireless)	SOIR asks to Rescue Vehicle to go to a specific place.
6	Rescue Vehicle (RuparWireless)	SOIR (EMT)	Vehicle transmits its position to EMT
7	COC (AOL)	SOIR (AOL), Prefecture (Email)	COC sends an update message to SOIR and Prefecture
8	SOIR (AOL), Prefecture (Email)	COC (AOL)	SOIR and Prefecture mark the message as read.

Fig. 14. Unique emergency number involvement: pilot steps

Fire Brigade Involvement

Municipality discovers a fire accident at a big fuel station. So they send a request to the Fire Department and they accomplish the request. During their intervention SOIR (Regional Civil Protection Operating Room) is updated continuously (C2-SENSE is involved to allow message exchange from/to fire department using CAP (Common Alerting Protocol) protocol and to update SOIR on via the ActOnLine system). SOIR operator reads the message and ActOnLine with C2-SENSE is used to provide a notification to COC (Municipality Emergency Operating Room) (Fig. 15).

MS10 – Fire Army involvement			
Interaction Step	Initiator	Target	Test Modality
1	COC (AOL)	Fire Department (CAP System), SOIR (AOL)	COC requires service to Fire Department
2	Fire Department (CAP System), SOIR (AOL)	COC (AOL)	Fire Department and SOIR mark the message as read.
3	Fire Department (CAP System)	COC (AOL), SOIR (AOL, EMT)	Fire Department sends update about situation to COC and SOIR and intervention is geo-localized

Fig. 15. Fire brigade involvement: pilot steps

6   Pilot Test

6.1   Test Phases and Procedures

At the end of the deployment phase of the Pilot Application, the C2-SENSE system will be tested in order to demonstrate the effectiveness and feasibility of the project. In this test phase the main components of C2-SENSE and interfacing with the local end-users systems will be tested. The test procedure is divided into three phases: Phase 0, Phase 1 and Phase 2.

In *phase 0* the C2-SENSE system is configured and made ready to be used in an emergency situation. In this phase, the Emergency Interoperability Profiles will be created. As stated above the Emergency Interoperability Profiles will address all the layers of interoperability stack, i.e. physical layer, protocol layer, data/object model

layer, information layer, knowledge layer. In this phase all profiles created for the different layer are generic, meaning that they are not specific to any country, organization or incident.

Phase 1 is located between before and during emergency situations. It can be regarded as a transition phase. In this phase, the generic Emergency Interoperability Profiles will be specialized for the Apulia region according to organizational structure and emergency procedures of this region. By using the Profile Specialization Tool, it will be possible to specialize and combine the profiles accordingly. To be more specific, they will be able to illustrate the Pilot Scenario through the GUI of Profile Specialization Tool and assign organizations, emergency teams, and emergency systems as actors of the scenario. By doing so, they will enable the execution and monitoring of the Pilot Scenario by the C2-SENSE system.

In *phase 2* the C2-SENSE system is used in a real life emergency situation, e.g. flood in Apulia region. The profiles specialized for Apulia region will be executed through Profile Execution Engine. Execution of the specialized profiles means that organizations taking part in the emergency plan of Apulia region will exchange information among themselves according to the specifications in the profiles. C2-SENSE system will control, monitor and track these operations and display the progress through Profile Monitoring Tool.

7 Summary

This paper described applicative aspects related to the project C2-SENSE, with the aim of providing valuable and assessable instruments with regards to effective emergency management and interoperability among the information systems of the involved stakeholders.

In order to ensure that the developed profiles are appropriate in real life, they are being assessed in a realistic flood scenario in Apulia region of Italy.

The Pilot Scenario represents an attempt to apply the C2-SENSE system to a real situation in which the involved stakeholders will use IT technology to enable them to interact and communicate in way they could not do before.

Furthermore the designed Pilot Scenario, demonstrates interoperability between the regional civil protection system and government agencies (Prefecture, Province, Municipalities), the other organizations like the fire brigade, the police, the medical rescue, and last but not least the citizens. Therefore the functional tests and results of different micro-scenarios presented in this paper shows that it is possible to adapt specific information technologies to a real emergency scenario, improving the interaction between the different organization and optimizing the response time during emergencies.

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