Vision for a Multi-level Emergency Response Framework

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e-Response: Pervasive assistance and emergency response on all levels: personal, family, organizational, local, regional, national and international.

The devastating tsunami of 26th December 2004 has highlighted the need for an effective global disaster monitoring and response system. It has also demonstrated the resilience and utility of global information networks in supporting innovative responses to the disaster. Responses range in level from the personal through support for local and national organization to the coordination of international relief efforts. Many IT tools used to enable these responses have been generic, for example: web pages, blogs, e-mail, or wiki. Thus, commercially-driven global investment in communications and information technologies has provided a resilient global infrastructure that already supports e-response at various levels (i.e., "dual use"). Commercial pressures will continue to ensure the development of new markets, products and services that will provide further opportunities for dual use.

We see opportunities to extend the range of current technologies accessible for e-response at various levels, to facilitate collection, integration, analysis and dissemination of information, within and between levels, and to influence the development and introduction of future technologies and ensure maximum leverage of commercially-driven investment.

Our vision is the creation of a global e-response system that:

1. amplifies the positive aspects of the use of global information networks by enabling flexible, devolved organization and providing effective linkage between different layers of response (personal, local, district, country international);
2. provides a platform for the integration of new, low-cost, pervasive, systems to provide a qualitative change in the timeliness and coverage of monitoring and response systems;
3. addresses the critical weaknesses of some current responses, e.g., the trust and security issues in systems that provide "open" access to survivors and relief workers (these are exemplified by the potential use of such systems by child traffickers or the vulnerability of systems to hoax messages).

Teams at the University of Edinburgh involved in relevant research in geological systems, simulation, information technology, command and control, e-health, and risk management would like to assist through their knowledge of state-of-the-art monitoring and response systems for natural disasters, terrorism, accident and emergency response. Edinburgh researchers are engaged with international groups concerned with multi-national response to incidents large and small. We are ready to assist in briefing government and relevant non-government organizations on current e-response technology, primarily to provide a medium and long term vision of how these systems could provide the basis for highly effective future systems which can evolve to support emergency response to a wide range of events: local to international, rural to urban, in the developing or the developed world..

The economics of a global monitoring and response system is undergoing radical change. In the past, single-purpose, dedicated, monitoring systems were very costly - often too costly easily to justify for low-probability/high-consequence events. Modern, robust, networks combined with new sensor technologies and pervasive general-purpose and embedded computers offer the possibility of developing a generic response system with appropriate monitoring based on the federation of local systems and focused deployment of economically

justifiable sensor networks. This, together with opportunistic introduction of new technology and processes when reconstruction is forced on us provides an evolutionary route to a global system. For example, building regulation codes and new infrastructure can be reconsidered when reconstruction is required, informed by the longer-term vision. Leaping to a new more flexible style of response, and using systems that can be most effectively deployed when reconstruction takes place could have many benefits.

The technologies can be used for a wide range of purposes beyond the large-scale disastrous events that may trigger the search for solutions. They are highly relevant for emergency response and citizen assistance on all levels from individual through family and organization, to regional, national and international. E.g.,

1. disaster response and evacuation
2. terrorism
3. civil accidents
4. disease control
5. business continuity
6. family emergencies

Imagine a situation in 2030, an environment where sophisticated sensors, pervasive computing, status reporting, autonomous or semi-autonomous diagnosis, protection and repair systems will be built into clothing, communications devices, vehicles, transportation systems, buildings and the environment. These would form the basis for a distributed and highly adaptable resilient safety net for every individual and organization from personal, through family, business, regional, national and international levels. In risk or natural disaster prone areas, building codes and insurance requirements would ensure that appropriate sensor/actuator systems were included in all future personal assistants and communication devices, vehicles and buildings to assist their uses. Systems would adapt and respond to the need for emergency response whether communication was possible or not. Local help would be used where feasible, but appropriate calls on shared services would be facilitated wherever possible when required. Needs for assistance could be validated and brokered to available and appropriate services through this framework in a highly distributed “market” fashion. Services would be provided to individuals or communities through this network to add value for all sorts of assistance beyond the emergency response aspects. In emergency situations, the local built infrastructure would be augmented by the facilities of the responder teams at any level from local police and fire response, right up to international response. An emergency zone’s own infrastructure could be augmented on need by laying down temporary low cost sensor grids, and placing specialized devices and responders into the disaster area.

In poor rural areas where reconstruction is likely to be slow and patchy, low-cost mobile technology could be used to provide local coordination, information and education together with good monitoring of a wide range of potentially hazardous situations. Currently teams in Edinburgh are exploring this kind of approach to health education and disease surveillance and control, in collaboration with the World Health Organization.

Developments could be made in stages. Systems already available can be used immediately to make a difference. Technology challenges and public reassurance demonstrations as the technology improved would ensure public support for the work and provide realistic and socially valuable platforms for new generations of researchers and developers who could be attracted to direct their attention to this socially valuable research area. Emergency response using a mixture of civil and military interventions would encourage new doctrines and operating methods.

Relevant technology areas include:

1. Sensors and Information Gathering
    a. sensor facilities, large-scale sensor grids
    b. human and photographic intelligence gathering
    c. information and knowledge validation and error reduction
    d. semantic web and meta-knowledge
    e. simulation and prediction
    f. data interpretation
    g. identification of "need"
2. Emergency Response Capabilities and Availability
    a. robust multi-modal communications
    b. matching needs, brokering and "trading" systems
    c. agent technology for enactment, monitoring and control
3. Hierarchical, distributed, large scale systems
    a. local versus centralized decision making and control
    b. mobile and survivable systems
    c. human and automated mixed-initiative decision making
    d. trust, security
4. Common Operating Methods
    a. shared information and knowledge bases
    b. shared standards and interlingua
    c. shared human scale self help web sites and collaboration aids
    d. shared standard operating procedures at levels from local to international
    e. standards for signs, warnings, etc.
5. Public Education
    a. publicity materials
    b. self help aids
    c. training courses
    d. simulations and exercises