ISR Information Services —Lessons from the Web-Enabling Front

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The Office of the Secretary of Defense[1] (OSD) has described a vision where people connected by a trusted, dependable, and ubiquitous network are empowered by their ability to access information and are recognized for the inputs they provide. This network-centric way of operating is based on three goals:

- Make information available on a network that people depend on and trust;
- Populate the network with new, dynamic sources of information to defeat the enemy;
- Deny the enemy advantages and exploit weaknesses.

This paper describes lessons learned from a MITRE research initiative to address the second objective. MITRE has engaged the Intelligence, Surveillance, and Reconnaissance (ISR) and Command and Control (C2) communities to demonstrate what is possible today in applying Web technology to give the war-fighter access to real-time ISR information via the battlespace networks, for example, NIPRNET, SIPRNET, JWICS, NATO BICES and LOCE, etc.

Using Web technology in the national security community is not new. The intelligence community has been using an Intranet called *Intelink* to disseminate its products since 1994. What is new is the incorporation of Web technology into military operations as a way of providing a more agile system integration approach compatible with today's more agile threats.

Currently there is often a "bottleneck" between the producers of ISR data/information—the organizations that operate the sensor platform—and the C2 consumers that rely on the information to complete their mission. The data producers control access by exploiting the data with service-specific systems and then disseminating secondary products and/or providing dedicated communications pipes to stovepipe systems to satisfy joint requirements.

The OSD vision is to replace centralized processing and exploitation with a new paradigm that uses the network to make unprocessed data available to all legitimate users, applications, and systems shortly after it is collected. Centralized processing and

[1] See John P. Stenbit, Assistant Secretary of Defense for Command, Control, Communications, and Intelligence, http://www.c3i.osd.mil/.

exploitation are replaced with a variety of distributed activities that perform the processing/exploitation in a more timely fashion closer to where the information is needed.

The military services are formulating approaches to "Web-centric" warfare[2]. But what are the indicators that legacy systems and concept of operations (CONOPs) are in fact transforming to this new way of operating? One clearly necessary condition is the insertion of three basic Web technologies in the legacy stovepipe C2ISR systems: Internet Protocol (IP) for communicating, eXtensible Markup Language (XML) for accessing data, and Universal Resource Locators (URLs) for connecting through Web browsers.

But the adoption of IP, XML, and URLs is not sufficient—the key to this transformation to Web-centric warfare will be whether data and information producers make their unprocessed data and metadata available over the Web. In a real sense these military organizations must become more like commercial Web-based *information services*.[3] When that occurs, users involved in processing, exploitation, command, and control will be able to access these military information services through their browsers. Systems and applications will utilize the information service's XML language capabilities to initiate direct machine-to-machine transfers. Organizations will add their value and re-post their results. All of this will be done in a fraction of the time taken today and with greater precision to the current threat.

ISR INFORMATION SERVICES

To explore what such an ISR information service (ISRIS) would be like, MITRE developed a proof-of-concept Web-based information service for the Global Hawk Unmanned Air Vehicle (UAV) using real mission and sensor data from the Global Hawk Advanced Concept Technology Demonstration (ACTD). This ISRIS prototype provides access to Global Hawk mission planning data, near real-time situation awareness during mission execution, and thumbnails of collected imagery.

End users require nothing more than a standard Netscape or Internet Explorer browser on their workstations, which greatly simplifies the application software deployment and maintenance problem. The mission, navigation, and collection plans for current, past, and future missions are accessible over the Web via dynamic report generation and an interactive Web-based map display. Real-time UAV positional information is also visually and textually available during missions in progress. Imagery data is converted in real time to a Web-browser format with thumbnails and made available for user preview, enabling a quick assessment of the primary image for quality and usefulness before initiating a bandwidth-consuming download.

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[2] Air Force's *Joint Battlespace Infosphere*, Army's *Future Combat Systems*, Navy's *Web Enabling the Navy*.

[3] Financial market examples: www.nasdaq.com, www.djindexes.com; Shipping service examples: www.ups.com, www.fedex.com.

The same data that the users view in their browsers can be accessed simultaneously by external systems and applications at the machine level from the ISRIS XML-accessible database. Examples of possible applications that can connect through an ISRIS server include mission/sensor/collection planning, data exploitation, time critical targeting, and common operational picture (COP) displays.

