NAVAL WAR COLLEGE
Newport, Rhode Island

APPLICATION OF NETWORK CENTRIC WARFARE TO J-SEAD

by

DALLAS L. EUBANKS
MAJ, U.S. ARMY

A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College, Department of the Navy or Department of the Army.

Signature:

8 February 2000

Patrick Sweeney
COL, USA
Faculty Advisor

A-

REPORT DOCUMENTATION PAGE

1. Report Security Classification: UNCLASSIFIED	
2. Security Classification Authority:	
3. Declassification/Downgrading Schedule:	
4. Distribution/Availability of Report: DISTRIBUTION STATEMENT A: APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.	
5. Name of Performing Organization: JOINT MILITARY OPERATIONS DEPARTMENT	
6. Office Symbol: NWC Code 1C	**7. Address:** NAVAL WAR COLLEGE 686 CUSHING ROAD NEWPORT, RI 02841-1207
8. Title (Include Security Classification): Applications of Network Centric Warfare to J-SEAD (U)	
9. Personal Authors: MAJ Dallas L. Eubanks, U.S. Army	
10.Type of Report: FINAL	**11. Date of Report:** 8 February 2000
12.Page Count: 22	**12A Paper Advisor (if any):** COL Patrick Sweeney, USA

13.Supplementary Notation: A paper submitted to the Faculty of the NWC in partial satisfaction of the requirements of the JMO Department. The contents of this paper reflect my own personal views and are not necessarily endorsed by the NWC, the Department of the Navy or the Department of the Army.

14. Ten key words that relate to your paper:

Network Centric Warfare, Joint Suppression of Enemy Air Defenses, Suppression of Enemy Air Defenses, J-SEAD, JSEAD, SEAD, NCW, Battlefield Awareness, Joint Vision 2010

15.Abstract:

The Joint Force Commander has many competing demands for the resources available to him on the battlefield. Often, the most important resource he possesses is time, with the desire to get inside the enemy decision loop. With the rapidly expanding use of computers on the battlefield and the vision of the Joint Chiefs of Staff for information superiority on the battlefield, the JFC must capitalize at every opportunity to become more combat effective. The concept of Network Centric Warfare provides the JFC the ideas necessary to gain the initiative, with direct application to the vital mission of Joint Suppression of Enemy Air Defenses, or J-SEAD.

With the multitude of sensors and shooters on the battlefield, each with their own specific strength characteristics, the JFC must ensure he has a system, or network, that best utilizes these assets. While full implementation of network centric warfare will require further technology development and testing/experimentation, equipment on the aircraft and in the rocket/missile launchers is available to implement the basic concepts of networking J-SEAD. By tying all of the assets to an information grid, the combat power of the geographically separated sensors and shooters is more powerful networked that separate.

A refinement of the sensor-to-shooter link and creation of an information grid, applying the principles of Network Centric Warfare, is required on future battlefields for the joint force commander to provide effective, timely J-SEAD with limited resources and competing theater demands.

16.Distribution / Availability of Abstract:	**Unclassified**	**Same As Rpt**	**DTIC Users**
	X		

17.Abstract Security Classification: UNCLASSIFIED	
18.Name of Responsible Individual: CHAIRMAN, JOINT MILITARY OPERATIONS DEPARTMENT	
19.Telephone: 841-6461	**20.Office Symbol:** C

ABSTRACT

The Joint Force Commander has many competing demands for the resources available to him on the battlefield. Often, the most important resource he possesses is time, with the desire to get inside the enemy decision loop. With the rapidly expanding use of computers on the battlefield and the vision of the Joint Chiefs of Staff for information superiority on the battlefield, the JFC must capitalize at every opportunity to become more combat effective. The concept of Network Centric Warfare provides the JFC the ideas necessary to gain the initiative, with direct application to the vital mission of Joint Suppression of Enemy Air Defenses, or J-SEAD.

