

# Mapping the future

**W**hile better protected vehicles and protective EW systems, such as radio frequency jammers, save lives on the battlefield, they are prophylactics that protect people when they are unfortunate enough to encounter an IED. Getting ahead of the game involves the effective use of intelligence from many diverse sources. This is a very complex task now, but is made easier through the use of geospatial information systems (GIS) as the focal point for continuously updated threat information, correlated in time and location, that commanders at various levels and warfighters at the tactical edge can add to their maps via web services. Such maps can be built from the same core geospatial data.

At the DGI 2011 event held in London in January, an industry team led by Esri gave a demonstration of how GIS can bring together many information services that be could be used in the counter-IED fight as an example of its wider usefulness, while a team from the UK MoD explained

In the ongoing struggle against IEDs, a number of industry developers have joined forces to demonstrate how fusing their technologies and data can ultimately provide life-saving geospatial information, **Peter Donaldson** reports.

how such a capability has been put into service in Afghanistan.

Potentially life-saving information is gathered by an increasingly wide range of sources, usually in an equally wide variety of data formats. 'The challenge is to bring this mass of data together so that it can be effectively exploited to support the full spectrum of operations and save lives,' said Nick Rigby, non-executive director at Esri UK. 'The good news is that whatever the source, all this information has a place and time, so it can be geographically referenced.'

With Esri's ArcGIS as the centrepiece that provided the core mapping and geo-referencing capability, the demonstration brought together software and services from BAE Systems GXP, ITT Envi, i2, Cobham MMI,

Systematic and IHS Jane's to show how they can be used to build shared situational awareness and then plan, execute and debrief operations using bandwidth-friendly web services.

'As part of Esri UK's long-term commitment to its UK MoD customer, we took the initiative to bring together the best-of-breed providers to address this challenge and demonstrate how more can be achieved with available technology,' said Rigby.

## BUILDING UNDERSTANDING

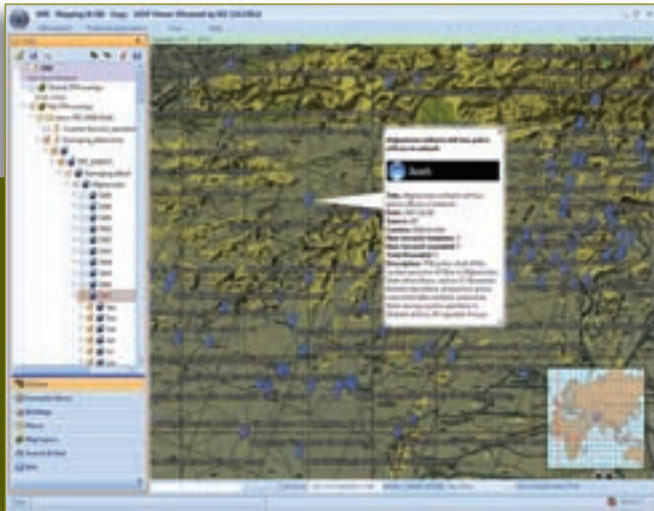
IHS Jane's provides open-source intelligence on terrorist events, activities and organisations. The demonstration used information from the company's Afghanistan dataset, showing how commanders can pull up a screen listing all the different terrorist groups active in the country and the events that they have perpetrated, and correlate them geospatially with IED attacks on coalition forces.

All of Jane's data is geo-tagged with the lat/long coordinates so that it can be displayed in a common operational picture (COP), enabling the user to read the analysis data and visualise it in a GIS environment. By viewing all the terrorist events in Afghanistan over a given period of time on the map, the user can then employ temporal analysis tools to visualise hotspots and trends, identifying where a commander needs to focus more effort.

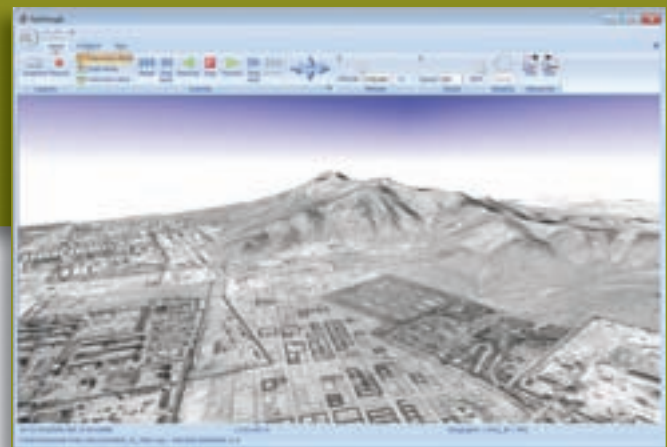
Using the C2 system supplied by Systematic, the commander can see icons representing friendly units displayed on the same map, accompanied by information such as identity,



