# SPOC

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# "IT'S ONLY LOGICAL"

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Imagine yourself in Iraq or Afghanistan conducting Missile Warning, Space-based Battlefield Characterization, Space Situational Awareness, Blue Force Tracking (Air, Land and Sea: surface and sub-surface), and Enemy force tracking. Imagine doing all this as well as monitoring the status of satellite collection. While doing this job you don't need five different computer systems and programs the rest of the Army is using; you only need one. This is not science fiction it is science fact. Let me introduce you to, the SPace Operations Common operational picture, or (SPOC).

The 8th Army Space Support Element, with the approval of the U.S. Army Space and Missile Defense Command/Army Forces Strategic Command's Future Warfare Center (FWC) and Battle Lab in Colorado Springs, Colo., and with the support of the FWC Models and Simulations Division in Huntsville, Ala., developed the SPOC. 8th Army uses SPOC as a replacement for multiple systems. SPOC takes multiple data feeds that are normally processed by different systems and merges it into one display that can be filtered. (See Figure 1) SPOC uses a classified Google Earth EC as its base platform for displaying all the incoming data. Currently the Overhead Persistent Infrared data is fed into the system through the Joint Embedded Messaging System; the other feeds are Keyhole Markup Language-based. Joint Embedded Messaging System was developed by L3 Communications for USASMDC and will be further explained later in this article. We

are attempting to move away from Keyhole Markup Languages as a primary means of data feeds and toward direct feeds with the use of Joint Embedded Messaging System. For now the Keyhole Markup Languages primarily come from, but are not limited to, three sites: Counter-IED Operations Integration Center (User Defined Operational Picture), National Reconnaissance Office, and another classified sensor Web site.

During exercise Key Resolve 2009 the 8th Army Space Support Element put the SPOC through its paces. After multiple changes to the baseline mapping code we ended up with an extremely effective and highly sought after tool used to provide global Space Situational Awareness. Our system was so effective the Air and Missile Defense element started using it as opposed to the Web warn, which is the theater system of record for providing tactical missile warning information. SPOC received the Overhead Persistent Infrared data faster and it provided clearer amplifying data. The immediate solution was to remotely display SPOC at the Air and Missile Defense desk using an extra monitor linked directly to our Space Operating Systems Workstation. This exercise would not have been as great a success had we not received excellent support from Kevin Crumlish's team in Huntsville and the augmentee Army Space Support Team leader CPT James French. This group of people took our requirements and direction and created an extremely powerful tool from what was already a working product. (See Figure 2)

We also conducted real world tests before, during, and after Key Resolve 2009. Tracking everything from real world Blue Force Tracking, to real world missile launches. We tracked the launch of the H2A prior to Key Resolve 2009 as well as Overhead Persistence Infrared hits from combat operations in the Central Command Area of Responsibility. After Key Resolve 2009 we were asked to provide our system to the U.S. Forces Korea commander GEN Walter (Skip) Sharp to monitor the TD-2 Launch out of North Korea. We established two systems, one with the 8th Army watch team and one with the J2 at U.S. Forces Korea. During the launch GEN Sharp was briefed using our system. Comments from the J2 and others were that our system was invaluable.

The best part about SPOC is that it is extremely versatile and can be tailored. If you have new data you want to display you can. This will allow you to adapt SPOC to your units needs. With this system you also ensure multiple methods of gaining access to data. This came in handy during the TD-2 launch in April 2009. Prior to the TD-2 launch the operator, a non-FA40 and someone not familiar with our system, had not turned on the Joint Embedded Messaging System feed. Fortunately we had configured a secondary and tertiary back up which allowed them to maintain situational awareness without even knowing the main system was offline. This is not to say the system is complete. I don't think that will ever be the case, but I do believe it is an effective

"JEMS (Joint Embedded Messaging System) will bring the SPOC (Space Common Operational Picture) to the desktops of not just Space officers but every staff officer who needs to know."

