Saddam Airport, Bagdhad

The transition of digital earth imagery, once considered simply data, to a critical element in homeland security

More than imagery — intelligence

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The proverbial "eye in the sky" has come a long way in 60 years, from the earliest operational use of aerial photography during World War II to the current use of satellites by the military, civil authorities, and industry—for a wide range of applications.

Along the way, the world has become a much more dangerous place, as tragically revealed in the 9/11 acts of terrorism and their aftermath. The United States no longer faces a predictable and definable threat from an adversary like the Soviet Union. Its enemies have disappeared into the shadows of "asymmetrical" warfare, reverting to seemingly unpredictable strikes at the country's infrastructure and unprotected population centers.

Fortunately, over the last decade, new technology has given us tools to combat terrorism by gathering intelligence in near real-time. The U.S. military has changed its mode of procurement from a procedure known as MILSPEC (military specifications) contracting—driven by a meticulous, time-consuming and costly process of custom crafting hardware and software—to a method known as COTS (commercial-off-the-shelf), thereby exploiting the efficiencies of hardware developed for the private sector.

This capability is being used today in Iraq in the form of a command and control system known as the Theatre Battle Management Core System or TB-MCS. TB-

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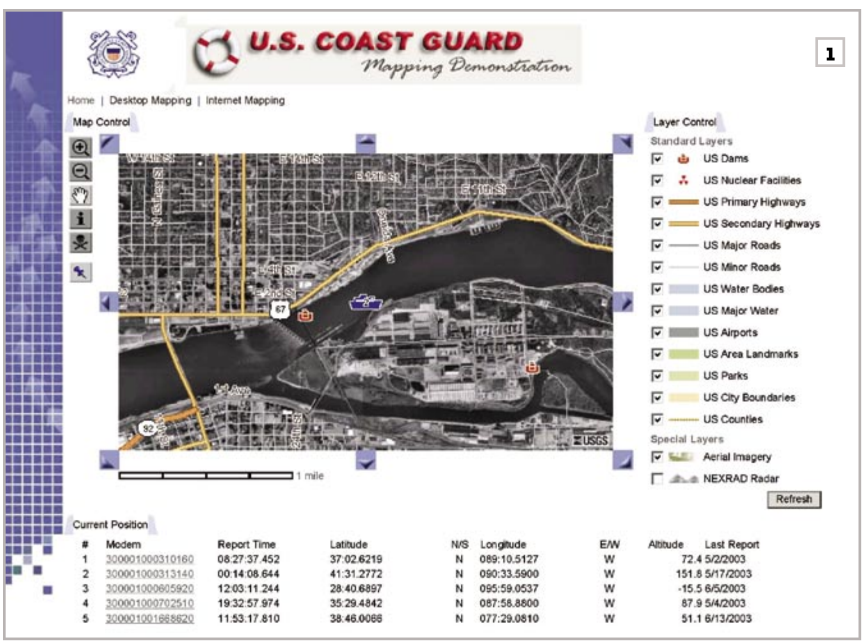
MCS is a Web-based system for planning, managing and executing the air war. Fifty computer programs keep track of the latest information on targets, weapons, fuel-loads, weather and navigation. Combined with manned surveillance aircraft like JSTARS (Joint Surveillance Target Attack Radar System) and unmanned UAV/RPV’s like the Air Force’s Global Hawk, in addition to precision munitions like the GPS-guided J-DAM, the military has completed the transition towards “network-centric” warfare, a faster way of sharing tactical information and deploying offensive and defensive forces.

The end result of this successful transition by the military is the availability of



functional and affordable tools to process the high volumes of geographic raw data produced by airborne or satellite-based sensors. Equally important is the parallel development of broadband communication technology to move data anywhere in the world in real-time, paired with database capabilities permitting the cataloging and organization of complex geographic information. The customization of these technologies to serve a specific task, like homeland security, is the final step in creating a capability which will provide an edge in defending the U.S. from outside threats.

