AWACS command post, Amalgam Warrior.

DOD (Robert Fleugel)

Delivering Joint Information Superiority

By CHARLES N. CARDINAL

Joint tactical C4ISR architecture—or the integration of command, control, communications, computers, intelligence surveillance, and reconnaissance assets—has long been a focus of defense visionaries. They picture systems linking assets, enabling the Armed Forces to detect and strike targets with blinding speed. Such architecture has broader implications. It can enable *Joint Vision 2010* and ultimately a revolution in military affairs. An advanced concept technology demonstration (ACTD) by U.S. Pacific Command (PACOM) represents progress in realizing such visionary concepts.

Colonel Charles N. Cardinal, USA, is commander of Area I Support Activity, U.S. Forces Korea, and formerly served as chief of the Advanced Concept Technology Demonstration Division (J–3), U.S. Pacific Command.

The Promise of Technology

The Under Secretary of Defense for Acquisition and Technology testified before Congress that, "We must achieve an interoperable and integrated, secure, and smart C4ISR infrastructure that encompasses both strategic and tactical needs. Enhanced situation awareness and information assurance are . . . the backbone of the revolution in military affairs." That potential was realized in part during the Persian Gulf War. U.S. forces

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Communications vehicle coming ashore, Kernel Blitz.

Fleet Imaging Command, Pacific (Tyler A. Swartz)

could see targets faster with airborne warning and control and joint surveillance target attack systems. And they could hit them with greater precision. But operations are often far from perfect. The old problem remained—getting the right information to the right place at the right time.

A fully integrated C^{4}ISR architecture is the solution. It can bind the services together with defense, intelligence, and other governmental agencies. It will synchronize the unique strengths of organizations and enable the "more seamless integration of service capabilities" sought by *JV 2010*. This system of systems can link all sensors—strategic, theater, and tactical—within an enhanced command and control framework. Information will be fused with other friendly information and distributed as a common operational picture to users. An integrated architecture will essentially function as a nervous system with fire support acting as muscles.

the defense establishment is being digitally linked by a global command and control system

Maximizing capabilities will largely come from improved performances on the joint tactical level. Just as the computer and Internet have empowered individuals, shared information from an integrated C^{4}ISR architecture may do the same for small units. As *JV 2010* declares, "Improved systems integration . . . could empower a degree of independent maneuver, planning, and coordination at lower echelons." It is likely to make small units more opportunistic, resulting in a joint force that self-synchronizes from the bottom up.

Technological Challenges

Despite great promise, creating a robust, fully integrated architecture remains a challenge. On the strategic level, the defense establishment is being digitally linked by a global command and control system, which is dedicated to providing an information network for warfighters. Much of this network will rely on a mature infrastructure. The challenge is what communicators in Bosnia have called the last mile—extending the network down to the tactical level and imposing a C^{4}ISR architecture over an austere operating area.

The challenge increases when this architecture must extend over the likely point of entry by an expeditionary force—the littorals. Few types of terrain pose more difficulties. There is natural interference from landmasses, weather, and inversion layers as well as manmade clutter such as urban development and traffic. Moreover, C^{4}ISR architecture must cover broader littoral expanses because of the increasing range of weapons systems and mobility platforms.

The architecture must also overcome a number of technical problems and the integration of multiple technologies. Artificial intelligence must fuse information. Object-oriented computing is needed to track targets and friendly forces. Moreover, there is also the question of how much data this architecture can carry—bandwidth. Further, new technologies must interface with older ones such as legacy systems that will

P–3 firing flares during Deliberate Guard.

1st Combat Camera Squadron (Diane S. Robinson)

be in service for years. Obsolescence must also be considered: the life of information technologies is measured in months.

Architecture for the 21st Century

PACOM is demonstrating a revolutionary architecture with extending the littoral battlespace ACTD. Its genesis was the Defense Science Board study in 1996, *Tactics and Technology for 21st Century Military Superiority.* The board recommended an enhanced C4ISR for joint expeditionary forces to provide improved theater-wide situation awareness, effective remote fires, and a vigorous interconnected infrastructure. Such an architecture could reduce equipment carried ashore, making forces more agile.

An expeditionary-style architecture is particularly interesting to PACOM. While the command's budget has declined, its responsibilities have not. It still encompasses 100 million square miles and 60 percent of the world population. From Indonesia to the Korean peninsula, the possibility of crisis is ever present. "Teamwork is key," as the Commander in Chief, U.S. Pacific Command, has put it. "Our need to integrate capabilities will place a premium on joint/combined interoperability." This integration depends on an integrated network.

