A Policy Driven Meta-Alert System for Crisis Communications

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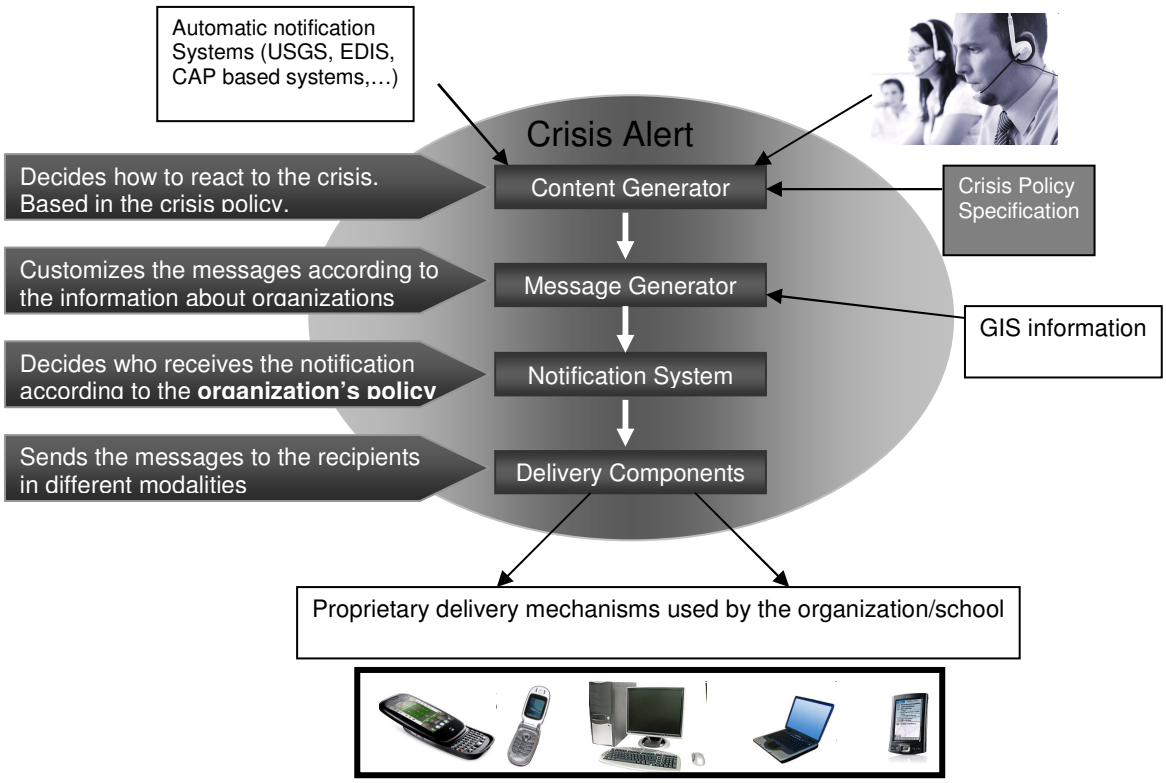
Public communication during natural and man made disasters is a key issue that must be addressed to protect lives and properties. This paper focuses on information that is disseminated to the public at large specifically to encourage self-protective actions, such as evacuation from dangerous areas, sheltering-in-place, and other actions designed to reduce exposure to natural and human-induced threats. Specifically, we have developed an understanding of the key factors in effective dissemination to the public and designed technology innovations to convey accurate and timely information to those who are actually at risk (or likely to be), while providing reassuring information to those who are not at risk and therefore do not need to take self-protective action. There are three key factors that pose significant challenges (social and technological) to effective information dissemination in crisis situations – variation in warning times, determining specificity of warning information to effectively communicate to different populations, and customization of the delivery process to reach the targeted populations in time over possibly failing infrastructures. Our approach to address these challenges is a focused multidisciplinary effort that 1) understands and utilizes the context in which the dissemination of information occurs to determine sources, recipients, channels of targeted messages and 2) develop technological solutions that can deliver appropriate and accessible information to the public rapidly. The ultimate objective is a set of next generation warning systems that can bring about an appropriate response, rather than an under- or over-response.

