Analysis of Alert Messages formats for Environmental Disaster Management

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ABSTRACT:

Crisis and emergency management require fast response times and the most efficient use of resources. It is required to have an effective response to hazards, for example, calls for early alert, reliable and accurate position information about the location of event.
Police and emergency services need reliable and accurate knowledge of the location of deployed forces in order to coordinate them efficiently.
This issue is particularly critical when the'traditional'infrastructures are not available because of the emergency conditions (i.e. floods, maritime emergencies, oil spills, earthquakes and humanitarian aid operations).
In this paper a contribution to environmental disasters prevention and management is given by the analysis of parameters relative to the identification and georeferencing of different kind of natural and anthropic emergenciesthrough the study of the format of the Common Alerting Protocol (CAP) version 1.2, implemented by Oasis, that allows a consistent warning message to be disseminated simultaneously over many different warning systems, thus increasing warning effectiveness while simplifying the warning task.
The means of transmission of alert messages are also examined including the possibility to use EGNOS (European Geostationary Navigation Overlay System) SIS (Signal In Space).
The final objective is the extraction and real time visualization of the information on a mobile device (PDA, mobile phone).

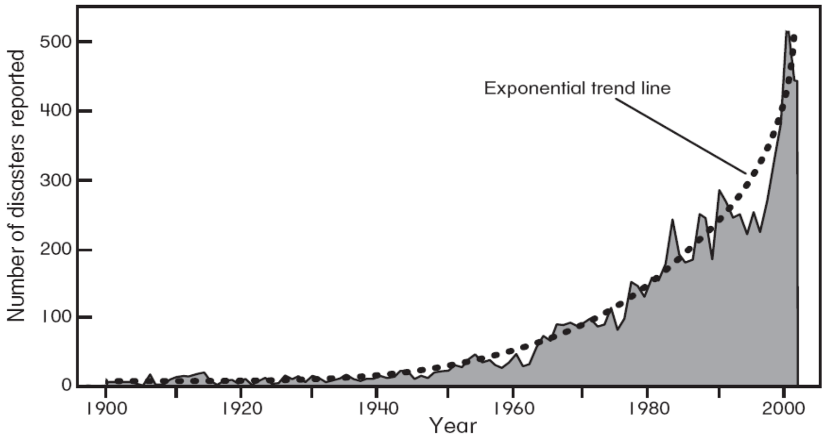
1. INTRODUCTION

The **vulnerability** of the European continent towards natural and anthropic disasters is widely recognized.
Highly disruptive events cause suffering, deprivation and even death. Economic and social costs on account of losses caused by hazards continue to increase year after year.
Table 1 shows the list of the major natural hazards, divided in subgroups.

Disaster Subgroup	Definition	Disaster Main Type
Geophysical	Events originating from solid earth	Earthquake, Volcano, Mass Movement (dry)
Meteorological	Events caused by short-lived/small to meso scale atmospheric processes (in the spectrum from minutes to days)	Storm
Hydrological	Events caused by deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up	Flood, Mass Movement (wet)
Climatological	Events caused by long-lived/meso to macro scale processes (in the spectrum from intra-seasonal to multi-decadal climate variability)	Extreme Temperature, Drought, Wildfire
Biological	Disaster caused by the exposure of living organisms to germs and toxic substances	Epidemic, Insect Infestation, Animal Stampede

Table 1

In the last century it has seen that climate change is expected to increase the risks of disasters, not only causing more frequent and intense hazard events but also producing a greater vulnerability to the existing hazards. During the last century, the number of recorded disasters has increased exponentially, as seen in Figure 1:



Reporting incidence of natural hazards over time 1900–2001 (based on CRED, 2002).

Figure 1

Several areas of the world are affected by different kinds of disasters. In such a situation the community needs to understand and be able to implement certain measures of preparedness when required to do so. **Warnings** are safety communications used to inform people about hazards with the aim of avoiding and minimizing unwanted consequences. A priority in immediate and short term should reduce **vulnerability** and build resilience to extreme events. Disaster risk and the adverse impacts of natural hazards can be reduced by systematically **monitoring**, **analysing** and **managing** the causes of disasters.

"Natural hazards by themselves do not cause disasters; it is the combination of an exposed, vulnerable and ill-prepared population or community with a hazard event that results in a disaster. Human activity, such as land use changes, environmental exploitation and unplanned settlement, often exacerbates the level of disaster risk" [1].

The final purpose is to provide people adequate information's about disasters. In this way they can take informed decisions on how to avoid damages.

So warnings are intended to influence or modify people's behavior in ways that will improve safety.