With the multitude of sensors and shooters on the battlefield, each with their own specific strength characteristics, the JFC must ensure he has a system, or network, that best utilizes these assets. While full implementation of network centric warfare will require further technology development and testing/experimentation, equipment on the aircraft and in the rocket/missile launchers is available to implement the basic concepts of networking J-SEAD. By tying all of the assets to an information grid, the combat power of the geographically separated sensors and shooters is more powerful networked that separate.

In this paper, I will propose that a refinement of the sensor-to-shooter link and creation of an information grid, applying the principles of Network Centric Warfare, is required on future battlefields for the joint force commander to provide effective, timely J-SEAD with limited resources and competing theater demands.

Introduction

As we enter the twenty-first century, technology is ever increasingly linked with military tactics and concepts. With the advent of high-speed Intranets, super-computers that fit in the palm of your hand and the technological push to networking, the military must harness the potential of these new technologies to defeat future enemies. It has always been the mission of commanders to find leverage over the enemy to defeat him quickly and convincingly. Information technology, with computer technology as the enabler, may provide the future link to asymmetrical leverage.

Joint Vision 2010 talks of dominant maneuver that will "require forces that are adept at conducting sustained and synchronized operations from dispersed locations."[1] To achieve this dominant maneuver, connectivity, decisive speed and positional advantage all play important roles. This connectivity is provided with communication networks and the latest in computer technology. All the armed services are currently experimenting with computers and communication networks, attempting to see how they might improve the situational awareness and decision-making for joint force commanders. The need to achieve dominant maneuver becomes increasingly more important with today's decreasing resources and increasing deployments around the world. The joint force commander must be innovative in using the available technology and take advantage of the resources each service brings through integration, including capitalizing on the capabilities of networking.

Further, the U.S. Navy has developed a concept known as Network Centric Warfare, championed by Vice Admiral Arthur K. Cebrowski, President of the Naval War College in Newport, Rhode Island. This future concept capitalizes on developing and leveraging information superiority, providing an obvious link to the Chairman of the Joint Chiefs of

Staff (CJCS) vision of dominant maneuver and information superiority. Network Centric Warfare allows more flexibility for the joint force commander to employ his forces, resulting in a more agile force. "Potential relationships between the proposed operational concepts of JV2010, Information Superiority and Network Centric Warfare can be explored by examining operational architectures that effectively link sensors, command and control and shooters to increase joint combat power."[2]

Direct applications can be drawn from Network Centric Warfare and applied to Joint Suppression of Enemy Air Defenses (J-SEAD). The number of airframes in the Navy and Air Force capable of performing the J-SEAD mission is decreasing. While the reduction is something all services are currently experiencing in the post-Cold War era, the SEAD mission has grown with the continuing missions in Southwest Asia, and the two recent air operations in the Balkans. With the passing of the F-4G and EF-111 in recent years, the Joint Force Commander (JFC) must look for other ways to capitalize on service strengths to meet the mission, including rotary wing assets, Unmanned Aerial Vehicles (UAVs) and available national intelligence collection platforms. Additionally, the JFC must not forget the critical role that the Army can play in J-SEAD with its ability to destroy targets at long ranges with the Army Tactical Missile System (ATACMS). In this paper, I will propose that a refinement of the sensor-to-shooter link and creation of an information grid, applying the principles of Network Centric Warfare, is required on future battlefields for the joint force commander to provide effective, timely J-SEAD with limited resources and competing theater demands.

Background on J-SEAD

The suppression of enemy air defenses, or SEAD, has been around almost as long as aircraft. Reports of balloon and anti-balloon batteries during the American Civil War, and later the Russian testing of a field-gun battery against balloons moored three kilometers away, are some of the beginnings of SEAD.[3] Since WWI, the neutralization, suppression, destruction or temporary degradation of enemy air defenses became known as SEAD, and took on a very important role in warfare. Recently, a study highlighted the obvious need to make SEAD a top priority for the joint force commander:

> "If an air force of 1,000 aircraft flying two sorties per day per aircraft suffered only a 1 percent attrition rate, that air force would fly 45,150 sorties and have only 557 aircraft remaining at the end of 30 days of combat. If the attrition rate jumped to 10 percent, that same air force would fly only 8,320 sorties and have but two aircraft remaining at the end of 30 days!"[4]

This startling but true 'math problem' shows how the inability for the joint force commander to either suppress or destroy the integrated air defense system (IADS) could lead to a near depleted air combat force.