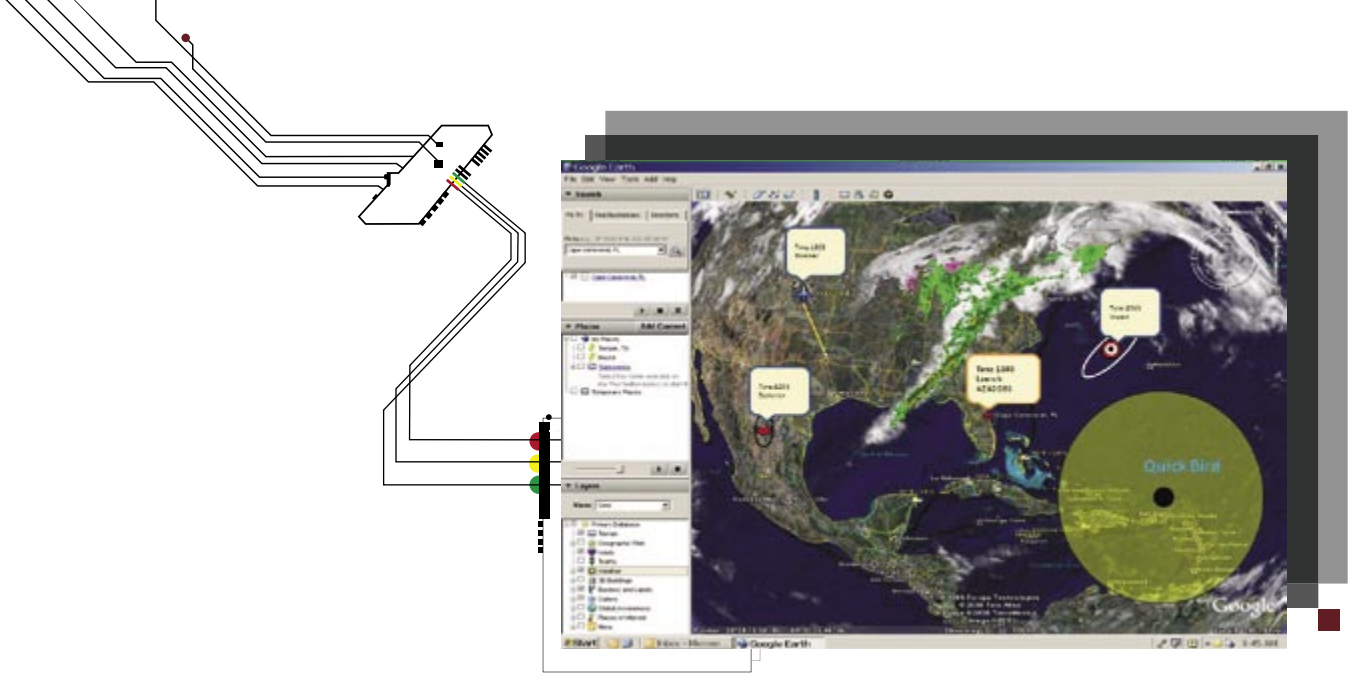
CPT James French, EN
Army Space Support Team
15 Team Leader

tool that if used properly is a huge combat multiplier.

The questions that continually come up when anyone sees SPOC in action is where did this concept come from, and how did we do it? First, it was a long and painful process with lots of smart and dedicated people working together to make this vision a reality. It all started in 2006 when I was a missile commander at Cheyenne Mountain in Colorado Springs, Colo. The, then, Missile Correlation Center was transitioning from the Command Center Processing and Display System Replacement (CCPDS-R) to the Missile Analysis and Reporting System. The CCPDS-R system we were using was decades old but it had been upgraded. While the display looked like something out of the 1960's, (See Figure 3) CCPDS-R gave us the big picture, however; it was designed for the strategic missile warning mission, i.e. Intercontinental Ballistic Missiles. Although it could detect smaller systems it was extremely inefficient for tactical warning and giving the combatant commander good situational awareness. One reason for this is there was an extremely limited drill down capability on the CCPDS-R and it would not give you city locations of the events. The Processing Display System – Migration was designed to fill that gap in the theater missile warning mission area however; the way the system was designed it automatically filtered out much needed Overhead Persistent Infrared data that is extremely valuable to the ground forces commanders. The Processing Display System – Migration was a little better with its drill down capability but was still limited. Ground forces need something more effective for battlefield characterization. If a large explosion was detected usually the best location we could give was Russia and a latitude and longitude. (See Figure 4)

When we transitioned to the Missile Analysis and Reporting System we incorporated the limited Processing Display System – Migration map type display with the strategic feeds. This system was better than CCPDS-R but for 2006 it was terribly inefficient. (See Figure 5) When I attended the Tactical Space Operations Course I discovered how to integrate certain Overhead Persistent Infrared Keyhole Markup Languages into Google Earth on SIPR. This gave me an idea. First, I lobbied to get Google Earth on the Cheyenne Mountain Operations Center computers to assist us in our daily duties. This would give us drill down capability and the ability to update the imagery as the terrain changes due to construction and battlefield damage, thus giving us excellent situational awareness. This would also allow us to make an initial assessment to the cause of some large explosions. For example the Circular Error of Probability is represented by an ellipse. So if we detect a large explosion we can drill down and if the ellipse encompasses an industrial area it could be an industrial fire or refinery. If it is in the middle of the woods it could be a forest fire. If it is in the middle of the desert miles from the city it could be an Improvised Explosive Device testing facility.