Thus, with the addition of one drop-in Web-service component at the Global Hawk ground station, a large percentage of dissemination requirements for the unprocessed information can be fulfilled. This concept can be applied to the entire spectrum of tactical ISR assets and be expanded beyond the ISR realm. MITRE is currently developing an ISRIS prototype for the Predator UAV to show the diversity of platforms and sensors that can be Web enabled.

LESSONS FROM THE WEB-ENABLING FRONT

The ISRIS concept and the Global Hawk prototype were presented and demonstrated throughout the military services and joint community to obtain feedback from both ISR data producers and C2 consumers. In this section we describe the lessons we have learned from the ISRIS prototype and these interactions.

- **Legacy stovepipe systems can be Web enabled today.** MITRE's ISRIS research has shown that information services can be implemented quickly by integrating today's commercial Internet technology. A redesign of the target system is not required; rather an ISRIS server becomes a drop in component to supplement operational stovepipe systems. For example, connecting the Global Hawk ISRIS server will require no changes to the ground station architecture. This immediately opens network access to the data without affecting current operations and interfaces. Existing data links can be migrated to the network as time and priorities permit while new systems and applications can immediately take advantage of the new data resources. Browser protocols and the flexible formatting capabilities of XML greatly reduce the need for dedicated data feeds and frees systems and applications from maintaining these feeds. Migration of operational assets to the Web can begin immediately.

- **Collection management programs will be the catalyst for Web enablement.** We have seen the most interest in the ISRIS concept from collection management programs that seek access to tactical ISR mission information. These are programs like Collection Management Mission Applications (CMMA), Planning Tool for Resource Integration, Synchronization, and Management (PRISM), and Surveillance and Reconnaissance Management Tool (SRMT). These programs need to fuse theater and organic-level ISR source data with the national data that they already possess to provide a complete collection, sensor, and mission picture to their users. Currently, their only recourse is to negotiate stovepipe source data feeds and APIs with each data provider. We have been working with these programs and the data providers to

create Web-enabled information services like ISRIS that can provide a network-based common access point for obtaining the information they need.

- **Web browser capability will continue to improve with each "model year**." In the commercial sector, products are developed and improved in stages, and periodic releases—called "model years"—are common. The information display capabilities of today's Web browsers cannot compete with custom-built applications, but the gap is closing. Browser technology is limited by the current state of the Internet protocols the browsers support (HTML, Javascript, etc.) and the sophistication of the Web-server applications that feed them. Custom systems and applications handle data in milliseconds, while today browsers connected over the Web require seconds or even minutes to perform the same function. The commercial and academic world is working to close this gap. The trend will be for more and more custom applications to move their full capabilities to the improving browser client. The lesson is to adopt a "model-year" acquisition strategy that anticipates these browser upgrades, rather than developing a custom interface. The obvious advantage of this approach is that all DOD client workstation baselines have Web browsers already installed.

- **There is a tension today between accessibility and usability.** Web enabling any data source requires that the amount of data to be disseminated is compatible with available network bandwidth and that the data format is consistent with the end application. This means that primary imagery and video need to be significantly reduced in resolution to meet bandwidth constraints and converted into a format that is usable by common user applications. Streaming data from SIGINT, ELINT, and GMTI sensors may have to be temporally averaged to limit bandwidth requirements. While accessibility to the data is greatly increased, the utility of the data is diminished. The imagery data may be viewed in a Web browser to check image clarity and determine usability, but this view may not be sufficient for precision targeting and high-resolution exploitation. The other side of this argument is that by making the data accessible over the network, its utility will increase by enabling more users and systems to process it. Furthermore, data utility will increase as network improvements are implemented and more bandwidth becomes available.

- **XML does not ensure universal interoperability, but it is the first step in that direction.** The data exchange protocol for Web-enabled systems is XML, currently being widely implemented throughout the DOD. It is not a language per se, but provides a syntax that enables the creation of data languages so that users/systems/applications from the same functional "community" can communicate and exchange information. Unfortunately, not everyone within these functional communities is cooperating with or even aware of one another. The effectiveness of XML to promote interoperability is reduced when the meanings of what is being encoded are not mutually understood. Working groups are emerging to address these semantic interoperability issues, but the process will take years to organize, complete, and implement. The lesson here is "don't wait"—the value of the Web is directly related to the number of data sources on it and early adopters will set the agenda for subsequent standardization of definitions.

