

Task Force Web...transforming interoperability through Web Services

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The Achilles' heel of military operations has traditionally been the lack of interoperability between Command and Control, Communications, Computers and Combat Systems (C5). While improvements have been made to the communications infrastructure, interoperability issues continue to plague the Department of Defense (DoD). Web Services technology is the Navy's solution for overcoming these systemic weaknesses.

To understand how Web Services will improve interoperability, it's important to look at some of the distinctive challenges the Navy has faced with its C5 infrastructure. In the 1980s, interoperability problems were highlighted by the inability of systems to communicate in fundamental ways at the First Layer (Physical Layer) of the Open Systems Interconnect (OSI) reference model. This was characterized by the use of different frequency bands by land, sea and air forces during Operation Urgent Fury in Grenada. As the Services overcame layer one issues and began using common radio frequencies which were deconflicted at the joint level, new issues surfaced.

Once the physical layer compatibility issue was understood and addressed, the next layer of incompatibility came to light. The introduction of operational level geographic displays such as the Joint Operational Tactical System (JOTS), the great-grandfather of the Global Command and Control System (GCCS), led to the requirement for collection and display of data from multiple disparate systems in a single, integrated environment. However, almost every system used unique and system-proprietary mechanisms to communicate data. Some used serial pipes over Ultra High Frequency (UHF) satellites, others used polling mechanisms over UHF and High Frequency radios, and others relied upon the parsing of formatted message traffic. Integrating these multiple data feeds became a tremendous systems engineering and management nightmare. Translators had to be built for the many protocols in use to create links between systems that were highly sensitive to changes in any of the feeder systems.

While these problems may seem esoteric to operators who consider only things that actively engage the enemy to be real combat capability, it must be noted that two frontline Aegis cruisers were put out of commission for several years due to interoperability problems between the two different shipboard combat systems: the Aegis Baseline 6 and the Cooperative Engagement Capability (CEC). The combat systems on both of these platforms were critical to Navy warfighting capability. CEC gathered and shared radar data from multiple ships but could not operate with the Aegis Baseline 6 systems and other legacy systems aboard ship. The problem was not in the operating functionality of either system, but rather that they failed to interoperate.

Ensuring systems interoperability requires that standards and protocols at the different layers of the OSI reference model be addressed with a focus on the enterprise system. The advent and

widespread deployment of the joint Non-classified Internet Protocol Network (NIPRNET), Secret Internet Protocol Network (SIPRNET), Joint Worldwide Intelligence Communications System (JWICS) and IP-based coalition networks provide an infrastructure that yields compatibility up through the first four layers of the OSI model.

While DoD application owners have embraced IP networking, this capability has exposed yet another interoperability seam. While IP-enabled applications are easily connected, they are still largely unable to seamlessly share data. This is because they use application-specific mechanisms to format and transmit their data over IP networks. Web Services address incompatibility at Layers Six and Seven (Presentation and Application (see Figure 1)). They provide a mechanism for more rapid and reliable deployment of operational and business applications throughout the DoD enterprise. Historically, operational application development meant hard choices — it could be reliable, cheap or secure, but not all three. Implementing Web-Services architecture and technologies makes this paradigm obsolete.

Implementation of Web Services standards with a supporting enterprise architecture can increase the combat power of the U.S. military by addressing critical interoperability issues that continue to plague joint military operations. By employing Web-Services technology, systems that were previously incompatible as described earlier can become interoperable. A Web Services approach creates a layer of abstraction around the legacy system that will facilitate future development and integration efforts.

What is a Web Service and how is it different from the basic Web page technology that most Internet users are familiar with today? "Web Services" is a term often used in Web technology discussions yet it is seldom understood. For an industry example of Web Services, one need look only as far as your next trip. In a traditional Web environment, a traveler would visit Web sites for American Airlines, Delta, United, US Airways, etc., to compare prices and availability. Now the research is done automatically for a traveler by online commercial travel businesses such as Expedia.com or Travelocity.com. These Web sites are built on a Web-Services architecture. When a traveler wants to find the cheapest fare from Los Angeles to New York, he enters a few bits of information (i.e., departure city and date, and return city and date) and requests feedback. Web Services, using industry standards for describing data (Extensible Markup Language or XML) and moving data (Simple Object Access Protocol or SOAP) do the rest.