The next step I took was to look around for a way to pull SIPR Integrated Broadcast Service data into Google Earth. The first call I made was to the Integrated Broadcast Service Support Office at the National Security Agency. I asked if there was away to pull Integrated Broadcast Data into a Google Earth readable format. They told me they had heard someone was working on it but they did not know who. I continued to ask around and found David Estacio, a contractor supporting the FWC Models and Simulations Division in Huntsville. He put me in contact with Kevin Crumlish, the government lead for Joint Embedded Messaging System. I outlined my idea and although this was not a part of the original design for the system he believed it would work. For the next few months I spent time on the phone with Chris Rule, a member of the Joint Embedded Messaging System team developing the Missile Warning display. By the time I moved to Korea we had established a baseline of what we wanted the Missile Warning display to look like. We also tested the display by running real world historical data through a closed system and comparing the new display with the historical Processing Display System – Migration display screen captures; both displays use the same data feed. The next step was to see if we could get the




system to accept a live feed. When I got to 8th Army I pitched what I had been working on to LTC Annie Merfalen, the 8th Army Space Support Element Chief. She was very supportive and allowed me to continue to develop this concept for 8th Army use. After I received the blessings of the USASMDC/ARSTRAT Battle Lab to conduct testing on the concept using our Space Operating Systems Workstations, I went back to work with the Joint Embedded Messaging System team. We ran into many brick walls but ultimately through trial and error we found the right configuration. With the use of the Global Network Initiative network and Joint Embedded Messaging System we are able to pull in all the Overhead Persistent Infrared data we needed to conduct the missile warning mission.

To better understand the flexibility of SPOC you must first understand the power of Joint Embedded Messaging System, so I asked Kevin Crumlish to give an overview of it.

- The Joint Embedded Messaging System was developed by the FWC Models and Simulations Division. The system translates messages and protocols for command and control, simulation, and other systems using an operator configurable application for input and output formats. The system is typically used to translate simulation-based information into tactical message formats and other simulation formats. Command and control systems are often at the mercy of incompatible message formats, differing transmission protocols, and bandwidth limitations. The command and control systems and message formats are continuously evolving, often rendering preset message translations obsolete. The Joint Embedded Messaging System was developed as a more adaptable solution – a generic translation tool to apply as needed and without software changes. It is used in Joint and Army experiments and exercises to enable disparate simulations to participate and also to drive Command, Control, Communications, Computers, and Intelligence systems like Command and Control Personal Computer, Force XXI Battle Command, Brigade-and-Below (FBCB2), Global Command and Control System, and Command Post of the Future.

A Joint Embedded Messaging System operator interfaces with its Graphic User Interface editors to establish translations and communication routes; through the use of three main options: the Message Editor, the Map Editor and the Communications Path Editor.

The Message Editor is used to create text, binary, or mixed messages defined at the field, line, or group level with characteristics like length, delimiters and content rules. Messages are created using a point-and-click interface and a completed definition is called a Message Specification.

The Map Editor centralizes the translation between input and output message specifications. This editor provides graphical representation of translation logic and operations. The Map Editor uses more than twenty data conversion operators. They perform functions like transforming coordinates, generating unique track numbers, and completing mathematical calculations. The combination of input and output message specifications with associated translations is called a Map.

The Communications Path Editor routes message specifications to defined recipients. Routes are data, protocol, and translation relationships between external systems. The external systems can have the following characteristics: interface type, communication protocol, supported data formats, high level protocol and classification. All the editors can be used during the operation of the system to affect changes without interruption of other translation activities.

The Joint Embedded Messaging System Input/Output (I/O) Component controls the transmission and receipt of data from external systems. The Joint Embedded Messaging System can be configured with multiple I/O Components on sepa-

> "The creation of a standard Space operations COP (common operational picture) allowed 8th Army's SSE (Space Support Element) to take our support to the next level. The integration of SPOC on the Combined Operations and Intelligence Center floor allowed us to incorporate multiple data sources into one common display, and thereby enabling the SSE to provide a continuous assessment of theater Army operations and recommend actions to achieve the CDR's key effects."
>
> LTC Annie Merfalen, Chief,
> 8th Army Space Support Element

rate computers to allow remote operations. In single machine operation, the system can test message routing for validity and accuracy before an exercise or operation takes place to ensure that the training event or operation is not hindered by message incompatibility issues.

