Review of satellite and wireless solutions for homeland security systems

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The utilisation of satellite communication and wireless homeland security systems (HSS) are in the development phase in many industrialised countries.

Some governments, having recently completed their comprehensive reviews, are still wondering what vital role satellite and other wireless technologies will play in improving intergovernmental efficiency and operational coordination for all hot zones in one hypothetical country.

The focus on improved homeland security initiatives has never been greater. More attention is being paid to protecting border crossings, site security, trade corridors, tracking of freight over highways and railways, and securing all airports and critical facilities, seaports and coasts. Areas impacted by natural disasters, environmental pollution, epidemic diseases, and even the site where a weapon of mass destruction may be unleashed, need to be studied, monitored and analysed.

Global radio and satellite communication systems

For starters, let us remind ourselves and the the public that the common radio/TV broadcasting, cellular and landline telecommunication facilities are generally only intended for normal urban life. We know well that these terrestrial facilities are not able to cover all areas countrywide, including remote and rural environments. Also, the current National Communication System (NCS) cannot solely be an Emergency Support Network (ESN) for large-scale disasters.

Thus, we have to be realistic and supportive, and suggest that all the communication alternatives need to constitute a seamless solution, and that a single entity is required to ensure that all the pieces fit and work together. For these and other national reasons, is necessary to urge government to create a national Emergency Satellite Communication Agency (ESCA).

Only then will the satellite resources, assets, procurement strategies and planned applications fall under one roof, and it makes sense that some governmental agency should emerge as the formal satellite coordination and planning entity. All the new solutions need to be integrated in the ESCA, which must have a specific state and local outreach and training mission, giving it a focus well beyond the scope of either military or civilian applications.

We need to establish ESCA programmes, including anti-terrorist, emergency, disaster and epidemic response systems. In the event of any national disaster or attack of mass destruction, emergency responses and distress alert traffic will begin to flow. This may start with a noticeable increase in satellite phone traffic, followed by a series of broadcast alert emissions over the Inmarsat portable palmtop Global Area Network (GAN), notebook Broadband GAN up to 432 kbps or DVB-RCS facilities up to 45 Mbps. Homeland security systems (HSS) can be employed in existing Transportable Earth Station (TES) or Mobile Earth Station (MES) terminals as used in maritime, land and aeronautical applications, including Inmarsat Payphone solar powered satellite phones in rural areas. Where these satellites are destroyed or their transponders blocked, the use of the classical MF/HF/VHF radio communications systems remain.

Some equipment offers: voice via telephone set; voice over internet protocol (VoIP) via MPDS; voice over mobile ISDN telephone set; 12 DECT (cordless telephones); G-3 fax via telephone line; G-4 Fax via mobile ISDN; videoconference over IP (VCoIP) via MPDS; videophone via mobile ISDN videophone set; low, medium and high speed data communications; and tele-education, telemedicine and e-commerce.

Global satellite asset tracking and fleet management systems

The integration of satellite communication and navigation (SCN) systems is ideal for establishing asset tracking and fleet management for aeronautical transport, maritime transport, and land transport on road, rail or inland waterways, to increase both the capacity and the safety of transportation operations. Civilian airlines and transportation companies need to know where their vehicles are at all times, as do other government and public services such as the military, police, intelligence, fire fighting, ambulance, taxi and other services.

As well as improving safety and security, the new system will be an invaluable aid for monitoring, logistics, asset tracking, communications, control, surveying and managing transport operations. Managers will be able to know exactly when a consignment has been held up, as well as its exact location. This will also improve customer service, as clients can then be notified of delays and the reason for them, and when necessary, breakdown crews can be sent out without delay.
The system for security and control of mobiles and freight in civilian and military transportation, including safety of passengers and crews, offers the following services: mobile tracking and positioning; enhancement of traffic management, monitoring and control; monitoring of mobile performance such as trip records; optimised use of time to meet customer demands and deadlines; engine control, monitoring and maintenance notification; provision of data of engine irregularities; reports on mileage, speed, and fuel consumption; identification of mobiles and containers and their location; analysis of loading operations; casualty analysis; special control over the shipping of high value loads, bank securities and hazardous materials; control and monitoring of temperatures and humidity of perishable fresh goods or frozen products; detection of unauthorized access to cargo using door sensors; analysis of fleet performance parameters; pollution control; and the enhancement of safety and security of movements.