The ACTD C4ISR architecture depends extensively on commercial technologies, which are rapidly outpacing defense innovations. To exploit new technology, the program office, under the management of the Office of Naval Research and Marine Corps Combat Development Command, departed from traditional government specification-based acquisition. Instead it conducted an open competition for the best ideas and technologies from industry. After reviewing four proposals the program manager made a selection in February 1998.

The network is designed to last for a decade while accommodating technological changes. Essentially it is a plug-and-play structure, which is compliant with industrial and joint standards. As one component becomes obsolete another can be inserted. This architecture will overlay current communications systems for littoral operations, such as the single-channel ground and air radio system and the enhanced position location reporting system.

Because of the likelihood of joint expeditionary operations in the littorals, the architecture will be sea-based. The critical node is the command center aboard the command ship, consisting of cells for command, combat information, planning and shaping, and engagement coordination. This center integrates command and fire support functions. Fire support systems receive real-time sensor information, enabling shooters to rapidly engage targets. This will allow commanders to direct a range of joint weapons systems and mass fires against specific targets. The engagement coordination cell directs naval surface fire support using the land attack warfare system. The cell also deconflicts and visualizes air operations using a

Monitoring humanitarian relief with experimental vehicle, Urban Warrior.

DOD (Edward Aspera, Jr.)

dynamic airspace management system. Fires ashore will be directed by the advanced field artillery tactical decision system.

In addition, a central information processor aboard the command ship provides a database containing information on terrain, weather, sensors, units, weapons, readiness, and intelligence. It will eventually be linked to databases outside the theater.

This advanced concept technology demonstration also employs an airborne node, such as a P–3 or unmanned aerial vehicle, to enable the establishment of a wireless wide-area network over the littoral battlespace, which will allow the architecture to overcome line of sight communications problems. The network will carry high rates of data and voice transmissions and link all computer nodes on land, at sea, or in the air. Small units and sensors ashore will operate on local area networks, connected to the overall network, that will also tie into theater and strategic sensors.

information will be fused into a common situational picture that can be distributed to tactical displays

Importantly this architecture is a tactical network. Users will pull information by accessing messages or making queries. Information will be fused into a common situational picture that can be distributed to tactical displays which allow the warfighter to sort and retrieve information. They can portray data on any object in the battlespace. Warfighters will also be able to focus on specific areas using drill-down technologies.

A high degree of automation helps network users. Warfighters must see the big picture and cannot afford to be fixed on monitors. Technologies such as human-computer interface will allow verbal interaction. For instance, warfighters may direct "locate all ports in the operating area" and the computers will respond audibly. Object-centric computing will track ships or other contacts. Intelligent agents will alert users to previously requested information like the launch of an enemy anti-ship missile.

If systems are degraded the architecture will have an automatic fallback capability which consists of alternative networks. Satellites will provide wideband communications to all ships and command nodes ashore. Commercial satellite systems will furnish narrowband communications between operations centers and warfighters. Should it be necessary to replace the overall system, an Internet-in-the-sky will be used for wideband communications while land mobile radios provide narrowband.

Visionary Capabilities

The demonstration of the architecture involves two phases. First, it evaluates which subsystems work and which do not. The overall architecture was initially tested in April 1999 during Kernel Blitz '99. The joint task force for this exercise was led by the commanding general, I Marine Expeditionary Force. The land forces included a special purpose Marine air-ground task force and a joint special operations task force made up of Army and Air Force units. The joint task force seabase consisted of *USS Bonhomme Richard*, *USS John Paul Jones*, and *USS Coronado*. The demonstration was concurrent with the Fleet Battle Experiment executed by the Maritime Battle Center and the Urban Warrior Advanced Warfighting Experiment conducted by the Marine Corps Warfighting Lab.

The second phase of this demonstration will examine the ability of the architecture to plug-and-play new technologies. It will include a series of integrated feasibility exercises and culminate in another major system demonstration in April 2001. It will also be linked to the Capable Warrior Advanced Warfighting Experiment conducted by the Marine Corps Warfighting Lab.

Visions of the future are pinned on a fully integrated C^{4}ISR architecture that will do more with less by generating increasingly cohesive joint forces that maximize the strengths of the Armed Forces and defense agencies. All this makes upcoming demonstrations in the Pacific important. As the former Commander in Chief, U.S. Pacific Command, Admiral Joseph Prueher, has noted, this advanced concept technology demonstration "is one of the few efforts integrating a myriad of emerging technologies into a coherent concept of joint expeditionary warfighting and truly leveraging information superiority." JFQ