2. MAPPING THE IMPACTS OF NATURAL HAZARDS IN EUROPE

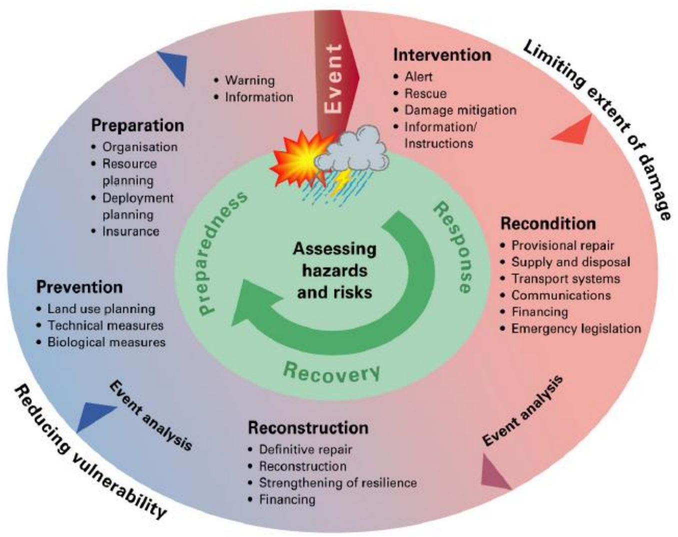
Limiting the detection of events at the European countries, we assist to a growing trend in data collection about disasters. Some of them are affected by considerable amount of hazards as seen in Figure 2. The trend in disaster impact on society is strongly influenced by single major events with exceptional human impacts.

These events lead to a high variation in disaster impact figures from one year to another. Most victims were caused by geophysical disasters (50.9%), in particular as far as regards the L’Aquila earthquake on April 6, 2009, followed by hydrological disasters (37.9%).

Figure 2

The general scheme for the management of an emergency situation gives rise to the risk knowledge, to the environmental monitoring and to quickly alerting services.

In Figure 3 it is possible to understand the interventions chain implemented to deal with the different aspects of a situation of alert. It deals about the immediate actions and the future actions that need to be taken into account.



Source: Swiss Federal Office for Civil Protection FOCP, 2010.

Figure 3

Hazard type	Recorded events	Number of fatalities	Overall losses (EUR billion)
Storm	155	729	44.338
Extreme temperature events	101	77 551	9.962
Forest fires	35	191	6.917
Drought	8	0	4.940
Flood	213	1 126	52.173
Snow avalanche	8	130	0.742
Landslide	9	212	0.551
Earthquake	46	18 864	29.205
Volcano	1	0	0.004
Oil spills	9	n/a	No comprehensive data available (a)
Industrial accidents	339	169	No comprehensive data available (b)
Toxic spills	4	n/a	No comprehensive data available (c)
Total	**928**	**98 972**	**148.831**

Note: (a) Estimation is between EUR 500 and EUR 500 000 per tonne of oil spilled.
(b) Costs for major events reported in Table 12.1 aggregately amount to more than EUR 3.7 billion.
(c) Costs for one particular toxic spill amount to EUR 377 million, see Chapter 13.

Source: EM-DAT, 2010; EMSA, 2010; MARS, 2010.

Table 2

It is possible to divide Management organization into four main parts:

– Knowledge of the risk that allows the systematic collection of data related to the events and the Risk Assessment according to geographical and environmental factors;
– Monitoring and Alert Service at all type of levels (local, national, international);
– Dissemination and Communication; their major purpose is the maximum distributions of messages;
– Response capability with the aim to create national and local systems able to handle the disasters.

In this work the attention is focused on the distribution of the information's after the catastrophic events. A particular rise is given to the possibility to reach quickly all the users to prevent and limit the damages caused by natural events.
So it is important to concentrate on the possibility to disseminate simultaneously alert messages over different warning systems.

3. THE COMMON ALERTING PROTOCOL

The Common Alerting Protocol (CAP) is a simple but general format for exchanging all-hazard emergency alerts over all kinds of networks [2].
It has been developed by OASIS (Organization for the Advancement of Structured Information Standards) and disseminated simultaneously over many different warning systems.
Its format is compatible with emerging techniques, such as Web services, as well as 5 existing formats including the Specific Area Message Encoding (SAME) used for the United States" 6 National Oceanic and Atmospheric Administration (NOAA) Weather Radio and the Emergency Alert 7 System (EAS).
The warning message must be flexible, clear, specific, accurate and consistent. It should indicate the nature of the hazards, which persons are at risk from a

particular hazard, in terms of their location or some other distinguishing characteristic, including recommendation.
A particular aspect of warnings is the uncertainty; infact where facts surrounding a warning situation are uncertain, that uncertainty should be disclosed frankly in the warning message, to avoid the creation of a false sense of precision.
The CAP offers enhanced capabilities that include flexible geographic targeting using latitude/longitude shapes and other geospatial 9 representations in three dimensions. It has also multilingual and multi-audience messaging, enhanced message update and cancellation features, template support for framing complete and effective warning messages, compatible with digital signature capability, facility for digital images and audio.
Each CAP Alert Message consists of an <alert> segment, which may contain one or more <info> segments, each of which may include one or more <area> and/or <resource> segments. Under most circumstances CAP messages with a <msgType> value of “Alert” SHOULD include at least one <info> element.