Web Services query the authoritative data sources maintained by the airlines and present the information back to the traveler in one Web frame with a common look and feel. No longer do travelers need to individually query a multitude of airline Web pages to do a comparative analysis. This type of powerful Web Services capability is what the Navy is developing as the infrastructure to

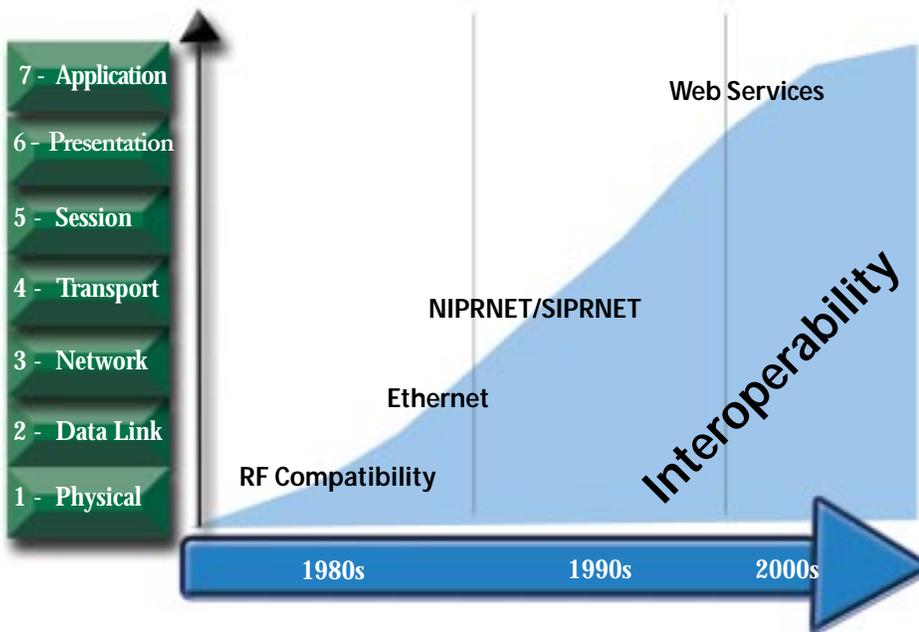


Figure 1.

support all business and operational applications. Web Services will give the Navy the capability to transform their strategic direction by maximizing the capability of our networks to more effectively make command and control and business decisions. The Navy will be able to reach more organizations, information, and do it more rapidly, securely and economically.

Web Services allow exchange of information more reliably and rapidly. At the heart of Web Services is authoritative data and its reuse. Today, there are many duplicative applications in the Navy, and as new functional requirements emerge new stovepipe systems and supporting databases are developed to support them. This duplicative infrastructure results in the same or similar data being maintained in many places, with no one-stop shopping for authoritative data. The result is duplicate, and often conflicting data that seeds user distrust with the entire data infrastructure. Web Services provide the key mechanism to expose authoritative data sources to external applications in an open and well-documented manner. When a command has a new requirement for information, it consults the directory of available Data Oriented Services (DOS) and consumes the applicable authoritative data — no costly new application, no duplicative data or infrastructure, and no lengthy procurement and development process. By using Web Services, it is possible to continuously update reportable information on a near real-time basis, avoiding the danger of making decisions based on stale information. Assigning functional owners to data sources and data elements will provide improved data reliability and accessibility throughout the Navy.

Additionally, in the old client-server approach to sharing information, updating legacy applications took time. Because Web Services are built on commercial standards, all development efforts begin with the same basic design for exchanging data and information. Commercial vendors sell programming products to facilitate development of Web Services based on industry standards. Also, the speed at which updates to services take place dramatically improves over the traditional client-server configurations, shortening the process from months to days.

Web Services enable exchange of information more securely. This is because Web Services use standard ports and protocols on communications equipment, thus mitigating the risks of exploitation by hackers or others with malicious intent. This creates a more secure information exchange over the traditional client-server applications that sometimes rely upon nonstandard and easily exploitable ports to access, replicate and synchronize data. Additionally, firewall concerns that plague any application using atypical ports are addressed as Web Services run over existing ports (typically HTTP/HTTPS). Web Services also allow developers to leverage a common security infrastructure, promising to eliminate the multiple logons that confront users today.

Web Services result in significant fiscal savings. Industry continues to develop products for converting existing legacy applications and databases into Web Services, making this conversion process extremely efficient and economical for commands. Cost savings will also be realized under this architecture by significantly reducing the redundant databases in use by the DON.

Implementation of a Web-Services environment also provides a return on investment. Traditional application development included funding for dedicated operating system hardware and software, separate application servers and database storage, client-workstation licensing and installation costs. In a Web-enabled environment, the operating system hardware and software, client-workstation application software and associated installation costs are avoided by leveraging the existing Web infrastructure. A recent assessment of industry practices by the MITRE Corporation indicated application developers could recoup the cost of Web enablement within the first year of transitioning a legacy application to a Web-based service. Program life-cycle development times and costs would also be reduced depending on the complexity of the application.

Web Services enable speed of transformation. Secretary of Defense Donald Rumsfeld places the transformation of the military as one of his top priorities for this administration. In an article he wrote for the *Washington Post* he states, "The fact is that the transformation of our military capabilities depends on the transformation of the way the Defense Department operates."¹ For the Navy, rapid change in the way it operates can be facilitated by a Web-Services environment, where data are exchanged and used in an unprecedented way. Web Services enable the transformation of mission accomplishment mechanisms to occur an order of magnitude faster than with legacy technologies. This will move the Navy in a strategic direction that positions the force to leverage the Semantic Web and achieve true knowledge management.