Domestically, the potential applications of this technology are numerous and diverse. Practically every component of the economy, from transportation to energy production, is vulnerable. Thus surveillance of some kind is being applied as a defensive layer in the security process. For example, the Coast Guard is tasked with protecting the inland waterways and ports that are the lifeblood of international commerce. The overhead perspective is the ideal vantage point to monitor ship and barge traffic in real time, using existing aerial and satellite imagery as a reference.

In the near future, ships and barges will be required to have GPS equipment on-board capable of instantly communicating via satellite their location and status. Combined with other sources of information, such as proximity of pipelines and nuclear power plants, along with the graphic display of Coast Guard resources, such as patrol boats, the Coast Guard will have the equivalent of the military TB-MCS command and control system. Ultimately, organizations like the Coast Guard, FBI, and local law enforcement will have access to real-time sources of imagery from airborne platforms, with all data processed from its rawest form and geographically oriented into a useable form of intelligence that will give decision makers exactly the information they need when they need it.

Figure 1 shows a computer display of a possible Coast Guard surveillance scenario along the Mississippi River in which barge traffic containing dangerous cargo is being tracked in real time.

In this context, digital earth imagery from satellite and aircraft platforms is transitioning from an isolated source of information to one that is an integral part of a decision-making system in which the imagery is an important, but not the only source of intelligence. Imagery will frequently be the reference layer, often replacing or supplementing the digital street map as a way of determining the location of important resources. Imagery becomes much more of a critical layer in itself when it is created in real time, processed and integrated with other types of data, as a surveillance source of intelligence—again, similar to the military’s JSTARS and Global Hawk systems. It is this visual intelligence showing the status of a dynamically evolving situation that demonstrates the use of imagery rising to its greatest potential.

However, at this point, strategists among the homeland defense constituencies need to think outside the box. As the recent terrorist acts on the commuter rail system in Spain have demonstrated, asymmetrical attacks may come where and when you least expect them.

For example, imagery and associated command and control systems may be configured to deal with one of modern society’s most devastating disasters, wildland fires. These disasters traditionally have been ignited by natural forces such as lightning, but now are frequently attributed to malicious arsonists or, not an unlikely threat, to potential terrorists. Wildland fires are among the most dynamic and destructive of natural or manmade calamities. To date, the process of dealing with wildfires has been more reactive than proactive. In other words, fires ignite, are often influenced by atmospheric conditions and winds, and spread rapidly as time progresses, until countermeasures are applied.

Wildland fires parallel other types of natural disasters such as hurricanes, tornadoes, floods, and earthquakes, with one important exception—unlike other catastrophic events, these seemingly uncontrollable disasters are completely preventable. Many of these conflagrations, like the 2003 Southern California fires, could have been contained if they had been identified early and isolated using rapid response tanker aircraft and helicopters—a scenario that closely parallels the military aerial command control capability embodied in TB-MCS. Any fire fighter will readily acknowledge that time to respond to fires is the key variable in their suppression.

Figure 2 shows an example of such a system in which fire bosses get the "big picture" and rapidly respond to new threats in the field with instantaneous access to intelligence. Airborne sensors can detect early ignition of a fire. In a tactical mode, the raw imagery generated by these sensors is converted into a digital photomap in near real time. That information can then be combined with a variety of other data, such as road networks, location of known hazards, aerial tanker attack plans, and real-time meteorology overlays, to generate a complete intelligence database. Fire bosses can direct operations in the field in a manner that allows field crews to receive only the information they require when they need it.

There are many variations on this theme, in which imagery generated, analyzed and delivered in near real time can have a dramatic impact in limiting or containing the threat of terrorism. The availability of technology at an affordable price is no longer an issue. Institutional inertia may be the greatest inhibitor to the adoption of this technology, and this roadblock will disappear as government and the private sector successfully demonstrate the benefits that imagery, integrated into a command and control system, can generate. «