A final check with UAV video can be critical to the go/no go decision, and having everyone on the same map via the GIS speeds the process. (Photo: UK MoD)



GIS brings in multiple intelligence sources to provide a common operating picture. **Above:** Adding to understanding with open-source intelligence. (Image: IHS Jane's) **Above right:** Using hotspot analysis to identify an area of focus for the commander in ArcGIS. (Image: Esri) **Right:** 3D visualisation of an area of interest using BAE Systems' SOCET GXP. (Image: BAE Systems)



location and immediate intentions. The C2 system presents this information in an email-like display, translated from a wide variety of messaging formats.

Esri supplies a set of spatial and temporal analysis tools that users can employ to build an understanding of change and to reveal, for example, how concentrations of IED activity have varied over time. That timescale could be the last two years or, more likely, the last two weeks compared with the fortnight before that. Additionally, colour coding is helpful in such a scenario – in the demonstration, red areas indicated a significant increase in activity. Another display highlighted the types of incidents that had increased over the period of interest.

All of this information can be put into reports in the form of graphics or maps, and, in some cases, these can be generated automatically. Drawing on temporal analyses, reports produced for the demonstration compared periods of activity by friendly and hostile forces, in this case indicating that the Taliban were more active later in the day than coalition forces.

With this information available, the commander can quickly decide where to focus attention. For the demonstration, i2 provided its new ArcGIS-compatible Analyst's Notebook – Esri Edition, used to pull in information from multiple sources, consolidate it into a single set and help make sense of it.

The demonstration showed how this system can put SIGINT data into a topological view, showing when and exactly where particular sensors took hits. Again, with data intercepted over a period of time, it can be correlated with IED activity, helping analysts to focus on individuals and form hypotheses. By tracking individuals over time, they can build a pattern of life and, for example, combine it with human intelligence, and then exploit it all using social network analysis tools. These enable an understanding of a target individual's position within an organisation and that organisation's position within a global network.

#### DETECTING CHANGES

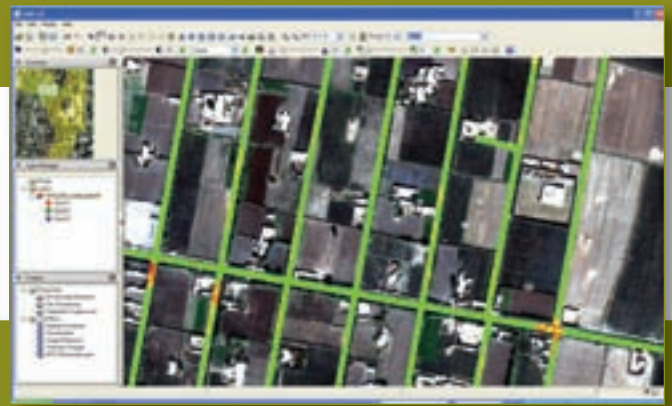
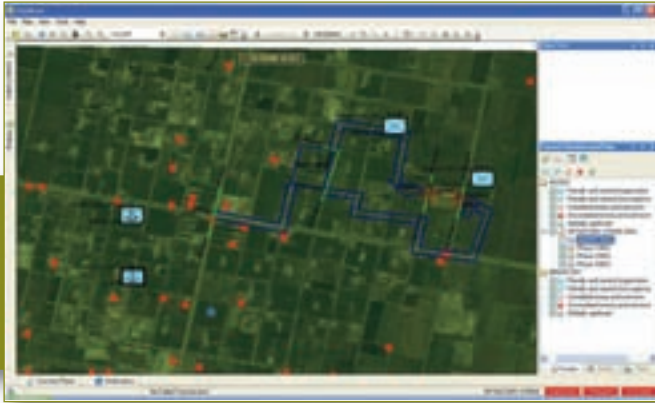
ITT Envi provided image processing capabilities for the demonstration, taking imagery from a wide variety of sources and processing it to make it as useful as possible for the COP. Using aerial images of a compound taken over a period of time, change-detection software highlighted evidence of vehicle activity and building work, correlated with imported enemy contact information and shell craters from earlier kinetic activity, indicating that the area was one that deserves further attention.

Again, colour coding enabled the change detection software to highlight in red the features that had gone away, and in blue things that had been added. Feature extraction tools help analysts to identify particular objects of interest within the scene.