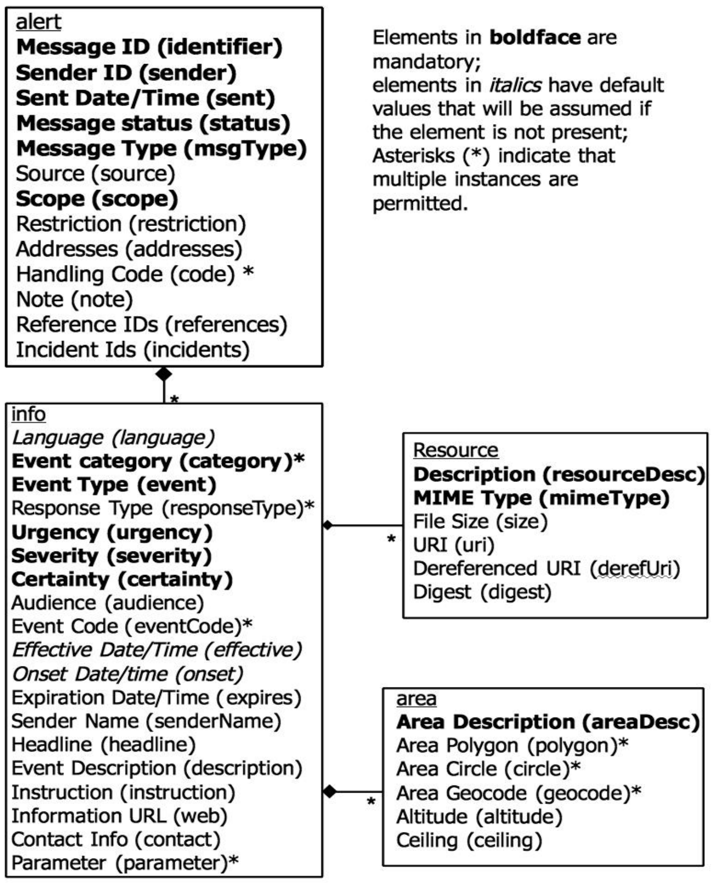


Figure 4

The **<alert>** segment provides basic information about the current message: its purpose, its source and its status, as well as a unique identifier for the current message and links to any other, related messages.
The **<info>** segment describes an anticipated or actual event in terms of its urgency (time available to prepare), severity (intensity of impact) and certainty (confidence in the observation or prediction), as well as providing both categorical and textual descriptions of the event itself.
The **<resource>** segment provides an optional reference to additional information related to the <info> segment within which it appears in the form of a digital

asset such as an image or audio file.
The **<area>** segment describes the geographic area to which the <info> applies. Textual and coded descriptions (such as postal codes) are supported. The preferred representations use geospatial shapes (polygons and circles) and an altitude or altitude range, expressed in standard latitude/longitude/altitude terms in accordance with a specified datum.
The most important aspects taken into account in the design of the CAP Alert Protocol are the **interoperability** with all kinds of emergency information systems, the **completeness** (the format should provide for all the elements of an effective public warning message), the **portable structure (XML)** and the **multi-use format** (one message schema supports multiple message types).

4. PROTOTYPE OF A CAP MESSAGE CONSUMER

The first purpose of this research [4] is the creation of an Application able to handle an alert message format according to the CAP Protocol. Defined conditions have been chosen. This Application should be able to handle the message according to the code and to a XML based file. OASIS is the used reference structure.
It extracts useful information for the users and ignores the formatting information to form the XML document.
In order to remain consistent to the features of portability and interoperability of CAP standard, the application must be independent to the platform where it is performed. A mobile device has been chosen (Figure 5): its screen size views all the contained information, the computing resources and the memory capability.

