IWEI Conference 2015

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Strategic Alliances Business Developer

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Safe Harbor

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Agenda
- The Paper
- The Emergency Management
- Validation
- Conclusions & Future Developments
The Paper
Credits for the Paper


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ABSTRACT: In order to manage emergencies, crises and disasters effectively, different organizations with their Command & Control (C2) and Sensing Systems have to cooperate and constantly exchange and share data and information. In other words, territorial emergency management requires a cross-organisational, cross-domain, cross-level interoperability between the involved C2 and Sensing Systems. 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 organisations. 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. Unlike the conventional profiling approach, which addresses only first three layers of interoperability stack, the profiling approach introduced in this paper involves all the layers of the communication stack in the security field. The work presented in this paper is achieved in the scope of the European Commission supported C2-SENSE project and partly in the scope of ITEA3 supported APPS Project.
C2-SENSE Project
(Seventh Framework Programme)

Grant Agreement: 607729
Project Acronym: C2-SENSE
Project Title: Interoperability Profiles for Command/Control Systems and Sensor Systems in Emergency Management
Funding Scheme: SEC-2013.5.3-1
Project Start Date: April 01, 2014
Duration: 36 months
Project Start Date: March 31, 2017
C2-SENSE Project

(Parnters - [http://c2-sense.eu/](http://c2-sense.eu/))

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**Sagem.** a high-tech company in the Safran group, holds world or European leadership positions in optronics, avionics, electronics and safety-critical software for both civil and military markets.

**Regola** has been designing software solutions and applications in the ICT since 1995 and most of products are decision-making support Platforms or Tools targeted to Healthcare and Public Administration, with a remarkable expertise in the Emergency Management.

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**Lutech S.p.A.** , part of the Laserline Group, is an Italian ICT engineering and services company, working successfully for more than ten years and delivering robust and timely solutions to leading corporate Clients.

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**Servizio Protezione Civile Regione Puglia -** In the field of Civil Protection the Apulian regional Government regulates the organization of functions and administrative tasks, for which it is invested or it is entitled, related to the care of the interests and the promotion of the development of its community according to cooperation principles with security force, Provinces, and other local authorities.
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The Emergency Management
Emergency Management

*(Scenario)*

Emergency situations: disasters *(hazards/damages for human beings and/or public properties)* caused by:
- Twisters
- Floods
- Earthquakes
- Wild Fires
- Crisis
- ....
in an environment that is:
- Vast
- Unpredictable
- Dynamic

- The **Domain/Context** of interest is Emergency Management.
Many **different stakeholders** (i.e. organizations/actors/agencies/entities/...) having different Command and Control Systems and Sensing Systems **have to cooperate**:
- Army
- Police
- Fire Fighters
- Hospitals
- Volunteer organizations
- Municipality
- Civil Protection units
- Rescue units
- ....

- Responding organizations can **change at run time**, have **different countries’ cultural, linguistic and legal issues** (especially in an international intervention case) and may be **dispersed**, creating an **Emergency Organisations Heterogenous Ecosystem** (this Ecosystem in **liquid** and **borderless**)

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Emergency Management
(Sensors)

Real-time Situational Awareness is paramount before, during and after emergency scenarios:

- **Before (Prevent):** i.e. Sensors implanted in infrastructures could aid in studies of human and physical world patterns and trigger maintenance actions.

- **During (Manage):** i.e. Sensors embedded in everyday objects could be used to locate persons during search and rescue efforts.

- **After (Recovery):** i.e. Mobile phone, clothing and bracelet sensors could help track evacuees’ status and locations (estimation and accommodation).

IoT is becoming affordable and widespread, so sensors may be:
- **pre-existing** (i.e. monitor infrastructure,...)
- **installed on site in real-time** (i.e. patients handling, search&rescue operations,...)

IoT from different sources generates **Big Data in a very short time.**
IOT Trends

(Google search trends since 2004: Internet of Things, IoT, Big Data)

The web search popularity, as measured by the Google search trends during the last 10 years for the terms Internet of Things, IoT and Big Data:

- search volume is consistently increasing
The Challenge
(Make the organisations cooperate through interoperability)
**Interoperability Stack**

All the layers of the Interoperability Stack must be addressed (to avoid chaotic responses, unnecessary duplication, waste of time and resources,…). :

Although there are commonly used standards and specifications (addressing different layers in the stack), there is no single specification of using these standards together especially in an emergency situation.

**Emergency Interoperability Profiles** in emergency domain are not yet another information model or data format: best practice documents on the use of existing dispersed standards to enable timely, effective and efficient exchanges of information among all the layers without requiring any prior special technical arrangements, eliminating the need for a prior bilateral agreement between any two information exchange partners.

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**Figure 1 Interoperability Stack**

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<thead>
<tr>
<th>High-level Harmonization (Operational Backbone – Soft Skills)</th>
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<tbody>
<tr>
<td>- High Level Objectives</td>
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<tr>
<td>- Harmonised Strategy/Doctrines</td>
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<td>- Aligned Operations</td>
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<td>- Aligned Procedures</td>
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<td>- Knowledge</td>
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<td>- Information Interoperability</td>
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<td>- Data/Object Model Interoperability</td>
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<td>- Protocol Interoperability</td>
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<td>- Physical Interoperability</td>
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<th>Low-level Harmonization (Technical Backbone – Hard Skills)</th>
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<td>- Technical Aspects</td>
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<td>- Organisational Aspects</td>
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Emergency Interoperability Framework

(3 main steps)

- All the Emergency Interoperability Profiles together form the Emergency Interoperability Framework.