Using this information, analysts can then start constructing risk assessments. For the demonstration, ITT Envi used a decision tree procedure to produce a map on which high-risk routes were shown in red and low-risk ones in green. The decision tree uses sophisticated logic to assess risk, a simplified exposition of which might go something like this: 'If there has been a previous incident in this area, the ground has been disturbed and perhaps the surface texture has changed, so there is activity there that should be monitored.' That goes onto the risk map, contributes to the COP and can be used to cue further intelligence collection, in this instance, by an RF and communications interception vehicle.

Armed with this information, the vehicle crew can drive around the area using the

## COMMUNICATIONS



*Left: Systematic's SitaWare is designed to enable ad-hoc planning of operations at the tactical level. (Image: Systematic) Above: Route analysis, drawing on IED incident history. (Image: ITT Envi)*

green roads and avoiding the red ones, listening into the target's RF communications and simultaneously working out where they are coming from, affirming that the compound of interest is the right one.

#### ■ PLANNING AND EXECUTION

The demonstration then moved into the mission planning phase, in which analysts, using tools provided by BAE Systems' SOCET GXP, were tasked with delivering geospatial intelligence reports to the commander. Understanding the commander's intent allowed them to focus on the essential intelligence elements that they needed to extract from the different sources. In this case, the intent was to disrupt the activity in the compound with a kinetic attack.

As they were working in a common GIS environment, planners could put precisely mensurated points onto the map to be used for weaponeering. They also produced planning packs that informed the commander of various options for courses of action. At the same time, planners made a collateral damage study, highlighting areas of significant civilian concern that might have impacted upon the commander's decisions.

In this case, the analysts highlighted another nearby compound where there was a lot of SUV activity, and a choke point where a convoy was involved in an ongoing incident, having become stuck at a culvert with some disturbed ground. The new information changed the plans, and the decision was taken to put ground troops in, which meant bringing in terrain data that would enable the helicopter crews to visualise the landing sites for troop insertion and casevac during their own mission-planning process. It also enabled

planners to identify the best infiltration and extraction routes.

With the plan constructed and imported into the Systematic C2 system, the demonstration moved into the execution phase. However, before H-hour, the plan was put back into the database to allow various experts to check that nobody will be driving over a known IED; that everyone is taking the right routes; that the walls are not too high to climb, etc.

The last action before issuing the go order was to put a UAV over the target to do a final check with full-motion video. This helps reassure the commander that there are no remaining collateral damage concerns. It also provides vital evidence if the operation is later challenged, perhaps showing that collateral damage that might appear on TV was already there a week before the mission.

To avoid revealing too much about actual operational procedures, the demonstration skimmed over the execution phase, but did show icons moving over the map, this time using a smaller screen of a type that might be found in a participating commander's vehicle.

#### ■ IN THE REAL WORLD

Moving into the post-mission phase, i2's social network analysis tools come into play again to determine the effect on the terrorist network and recalculate all the metrics. The same tools can also be used to identify the next point in the network that should be focused on.

This demonstration was very much an industry vision of how such joined-up systems could work. It is, however, much closer to reality than this description might suggest, because the UK MoD deployed such a system to Helmand Province, Afghanistan, in March 2010 with the British Army's 42 Engineer

Regiment (42 ER), which, along with No 1 Aeronautical Information Documents Unit and an HQ, forms the Joint Aeronautical and Geospatial Organisation.

Built around DataMan, a software application that supports the management and importing/exporting of data in databases and files, and the updating and publishing of related metadata, the system has quickly become the 'Tesco for data', according to programme manager Keith Mosley of 42 ER. Developed over five years using internal funding, it crept under the radar of the normal procurement process and was developed from the bottom up, he said, passing through many iterations and being tested in exercises, particularly the Coalition Warrior Interoperability Demonstration series.

DataMan runs on COTS Dell hardware and works with 42 ER's GeoNet system. It connects to other networks via geo-proxy, a proxy server that handles requests from clients who want services. 'The only thing that goes across that geo-proxy server is http and ftp', Mosley explained. 'No one gets direct access into the databases. The only people who get direct access to the data are our own analysts, so that means it's fairly safe.'

After reassuring incumbent commanders in Afghanistan that DataMan was not going to hog bandwidth by moving vast amounts of data, the system gained popularity and the number of requests topped the 1.2 million mark by the end of September. It is now providing services down to company level, across the Afghan Mission Network and even to the USMC at Camp Leatherneck.

A more portable DataMan 'lite' version is under development to improve service at the patrol, company and battlegroup levels where most of the battles are fought. **DB**