USASMDC/ARSTRAT is expanding the Joint Embedded Messaging System to become a Cross Domain Solution, facilitating allied and multinational participation in experiments and exercises. This effort provides and ensures a secure, Department of Defense accredited, interoperable and multi-level security solution to share data across networks of varying classifications. The connections between these networks prevent intentional infiltration of the network and unintentional loss of classified data. Each field in a message specification is individually classified and connections cannot be made via the Map Editor to fields of differing classifications. All Maps are approved by the foreign disclosure officer and security officer. Classified data must be routed through a data converter to filter or change the data to the appropriate level. The Joint Embedded Messaging System Cross Domain Solution enables command and control and simulation systems to be interoperable and reduces the timelines for passing critical command and control information to and from coalition partners.

Once the Joint Embedded Messaging System was online and we had the missile warning data process flushed out, we began to look at other applications of the system. With the help of Navy LT Rollie Wicks from the J2 at U.S. Forces Korea we were able to bring in additional dynamic Keyhole Markup Languages to improve the situational awareness seen on SPOC. Through the use of the SIPR Counter-IED Operations Integration Center Web site we can generate a dynamic Keyhole Markup Language with specific filters allowing us to track friendly and enemy forces to include but not limited to; current land, sea, and air locations. We can establish a National Reconnaissance Office account and generate a dynamic Keyhole Markup Language for limited satellite and intelligence, surveillance and reconnaissance collection tracking. We can also import a dynamic Keyhole Markup Language from another classified sensor and all of these can be displayed in Google Earth EC.

Through this development process we discovered many other uses for the SPOC. For example, 8th Army used Google Earth EC to conduct a Non-combatant Evacuation Operations Rehearsal of Concept Drill for Key Resolve 2009 as well as other exercises. This received enormous praises from GEN (Ret) John W. Hendrix, Battle Command Training Program, and the other 8th Army staff sections. When you bring the whole SPOC online with all the live feeds during these rehearsals you give the command a better understanding of the battlespace they will have to conduct these operations.

Another use for this system highlighted a shortfall in our battle tracking during Non-combatant Evacuation Operations. How do we track the Non-Combatant Evacuee locations on the battlefield in near real time? The answer is we can't. We are now in the process of rectifying that. We are working with a company

in Virginia in conjunction with the Joint Embedded Messaging System team to integrate individual GPS trackers for bus, train, and air movement of Non-Combatant Evacuees. By pulling in data off the Radio Frequency In-Transit Visibility server and feeding it into the Joint Embedded Messaging System we can track the Non-Combatant Evacuees' movements.

Another function includes a propagator for our satellite tracking; I built one but I have not tested it yet by integrating it into Google Earth EC. We are capable of receiving electronic intelligence data but we have not established all the proper filters. We also want to integrate the NEO Tracking System or Web version into our system so when you select a Non-combatant Evacuation Operations location it can give you an accurate count of the number of personnel on station. This is all possible but we have just not had time to complete it. 8th Army has built a handbook for the SPOC which tells you how to set it up and outlines operating instructions and warnings but they are at the Secret level. If anyone is interested in getting this system contact the 8th Army Space Support Element. In the near future we will hand this responsibility off to the USASMDC/ARSTRAT Battle Lab in Colorado Springs, and if approved, it can be configured on all Space Operating System workstations.

My recommendations to USASMDC/ARSTRAT are as follows. First, put the Joint Embedded Messaging System on all Space Operating System workstations and at the Joint Tactical Ground Stations to use in conjunction with their current systems. Second, ensure all 8th Army Keyhole Markup Language links are also loaded on all Space Operating System workstations. Third, put the SPOC Operators guide on the Space Operating System help desk Web site. Fourth, USASMDC/ARSTRAT needs to continue to develop the Joint Embedded Messaging System capability to augment the Keyhole Markup Language feeds. Fifth, add Joint Embedded Messaging System training to the Tactical Space Operations Course, Space Operating System Training and the Basic course. Sixth, USASMDC/ARSTRAT needs to put a full-time or part-time Joint Embedded Messaging System programmer in each of the U.S. Central Command, U.S. Pacific Command, and U.S. European Command theaters. Finally, maintain the Joint Embedded Messaging System program; I believe we have only touched the tip of the iceberg as it relates to its capabilities.

"The Space Operations Common Operational Picture (SPOC) provided near real time refinement of areas affected by theater ballistic missile threats ... this capability and situational awareness enabled the Air and Missile Defense cell to accurately provide detailed early warning of areas affected to all Joint and Coalition forces in the KTO (Korean Theater of Operations) ... a force multiplier at the Field Army level using Army Battle Command Systems to provide a Common Operating Picture to the Commander and his subordinate units."

LTC Roland Quidachay,
(USA) 8th Army Air and Missile Defense