- **Requirements have not caught up with vision.** The data owners (e.g., Air Force Global Hawk and Predator, Navy P-3, Army Hunter, etc.) have no requirement to make their unprocessed data available universally outside their service. Real-time data are collected, processed, and exploited by service-specific systems on closed networks. The rest of the community receives only secondary products. Some data flows to joint systems, but mostly through point-to-point communications paths. A recent Air Force Web technology directive[4] requiring use of IP, XML, and URLs in legacy systems represents a step in the right direction.

- **A change of culture will be required.** Adding an open access requirement to data collection systems will require a change of culture. There will be resistance to giving up control of raw data. Some will fear a breakdown of CONOPS and tactics, techniques and procedures (TTPs), and some will fear the competition of other value-adding systems. There will need to be a change in security posture from the current "need to know" position to a "need to share." We understand that the OSD vision is to make information access and data flow as open as possible, so as not to impede mission accomplishment, while at the same time monitoring to detect data misuse. In other words, when in doubt, let people have the data but keep an eye on them. This need for a culture shift is reminiscent of what happened within the Intelligence Community when Intelink was created. The initial resistance to change quickly dissipated as the benefits of Web accessibility became clear.

THE WAY AHEAD

It will be many years before the *operational* battlespace Internets approach the complexity of today's commercial Internet. Thus it seems clear that the commercial sector will continue to be way out in front in the development of novel Web applications and Web technology. DOD needs to invest today in incorporating basic Web technology (IP, XML, and URLs) into its systems so that it can best leverage all this commercial activity. Second, DOD should support a persistent experimental program coupling developers with users to discover new CONOPs that leverage the increase in flexibility and interoperability of Web-enabled systems.

The benefits and cost savings of Web-enabled systems will likely first be proven by ISRIS-like implementations within reconnaissance programs such as Global Hawk and U2 that require fairly long response times. Collection management, distributed exploitation (e.g., national exploitation of tactical sources), and the associated mission applications/systems will be the first to benefit from this trend. As the Web infrastructure is able to process finer-grain real-time streams reliably, the connection of surveillance

[4] See *Designated Acquisition Commander Enterprise Directive 002—Web-Enabling Systems for the C2 Enterprise*, Electronic System Center, Hanscom Air Force Base, 16 July 2001, http://diicoe.disa.mil/coe/aog_twg/twg/ssdmd/web_enabling.doc.

platforms such as Predator and JSTARS will follow providing an even more robust ISR picture that will help those using and developing time-critical targeting systems and tools.

DOD Web services will initially support subscription services that will deliver data to registered users, systems, and applications. As the number of network-accessible data sources grows, perhaps because of the proliferation of smaller, but more numerous, sensors or new intelligence sources, Web brokering may become necessary. These brokering services would use profiling to match the information needs of users with the relevant data/information that is available from producers.

Such technology should be commonplace in the commercial Web sector by the time the DOD needs it. Therefore, it is essential to scope near-term research investments into areas unique to the DOD problem: policy-based access to information, Web guards for sharing across security boundaries, and the tradeoff between browser usability versus data accessibility. Operational applications will require IP network technology that guarantees quality of service even under stress and Web services that can accommodate fine-grain real-time data streams. Longer-term research will involve incorporating notions under development in the next-generation "semantic" Web[5] designed to support efficient machine-to-machine information transfer within an increasingly complex national security Web.

CONCLUSION

To achieve an optimal, persistent, common battlespace view that supports rapid decision making and execution, data from all ISR assets must be made available via the battlespace networks so that users/systems/applications can exploit it quickly. Support from the DOD top leadership will be an absolute necessity if this goal is to be realized. We recommend that OSD create a "Web-Enablement" ACTD that would build on the ISRIS research results. This ACTD would use the ISRIS technology to connect operational data sources to the network and support experimentation with emerging Web-based information management technologies. This would be a large step towards the achievement of the OSD vision of a national security Web containing better and more timely information based on an expanding number of available sources.

For more information on how to apply these ideas to your situation, please contact your MITRE representative, John Kane at jkane@mitre.org, 757-673-5706, or Richard Games at rg@mitre.org, 781-271-8081.

[5] See http://www.w3.org/2001/sw/