This satellite system may use Inmarsat-D+ or C/mini-C or Orbecomm transceivers, integrated with a GPS receiver, which can be combined with Inmarsat-M or mini-M voice terminals. Recently, mobile systems have been developed based on GAN portable terminal such as Maritime Fleet 33/5/77/432, Land Voyager GAN and Aeroroyal Swift64/432. This equipment may offer Mobile Internet, LAN, VoIP, VCoIP, Videophone, etc.

The satellite communication and navigation (SCN) systems gives priority to regulate and minimize road traffic jams. In this way, if all vehicles are fitted with a satellite navigation receiver, such as GPS or GLONASS, and a data transceiver such as Inmarsat-C or D+, their positions can be relayed automatically to a central reference station. This information can then be used in a number of ways to control road usage, to charge motorists for using a stretch of road, to restrict access to congested roads, or to inform drivers of congestion and suggest alternative routes.

**Global satellite communications, navigation and surveillance (CNS)**

The Global Satellite Augmentation System (GSAS) of both military determination systems, the US GPS and Russian GLONASS, was recently started, with operations in Europe as the European Geostationary Navigation Overlay System (EGNOS), in USA, Alaska and Canada as the US-based Wide Area Augmented System (WAAS), and in Japan as the MTSAT satellite-based Augmentation System (MSAS). Both the GPS and GLONASS systems are compatible Global Navigation Satellite Systems (GNSS) for position, velocity and time (PVT), but are not accurate enough for use as the sole means of navigation for ships, land (road and railway vehicles), and aviation applications.

In the meantime, an Indian project is developing GPS/GLONASS and GEOS Augmented Navigation (GAGAN). This project is financed from internal resources of the Airports Authority of India, and was initially sponsored by the Government of India in the preparation of the feasibility study by Osmania University, Hyderabad. The next step is the announcement of development projects in Russia, China and Australia, and this then leaves South American and the African continent.

Following the ICAO idea, the GSAS system has to be developed to cover all air corridors and airports worldwide. Following the concept of EGNOS as a system for maritime, land and aeronautical communications, navigation and surveillance (CNS), the author of this article has already proposed a preliminary project for an African Satellite Augmentation System (ASAS) as a first step for the development of our own African satellite of augmented GPS or GLONASS system for all mobile applications. This article was published in the July/August 2005 issue of Position IT, and is available at www.eepublishers.co.za/view.php?id=2254

The ASAS service will improve the high-operating integrity, accuracy and availability requirements of the basic GPS signals, and allows GPS to be used as a primary means of navigation for en-route travel, precision approach and non-precision approach for air traffic control and air traffic management in air corridors over the African continent, the control of airport approaches, and the managing of all aircraft and vehicles movements on airport surfaces.

The Reduction of Separation Minima in flight corridors is improved by as much as 100%. Secure separations are thus minimised, with a doubling of capacity for aircraft. Much better flexible flight profile planning (FFPP) is enabled as compared to the fixed air routes and flying altitudes currently used. The FFPP solution allows the selection of the shortest or optimum route and flying altitude between two airports, and so provides more economic and efficient flight operation.

In the same manner, maritime traffic control and maritime traffic management can be optimised during course operations such as ocean crossings, navigation at open and closed seas, coastal navigation, channels and passages, approachings to anchorages and harbours, and inside of seaports.

Finally, it will improve land traffic control and land traffic management for land (road and railways) solutions. The technology of the ASAS system would be a handheld personal receiver, similar to a cell phone transceiver, which would use satellite navigation to avoid traffic jams in city centres, find the nearest free parking space, a business building or even the nearest pizza restaurant in an unfamiliar city.

**Global mobile personal satellite communications (GMPSC)**

Those people living and working far from the reach of cellular wireless or telecommunication networks, for example, roaming construction engineers, exploration workers, medical staff, journalists, rangers, farmers, fishing boat or crew members of yachts, small planes or helicopters, can also have access to the homeland security system (HSS) network. In particular, every customer can choose to use the Iridium or Globalstar satellite network and/or a convenient cellular network when they are in urban roaming areas, because mobile phones will be dual- and triple-mode.

The delivery features include voice, data and fax messaging in both satellite and cellular modes. Handsets have manual or automatic satellite/GSM mode selection, using a small extending antenna. Special, rugged GMPSC equipment with external antenna can be fitted on board ships, land vehicles or aircraft, similar to the ship-borne, vehicle-borne and air-borne Inmarsat solutions.