- C2-SENSE can be considered as a framework to enable and develop context-aware applications.

- Emergency Interoperability Framework will be developed in three main steps:

1. Emergency Domain Inventory *(we survey what’s existing on the field assessing all stakeholders’ knowledge)*

2. Emergency Domain Ontology *(let’s normalize, summarize and consolidate all of them in a lingua franca: Ontology represents a controlled vocabulary which is structured into a hierarchical taxonomy, where the key concepts are found)*

3. Emergency Interoperability Profiles *(here we create the real outcomes of the project)*
**Identified Profiles**  
*(work in progress)*

- A profile helps the information system to deliver the most relevant data in the right form at the right place and the right moment.

- An emergency profile is a **formalization of actors, mutual interactions and information exchange.**

- A profile is a **machine-readable, machine-understandable and machine-executable process.**

Up to now, 12 profiles have been identified based on the C2-SENSE scenario:

- **Situation Reporting**  
- **Mission Plan**  
- **Scheduling**  
- **Resource Management**  
- **Alert (Notification)**  
- **Sensor Management**  
- .....
The response to a critical event like a Fire Emergency (this is a specific Domain) requires a plurality of interactions between a lot of actors, all of this can be coded in a Fire Emergency Profile. This profile, when executed, specializes the platform and its collaterals systems to manage that kind of events.
Interoperability Stack
*(standard protocols up-to-now identified)*

- Security and Safeguarding Liberties Framework programme (SSL)
- WS-CDL and ebBP
- Linked USDL
- Linked USDL
- XML-based messaging standards (Emergency Data Exchange Language Resource Messaging (EDXL-RM)),....
- Enterprise Service Bus (ESB), TCP/IP, HTTP, SOAP, REST or SMTP
- SECRICOM (Seamless Communication for Crisis Management) Project’s results
Validation
C2-SENSE Interoperability Profile  
**Approach: Flood Scenario**  
*(validation on-the-field)*

C2-SENSE is validating its outcomes in realistic Hydro-geological risk scenarios located in **Regione Puglia**:  
- **extraordinary rainfall event lasting three days**

- First day: the **National Weather Service (CFC)** forecasts a meteorological situation that will determine bad weather conditions and the **Regional Functional Center (CFD)** will then publish a Bulletin of regional severity state.

- Second-third day: the monitoring network of **Regional Functional Center (CFD)** follows the evolution of the situation using a **Sensor Network System** installed in involved risk zones. Because the situation becomes worse, some municipalities communicate to **SOIR** a **flood emergency situation**.
C2-SENSE Interoperability Approach
(institutions and organizations involved in the flood scenario)

Figure 4 Actors’ relationships
Regional Functional Center (CFD) will use project pilot experimentation in order to automate the alerting system and launch interoperable process with the local actors in order to assess C2-SENSE profiling approach benefit moving from Data Layer to Information Layer and beyond. CFD actions (automating alerting system and launching interoperable process) will be performed according to the following profiles:

- **Situation Reporting Profile** is used for transmitting timely situation reports (In an emergency situation, it is crucial to have the picture of operation. Thanks to timely reports, situational awareness evolves, additional precautions can be taken or emergency plan can be updated etc).
- **Sensor Management Profile** is applied to manage properly before, during, and after emergency situations.
- **Alert (Notification) Profile** is executed due to the fact that when an emergency occurs, all the parties involved in the emergency team should be alerted first while, during crises, some organizations should be informed when specific events occurred.
- **Mission Plan and Scheduling Profiles** are used together to activate the emergency procedures and organize the institutions and organizations involved in emergency management.
Benefits
(validation on-the-field)

- **Acquisition and sharing of information**: the information coming from the site of the disaster is the input to the decision-making process -> need for such information to be complete, reliable and obtained in real time.

- **Simplicity and immediacy**: because of the urgency with which the different actions must be performed, it is essential to provide an immediate picture of the situation, simple to understand and easily actionable, and similarly to be able to handle every transaction with immediacy.

- **Availability of communication technologies**: one of the main problems encountered in the management of emergencies is related to communication. Therefore, it is useful to have different communication channels that operate in parallel and that complement each other (radio, SMS, etc ...)

- **Useful support for the human operator**: In decisional aspects the intervention of a human operator must remain irreplaceable and thus cannot and should not be automated. The enterprise interoperability system then needs to be a support tool and should serve to provide a detailed and comprehensive picture of the current situation, proposing appropriate solutions for intervention, but leaving the operator the option to choose alternative solutions.
Conclusions & Future Developments
Conclusions & Future Developments

(AS-IS -> TO-BE)

In this paper, a novel profiling approach, which addresses all the layers of the communication stack in security field, is introduced for the interoperability of C2 and Sensing Systems in emergency management. To the best of our knowledge, this profiling approach is the first in the literature. Through the profiling mechanism, already developed individual dispersed standards/specifications addressing different layers in the Interoperability Stack can be consolidated into a single uniform specification. By doing so, interoperability of C2 and Sensing Systems is achieved and cooperation of these systems is possible in an emergency situation.

In order to ensure that the developed profiles are generic and applicable in real life setting, they are being assessed in a realistic flood scenario in Puglia region of Italy. The current situation, namely AS-IS scenario, has already been analyzed; possible actors, missions, and drawbacks have been identified; and initial profiles have been created. The next step is to create TO-BE scenario, in which AS-IS scenario is improved. The goal is to make the scenario generic and comprehensive, while also adding missing actors and missions. After having AS-IS and TO-BE scenarios completed, profiles will be further improved, then finalized, and ready for execution in real-life applications.
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....thanks for your attention

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