In April 2001, the Chief of Naval Operations stood up Task Force Web to lead this transformation within the Navy. The challenge was complex: move the Navy from its current stovepipe legacy application development to a cohesive and integrated enterprise of Web-based applications and services that are fully interoperable

and accessible by users anywhere, anytime in the world. Since then, Task Force Web has worked with commands throughout the Navy and DoD to provide a Web-Services framework for transforming legacy applications and building Web Services to meet new data exchange requirements. Examples of Web Services in use today include:

◆ Readiness applications - The Director of Command and Control, Communications, Computers and Combat Systems at Commander, Atlantic Fleet has developed Web Services for all readiness and reporting functions. This results in easier and more reliable access to information for warfighters. These authoritative databases for readiness and reporting are now used by other commands to support their Web Services.

◆ Meteorological applications - Fleet Numerical Meteorology and Oceanography Center (FNMOC) has exposed almost their entire line of products as Web Services. This open interface has been used to integrate METOC data into various operational applications in support of the Navy's FORCEnet initiative.

◆ Commander Second Fleet Briefing Tool - Web Services are being used to provide the authoritative data to automatically update the Second Fleet status briefs to the commander. This results in increased fidelity of information being briefed and a significant time savings for the staff because the brief is automatically updated using Web Services. The commander does not have to wait for updates or travel to a specific location for a scheduled brief — he can view this information whenever and wherever he desires.

◆ FORCEnet - During the fall 2003 FORCEnet Integrated Prototype Demonstration Web Services will provide a variety of information and capabilities including collaborative tools, warfare publications and lessons learned, geographic information and readiness data.

◆ Medical/Dental Services applications - The Bureau of Medicine and Surgery uses Web Services to provide real-time medical and dental readiness data via XML. Individual and command medical readiness depends on personal demographic data mining and aggregation. Past operations relied on using "copies" of data provided by other systems. Naval Personnel Command owns these types of data. By invoking their Web Services, Naval Medicine can ensure that authoritative, accurate and reliable demographic data are obtained. This technique immediately eliminates duplicate data sources, lengthy update procedures and the grounds for questionable data. Eliminating the need to duplicate Web Service requests by other systems or applications for similar data, through brokering techniques, Naval Medicine is able to further this service within its environment to other applications that need demographic data such as the Dental Access System (DENCAS).

Task Force Web aligns with and facilitates broader Web-enablement efforts led by the Department of the Navy Chief Information Officer (DON CIO). These initiatives include the reduction of duplicative applications via the Functional Area Managers (FAMs) application rationalization process and the identification of data standards through the DON XML Working Group and the DON Functional Data Managers. The rapid pace of technological change and requirement for innovation in the DON necessitates that these efforts occur in parallel, as a serial approach would not enable the speed of transformation desired. The DON

Web Services

- ✓ Result in savings
- ✓ Provide return on investment
- ✓ Enable data exchange more reliably and rapidly
- ✓ Enable data exchange more securely
- ✓ Enable speed of transformation
- ✓ Allow data to be used and exchanged in an unprecedented way
- ✓ Will bring warfighting into the Information Age
- ✓ Will remove interoperability barriers
- ✓ Will improve operational and business processes
- ✓ Will deliver decisive combat power

CIO will continue to evaluate emerging technologies, set standards and policy for Web Services and Web-enablement across both the Navy and Marine Corps, and will establish common-user interface to Web Services.

There are those who argue that Web-Services technology is not mature, the standards are still evolving and being an early adopter could result in the Navy choosing the wrong technology and being stuck with "Beta over VHS." However, Web-Services technology is being used throughout industry with increasing frequency. According to a Gartner Group report, there is growing momentum behind Web Services and they estimate that the software and information technology services opportunity specifically related to Web Services will reach \$28 billion by 2005.

The Navy's ability to quickly integrate this new technology will overcome many obstacles previously encountered at different layers of the OSI reference model and will provide Navy warfighters and support personnel a more rapid, reliable, secure and economical information exchange. Implementation of a Web-Services-based enterprise architecture will enable the rapid transformation of the Navy from an industrial age warfighting force to a bona fide Information Age warfighting force. Perhaps more important, acceptance throughout Navy of a common set of Web development standards will remove interoperability barriers that have disrupted operations, both internally and with the other Services, agencies and multinational partners. This change in strategic direction will result in vastly improved operational and business processes and will provide the mechanism for delivery of decisive combat power.

References

1. Rumsfeld, Donald. "Defense for the 21st Century," *Washington Post*, 22 May 2003, p. 35.

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