Similar equipment is designed for use in rural and remote environments. The GMPSC model of rural public payphone will offer the ability to communicate.
with any location in the world using voice facilities and emergency numbers for access to medical, firefighting or security services. The terminal will be similar to a typical city payphone operated by phone cards, ruggedly constructed to withstand vandalism, simple to use, and able to indicate the amount of money remaining on the card, and powered using mains network supply or solar panels and batteries.

Additional services include remote fault diagnosis, local support to ensure rapid repair and high availability. This payphone can be used in remote suburban and village environments, in desert and forest areas, on cruise ships, on board aircraft, sea platforms and oilrigs. They are easy and cost-effective to install and operate, using prepaid smart cards. Local authorities can use the payphones for emergency calls, using a special access card.

Remote business sites and households can use an indoor GMPS standard phone set connected to an interface box and external outdoor antenna mounted on the roof. This box can be linked to standard telephone/fax or ISDN/internet lines, using mains power, 12 V battery or solar power.

The GMPS system network will also provide possibilities for organizations involved in fast-moving emergencies and interventions, such as disaster relief agencies, military and international peace-keeping forces, police squads, medical teams and civil authorities. This service offers assured communications for PC data, voice, fax, SMS and encrypted messages. For personal use it will offer dual mode functions on portable handsets for both satellite and cellular connection.

On the other hand, for group use the system will offer mobile handset terminals for fitting to ships, vehicles, aircraft and temporary camps or bases. Inmarsat, Iridium, Globalstar and other current GMSC systems have developed both common and special military mobile and portable satellite tactical and defense communications equipment. There is also possibility to install these in rural or remote areas, as well as PC public terminals for Internet service via wireless or satellite networks.

Regional stratospheric communication platforms (SCP)

A further suitable and autonomous solution comprises stratospheric communication platforms (SCP), deployed in solar or fuel energy powered manned or unmanned aircraft, or unmanned airships. For both civilian and military applications, this new broadband system is more advanced and cost-effective than a cellular network in terms of QoS, propagation, penetration of signals inside of buildings, and shadowing, offering Internet speeds in excess of 50 Mbps. In the future stratospheric communication platforms may replace cellular systems and spread the range of telecommunication landline and optical networks.

Local wireless and electronic systems

Intelligent transportation systems (ITS) for local wireless and electronic homeland security systems will offer: security, control and logistics on lane roads; traffic controls systems; freeway and tollway traffic management system; incident tracking and management systems; traveler information systems; adaptive signal control; traffic safety enforcement; order crossing and trade corridor systems; etc.

Automatic vehicle identification (AVI) systems identify, control, monitor, track and collect data on vehicle movements on the roads, seaports, airports, government facilities, oil refineries, power and chemical plants, depots, parkings, borders, gates, military deployment points enabling better management of vehicle activities.

Electronic vehicle registration (EVR) programs create a secure and efficient access control system for border crossings and public or private facilities. The system can be adopted for military bases, federal buildings, and state and local government complexes as well as for certain private entities that deal with sensitive materials. The system could also be used by inspection or regulatory agencies as part of licensing, tracking, and monitoring requirements for private or commercial vehicles.

Freight tracking systems (FTS) enhance security through AVI-based data collection and can benefit commercial operations via rapid processing and cost-saving management tools. FTS can combine AVI with electronic seals, which would provide data showing when a container was last opened. The system will provide location and seal-status information throughout the entire chain of custody. This will give personnel primary screening capability to know who, what, where, when, and how a container was shipped and whether it was opened legally. The enhanced tracking data improves asset management, customer service, and support of just-in-time objectives.

Border crossing systems (BCS) enable state security personnel to identify frequent, low-risk commuters. AVI tag and reader systems identify each vehicle, driver and approved passengers, to ensure only authorized vehicles and matching drivers cross the border. The system saves time for commuters and enables agents to focus on higher-risk, unknown vehicles and passengers.

Conclusion

It is an important issue of national interest that the Department of Defence, Department of Communications, Department of Transport and National Intelligence Agency should initiate the establishment an Emergency Satellite Communication Agency (ESCA) and Transport Augmentation Board (TAB) for development of the African Satellite Augmentation System (ASAS) project.

This could be done through civilian and military organisations, research bodies and educational institutions, such as SAA, ACSA, ATNS, CSIR, Satellite Application Centre, SunSpace, Electronic System Laboratory of Stellenbosch University, Rural Communications of UKZN, Maritime Institute, Military Academy, Transport Department at the of University of Johannesburg, etc.

The government of SA could be the initial sponsor for the ASAS project and, for example, ACSA could be the prime contractor. Other African countries could participate as a partners and shareholders of the project.

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