The choice of the best protective actions to take depends on a global situation-awareness that is not available to the general public. Emergency personnel and public authorities have the duty to inform the population before, during and after catastrophic events to support the disaster response. The choice of the best protective action to take also depends on a variety of factors, such as the location of the recipients, their distance from the crisis area and the type of event; hence, different people should receive different type of notifications. For example, schools in an area slightly affected by a chemical spill can receive a notification that says to close the windows and stay inside, while organizations in an area that is going to be affected soon by the same event can be notified to start an evacuation.

In this position paper, we advocate and describe PWS (Policy-driven Warning System), a system for public warning dissemination. PWS is not intended to replace existing systems or procedures, but to serve on top of them in order to leverage the current emergency response knowledge. In fact, awareness to natural and man-made disasters has created a rich know-how about crisis response: public authorities know what kind of protective actions are adequate in case of a certain disaster and certain conditions, and organizations have in place procedures to implement them. Leveraging this knowledge means being able to improve the current response without changing the way people are trained to react. PWS formalizes the response knowledge of the emergency personnel defining a policy language that enables an assisted or automated creation of warning messages, customized according to the characteristic of the crisis, type and location of the recipients, local conditions such as weather or hospital availability. Also, it takes into account the organization emergency plans by sending the right information directly to the key decision makers, helping them in organizing protective actions. Moreover, the architecture is able to integrate different communication technologies, such as phones, text messages and Internet, to adapt the use of the infrastructure to the crisis characteristics. Such multi-modal dissemination

enables the recipients to receive the warning in the way they prefer and allows the notification to be delivered even if part of the infrastructure is not available.

Enabling truly effective public/community alerting requires addressing four aspects. First, the community has to know which hazards it is exposed to and community level. Second, a continuous monitoring and a sound scientific forecast model have to be put in place to identify when one of the hazards becomes a real threat. Then a dissemination and communication system has to be available to allow the dissemination of warning notifications to the people at risk. Last, the members of the community must respect the warning service and know how to react to warnings. All those phases are necessary for an effective dissemination of the warning. In this scenario, the proposed PWS (Policy-driven Warning System) will assist in the communication and dissemination aspects of a public emergency dissemination system. This system is based on an architecture that clearly separates different phases of the warning communication, from the creation of the notification to its public dissemination. Each component has a clear input and output that enables the definition of an open architecture on the top of which complex systems can be created by the interconnection of multiple subsystems, developed by third-party companies. Communication between components is possible by the use of standard protocols, like the Common Alerting Protocol (CAP).



Targeted notifications are needed to improve the warning response. A warning system should be able to send information suited for each particular subset of population. Performing this process manually is a big burden for the emergency personnel. To overcome this problem, this process can be partially automated by leveraging the response knowledge of emergency organizations. A part of the emergency management is the definition of response plans to use in case of a disaster: in the early warning system literature this phase is called risk knowledge [1], in other response management models it is called preparedness [2]. In all cases, the hazards and the vulnerabilities

of a community are identified to guide preparation for response and disaster prevention. Part of this knowledge can be formalized into a set of rules - Crisis Policies, created by the emergency personnel according to the procedures that they have currently in place for each type of disaster. These rules specify which message template should be used for each specific event, how it has to be adapted to the current situation and what kind of information should be provided to the recipients of the warning. Through the application of these rules, a set of message template is automatically selected and filled with information about the current disaster, enabling the emergency personnel to easily create customized messages for different subsets of the population.

Our research team has addressed several research techniques for supporting high-speed, reliable, scalable and efficient dissemination given the range of events and diversity of recipient populations. At the content level, our focus was on using a distributed publish/subscribe based architecture for personalized content dissemination. The framework enables users to subscribe for notifications of interest – the subscription mechanism allowed end users to not only state what information they wished to receive, but also how, i.e., in which format and over what kind of channel (Internet, telephony, wireless messages etc.) they wished to receive notifications in. Enabling such customized notifications efficiently and reliably over large populations (i.e., scalably) was the main goal of our research[3,4,5,6,7]. At the delivery layer, we have developed fast and reliable protocols for delivery of heterogeneous warning content (short messages, images/maps and short video clips) over heterogeneous wired[8,9,10,11] and wireless networks[12,13,14]. Our current efforts revolve around incorporating these research results into a policy-driven warning system.

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