Before we discuss the future of J-SEAD, we must understand the current doctrine on the subject. Joint publications define J-SEAD as a "broad term that encompasses all SEAD activities provided by components of a joint force in support of one another."[5] The publication further divides the categories of J-SEAD operations into Area Of Responsibility (AOR)/Joint Operations Area (JOA) air defense system suppression, localized suppression and opportune suppression. Additionally, both SEAD and J-SEAD are a subset of counterair operations, with objectives specified by the Joint Force Commander (JFC). What the publications fail to cover in-depth is the future potential for networking the different capabilities of the four services to enhance the warfighting ability of the JFC.

Joint SEAD is different from SEAD for the obvious reason that multiple services are involved in the planning and execution of the SEAD missions. SEAD has evolved from a "bombs on SAM-site" concept to a more integrated force application involving fixed and rotary-wing aircraft, cruise missiles, artillery fire, helicopters and UAVs.[6] However, the true jointness mentioned above often does not fully manifest itself on the battlefield.

Defining Network Centric Warfare

Before describing the application of Network Centric Warfare (NCW) to J-SEAD, one must understand the underlying concept associated with NCW. The concept was developed from the business model of networking all aspects of their integrated functions, making productivity more efficient and keeping profits high. While the military is not in the business to make money, the basic application of networking has many applications to military operations.

For years, the Army has been fielding a digitized division (4th Infantry Division) at Fort Hood, Texas, linking all the combat systems on the battlefield to give the commanders better situational awareness of where they are and where the enemy is located, reducing fratricide and enabling more timely and lethal fires. While more testing is required to enhance the doctrine being developed by the Army, the basic idea of a network being established on the battlefield has been recognized as beneficial by Army leaders and is in line with Joint Vision 2010. Additionally, the Navy, Marines and Air Force have begun to realize the power of computers and networking, from enhancing command and control on the battlefield to e-mail capability for sailors on ships to maintain morale.

Specifically, the Navy, and now the JCS, has championed a vision known as NCW. The concept is really a new way of thinking about warfare, using sensor netting, data fusion and information management to gain an asymmetrical advantage over the enemy and creating a "lock-out" of his strategic possibilities.[7] While many of the specific details of the concept are beyond the scope of this paper, it is important to understand that the vision that joint force commanders must change their thinking from platform-centric operations to network-centric operations. This new thought on operations is realized when the functions of sensing, commanding, controlling and engaging are networked via digital data links and come together on information, sensor and engagement grids. The basic premise is that the power of this grid network is more powerful and effective than individual platforms operating on their own.[8]

Many advantages for the commander can be drawn from this concept of warfare, including; timely fires, better situational/battlespace awareness, reduced fratricide, and most importantly, better combat effectiveness.[9] While work remains to further the concept to real use on future battlefields, current experimentation in all the services includes many of the concepts in this vision, specifically in the Army and Navy. Additionally, new computer hardware and software will need to be developed to fully realize the effectiveness of this networking.

J-SEAD – What's wrong with it now?

Commanders agree that the need for J-SEAD still exist on the battlefield. However, there are mixed views of the current ability of the United States armed forces to provide J-SEAD using currently available assets and operating under the national strategy of fighting

two Major Theater Wars (MTWs) in overlapping timeframes.[10] With airframes to perform the jamming of SAM sites being moved out of the inventory, and the often-perceived lack of current assets available should a two-MTW situation arise, developing new concepts to utilize the assets available to the joint force commander becomes more important.

Recently, SEAD has experienced cutbacks with its loss of the EF-111 Raven escort jammer and the High-Speed Anti Radiation Missile (HARM)-shooting F-4G Wild Weasel, both vital aircraft to SEAD missions in the past. