JOURNAL OF AEROSPACE COMPUTING, INFORMATION, AND COMMUNICATION
Vol. 7, June 2010

Introduction: Integrated First Responder Technologies for the Global Transportation Industry

Following the terrible events of 9/11 in the United States there was widespread attention given to the weaknesses of the then existing orchestration and data sharing protocols between the various agencies of defense, security, and law enforcement. These tragic events led to the establishment of the Department of Homeland Security. As one of its roles it has the explicit target of providing more efficient systems integration and exchange of data with various emergency response and law enforcement agencies. Coupled to this is the desire and requirement to enable real-time cross-layer communications with other government intelligence agencies and military first-responder units. Other NATO government and first-responder organizations exist around the world with the same basic remit of providing emergency response solutions, securing national borders, and transporting utilities and communications systems in order to protect the quality of life of citizens and the free flow of people, trade goods, and services.

However, there have been a number of additional tragic events (the London Underground bombings on 7/7, the Madrid train attacks, the Mumbai hotel shootings, and the attacks in Thailand) that have resulted in loss of life in the developed and developing world that have exposed inconsistencies and inadequacies in the ability of the communications systems to interoperate and the lack of standard processes of intelligence gathering and information sharing between tactical and logistical agencies of governments supposedly working for the same objectives. Not least is to ensure the efficient integration of first-responder communications systems, but also providing standard methods for data acquisition, formatting, storage, fusing operational and intelligence data, secure distribution and integration of command & control with NGOs and other first responder teams from the military, security and law enforcement. One of the most challenging problems is that of ensuring consistency of technical and operational standards between the various groups within the respective first-responder communities, not just within the USA and other nation states, but between countries as part of coalition operations or in response to large scale events. With recent world events there are further pressures to provide for interoperability between former closed military C5I systems and those of national intelligence and law enforcement agencies to provide for Homeland Security and Emergency Response operations. Such systems are required to secure installations such as airports, seaports and railways. Of particular importance are the platforms, tools, and techniques to provide the front-line applications.

Currently in the U.S.A. there are numerous government agencies, offices, and federal government organizations all focused on the security of the US homeland, its infrastructure, and the US population. The U.S.A. is not alone in having numerous national agencies that 'touch' their intelligence data. The countries of Europe (in particular the UK), the Middle East, and Asia are all buckling under the pressure to be effective (pseudo real-time) in meeting the challenge formed by the new threats. The systems that are put in place need to share, query, and integrate their data with that of external countries, effectively extending the homeland security borders of each country involved.

One has only to glance at the web-site for the US Department of Homeland Security (DHLS) to get a sense of the multilayered matrix of directorates, divisions, and research projects that exist to create, process, and share data between HLS stakeholders. In the USA, the problems of secure integration of data and systems exist at local community, state, and Federal agencies. In the UK for example, the interoperability challenges exist between the various 'blue-light' agencies in the various cities and regions. Thus, the main bugbear is lack of scalable standards. Several good examples exist of attempts by the DHLS to investigate best practices and standards for computer aided dispatch (CAD), data labelling for sharing terrorist-related information across government agencies, critical infrastructure inspection and protection, data messaging standards, and multiband radio spectrum sharing. Whilst such initiatives are to be applauded at the DHLS, more work must be done to federate and integrate the systems of North America, Europe, Asia, and South America to address the ever increasing range of sophisticated threats to aerospace, shipping, and surface transportation.

In this Special Section we have several contributions that highlight and tackle some of these specific threats. The paper by Wowczuk et al. on "Complete Command, Control, Communications, Intelligence, Surveillance and Reconnaissance System for C-130 Aircraft" explores the wider utilization of the airframe for multi-mission objectives and the ability for the aircraft to act as a 'first-in-arena' platform in support of drug enforcement, field asset deployments, surveillance and multi-sensor tracking. The authors also examine the use of the platform for situational awareness in support of large scale urban-rural operations. Such a multi-role platform provides economies of scale for multiple agencies which are coming under increasing pressure to reduce operational budgets. As an example of special applications, the paper by Leed et al. on "Preemptive Response to Missile Threat Using Intelligent Video" highlights the technologies and techniques form image processing that can be provided to assess the threats from shoulder-based rockets and missiles that are fired against commercial and law enforcement aircraft and other assets. This could extend outside the domain of aerospace and could just as well apply to shipping and rail transportation. The authors introduce the concept of 'intelligent video' and discuss the merits of motion detection as a means to track and monitor targets' behavior and then use this data to inform and dispatch effective pre-emptive responses.

Lie et.al in "Concealed Weapon Detection: A Data Fusion Perspective" introduce the challenges of concealment of dangerous weapons, substances, or devices, a problem recently highlighted in recent airborne firebomb attempts by apparently normal passengers. Here the authors discuss the problems of multisensory data acquisition and fusion methods to the concealed weapon scenario and they postulate on the impact of operational range, environmental conditions and physical properties of the sensors to imaging and fusion performance.

Finally, the paper "Fast, Accurate Defense for Homeland Security: Bringing High-Performance Computing to First Responders" by Patnaik et al. introduces an urban-oriented emergency assessment system, called CT-Analyst® which was developed to evaluate airborne contaminant transport threats and to aid in making rapid decisions for complex-geometry environments such as cities where current transport and dispersion methods are slow and inaccurate. CT-Analyst® was designed for the military prior to 9/11 to incorporate verbal reports, to treat systems with mobile sensors, and to function in realistic situations where the nature, amount, and source location of an airborne contaminant or a chemical, biological, or radiological agent is unknown. This system can now be applied to urban defense in the wider Homeland Security context and the authors elaborate on its technical and functional description for such deployments.

As we look to the future, one can presume that, as with security and resilience attacks to our respective national telecommunications infrastructure, we must be constantly alert to the new and emerging techniques that will be deployed by those that wish to destroy our way of life. Funding for the fundamental research in our trusted academic institutions and industrial laboratories that can help mitigate against such attacks should not be compromised in the years ahead.

Gerard Parr
University of Ulster