Information standards for disaster response and recovery

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1 Introduction

Effective communication and information management are key aspects of disaster response and recovery, and are prime candidates for ICT support in the form of software such as Crisis Information Management Systems (CIMS). However, such systems are not yet in use today in most of the emergency sector, and uniform adoption of a single CIMS across the many organisations involved in disaster response and recovery is unlikely. Therefore, standards that formalise the semantics of the information, facilitate its exchange between various information systems, and support transformations between one format/presentation to another, are crucial.

In this abstract, we provide a brief overview of work on standards for information modelling and exchange in the emergency sector. We cover:

- our findings about current technology and future requirements from Exercise Reef Breaker, a tropical cyclone exercise held in September 2006;
- information standards for the emergency sector, focusing on work carried out by the OASIS Emergency Management Technical Committee; and
- our ongoing work on an OASIS resource messaging standard to facilitate resource management in the emergency sector, and markup languages for severe weather and tsunami warnings.

2 Requirements: Exercise Reef Breaker

Exercise Reef Breaker, held in Townsville in September 2006, aimed to exercise the capabilities of local and district groups in responding to a significant event such as a tropical cyclone. It centred around a scenario in which a category four cyclone crossed the coast north of Townsville at high tide, causing a sizeable storm surge. The exercise was held over three days, with the first two days focusing on preparation for the event, evacuations and pre-positioning of resources, and the remaining day on the short-term response.

Some of the key information management challenges that arose during the exercise were the following:

- How to ensure information reached the right person, and how to handle contact lists, taking into account staff/shift changes?
- How to efficiently aggregate and summarise many separate pieces of information? During Exercise Reef Breaker, common tasks included aggregating local situation reports into district situation reports for reporting up to the state level; producing an operations log to document all incoming and outgoing information and actions taken; and collating all available information such as BOM advice and situation reports into summaries suitable for decision making.

– How to manage resources in a coordinated and scalable way, so that the status of resource requests could be effectively tracked? Many resources were required (tarpaulins, generators, medical supplies, etc.), some of which could be sourced locally and some at the state or federal levels.

Our work focuses on how to introduce structured information formats that support these tasks and lead to greater opportunities for automation. At present, the most commonly used software tools are email (Microsoft Outlook) and spreadsheets (Excel). In addition, redundant hard and soft copies of information are frequently kept. As a result, the filing tasks involved in organising related documents are onerous and distract from the core disaster response activities. The filing burden could be reduced by providing an information system that is able to track threads of related messages and documents, produce summaries, and facilitate searching.

As resource management was also highlighted as a key challenge in the response to Cyclone Larry, the development of a standard for the exchange of resource-related messages is currently our main focus. The proposed standard aims to overcome some current shortcomings in resource management by providing a common structure and semantics for resource-related messages, facilitating automated message routing, processing and tracking. In addition, we are developing structured languages for representing tsunami and cyclone warnings, to facilitate similar kinds of automation.

3 Overview of Information Standards for Disaster Response and Recovery

There are several groups developing information standards for the emergency sector. These include the IEEE Incident Management Working Group and the OASIS Emergency Management Technical Committee. The first group is responsible for the IEEE 1512 family of standards [5], which define common message formats for exchanging the following types of information: situation awareness, plans of action, asset management, and warnings. As the original agencies driving the standards were the U.S. Department of Transportation and the U.S. Federal Highway Administration, the terminology is closely coupled to requirements of the transportation industry (focusing on traffic accidents). The standards are not well suited for use in natural disasters such as cyclones.

In contrast, the major players originally driving the development of the OASIS standards were the U.S. Department of Homeland Security and industry members of the Emergency Interoperability Consortium. The OASIS family of standards is broader in scope. One of the main standards in the family is the Emergency Data Exchange Language (EDXL), which has several sub-components. The most mature of these is the EDXL Distribution Element (EDXL-DE) [6], which was approved on 1 May 2006 as an OASIS standard. EDXL-DE captures information required to enable routing of XML payloads, in order to facilitate information exchange between the various organisations involved in emergency management and response. This routing information includes elements such as the target area for a message (in order to support location-based message delivery), information about the sender, keywords describing the message content, and so on. The payload can be any emergency-related information.

We are currently contributing to the development of a second component of EDXL - EDXL Resource Messaging (EDXL-RM) - which will address the resource management issues discussed in Section 2.