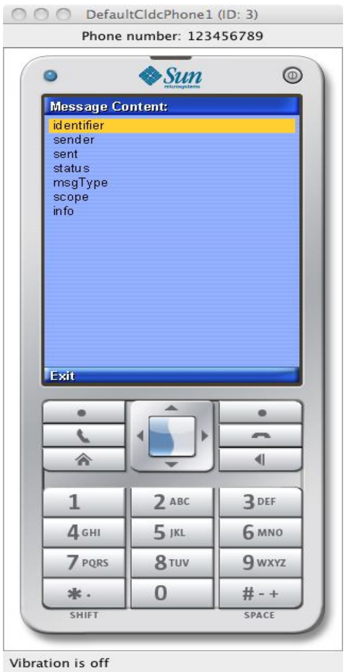


Figure 5

The final result is a prototype composed by two Java classes covering both the management of the text graphics as well the manipulation and extraction content of the message.
An interface containing a list composed by different elements within the <alert> segment, is presented to the user.

It is possible to interact with different elements selected from the display content.
In Figures 6 and 7 the mobile device screen, showing a selection of simple elements containing a limited number of entries and short text is displayed.

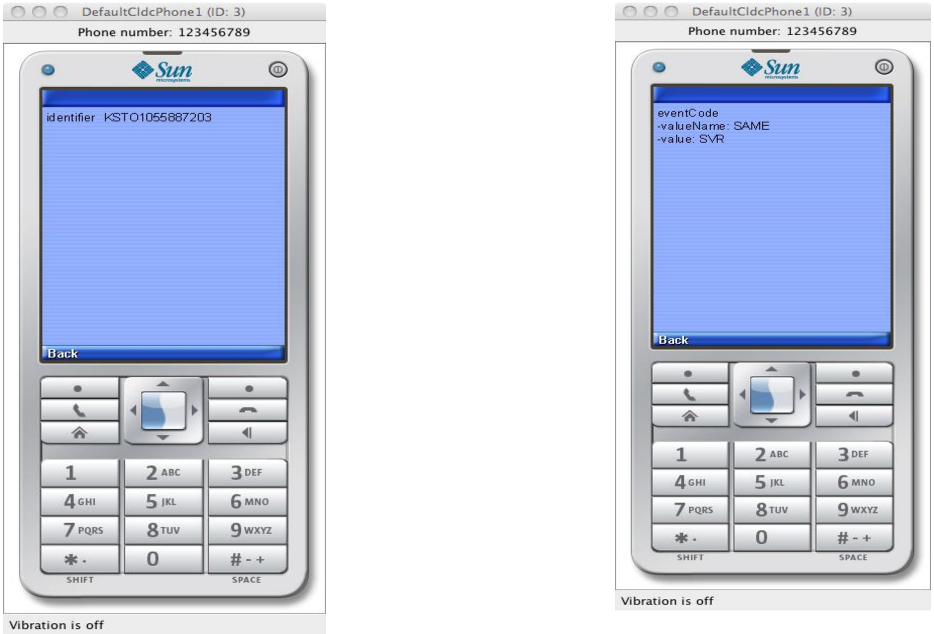


Figure 6 and 7

In Figure 8 the selection of complex elements containing others sub elements is displayed.

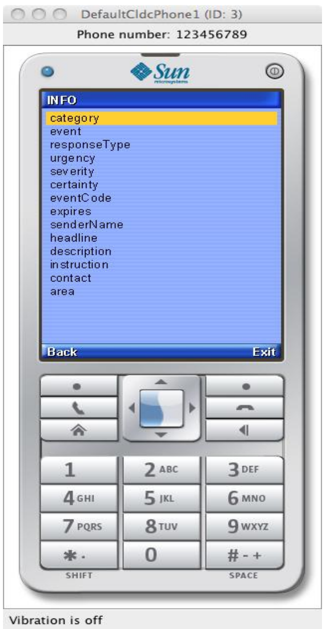


Figure 8

The product of this work is, as previously mentioned, a prototype.
The analyzed means of transmission for the Alert Messages are Internet and radio modem based, using a VPN connection to a server and TCP/IP links.
Furthermore the encapsulation of the Alert Messages inside the SIS (Signal In Space) EGNOS (European Geostationary Navigation Overlay System) structure is under study and implementation, using also the SISNeT Technology [5].

5. CONCLUSIONS AND FUTURE DEVELOPMENTS

In this paper a contribution to environmental disasters prevention and management has been given by the analysis of the Common Alerting Protocol (CAP) format. This format allows a consistent warning message to be disseminated simultaneously over many different warning systems.
A prototype, a mobile device, able to receive and display in real time the alert messages has been developed by the GeoSNAV Laboratory team.
Means of transmission of alert messages are also examined including the possibility to use EGNOS (European Geostationary Navigation Overlay System) SIS (Signal In Space).

Future developments include the possibility to handle multiple occurrences of the message elements, so avoiding problems if the message contains more occurrences of some elements.
Another improvement regards the possibility for the user to select the which messages to be displayed.
The possibility to display in graphical form the alert information's is foreseen, giving to the user the ability to better and more quickly understand the location and size of the area affected by the disaster event itself.

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