4 EDXL-RM Standard for Resource Messaging

EDXL-RM aims to provide a comprehensive set of message formats for resource management across all areas of the emergency sector. It encompasses messages for:

– requesting resources and responding to resource requests;

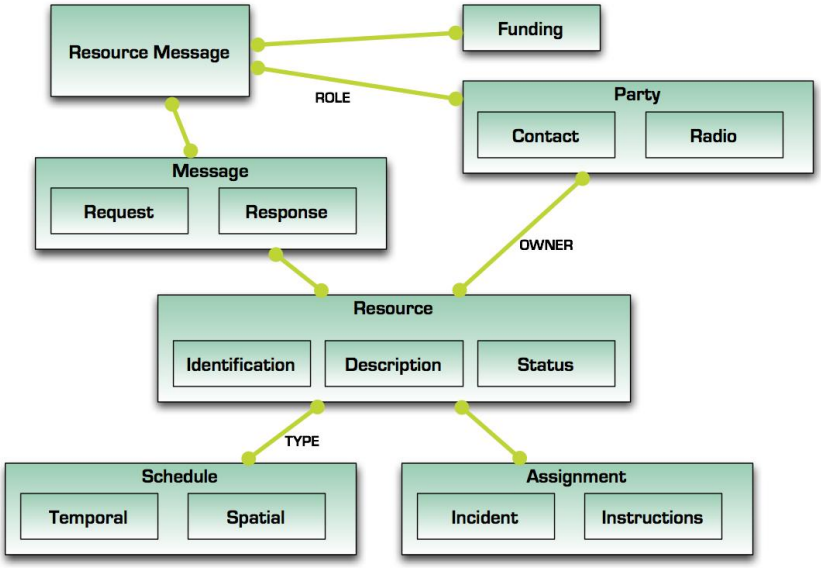

Fig. 1. EDXL-RM Abstract Reference Model showing the relationships between key components of a resource message.

- requisitioning and committing resources;
- requesting resource information and responding to requests for information;
- offering unsolicited resources;
- releasing resources;
- requesting the return of resources and responding to these requests;
- requesting quotes and responding to requests for quotes;
- requesting and notifying resource dispositions; and
- requesting extended use of a resource and responding to these requests.

The current draft of the specification [1] defines 16 distinct message types, each of which has a unique combination of required and optional message elements. The main components of a resource message are shown in Figure 1. Broadly, each message can be either a request or a response, and can have funding and contact information. A message can also contain information about one or more specific resources. Each resource description consists of identification information, general descriptive elements and status information. A resource description may also contain scheduling information (when/where the resource will be deployed and returned, etc.) and assignment information (incident details and instructions related to the task for which the resource is required).

The information modelling for EDXL-RM is inherently complex, as the combination of message elements that must/may be present is unique for each message type, and the number of possible elements is large. The current information models developed for the specification are not able to adequately capture the differences between the 16 message types and do not capture the intended semantics well. One focus of our current work is therefore on improving the information modelling. We also plan to work on extensions of EDXL-RM to support tasking of personnel. A more detailed discussion of this ongoing work can be found in [2].

5 Languages for Severe Weather and Tsunami Warnings

Another aspect of our work involves the development of structured representations for warning information, including cyclone/hurricane and tsunami bulletins. Our approach has been to analyse the current textual bulletins, construct formal information models that capture the main elements of the bulletins, and map these models to XML schemas.

The first version of our Tsunami Warning Markup Language (TWML) is documented in [4]. At present, there are many variations in the structure and content of the bulletins produced by each of the tsunami warning centres. TWML aims to provide a common format and semantics for all of these bulletins. Version 1.0 considers only a subset of all possible bulletin types, but will be extended in the future.

An overview of the information models we have developed for cyclone and hurricane bulletins can be found in [3]. We plan to develop the cyclone model further to produce a Cyclone Warning Markup Language (CWML), similar to TWML.

6 Conclusions

The development of structured information formats - such as EDXL-RM, TWML and CWML - provides crucial underpinnings for future software tools such as CIMS. Although some software solutions for emergency management do already exist, such as WebEOC[1], this software lacks open, standardised information formats that support interoperability. Therefore, these solutions break down unless they are uniformly adopted across all organisations in the emergency sector. In addition to our work on standards, we are developing an architecture (CAIRNS) for more flexible management and exchange of information for disaster response and recovery.

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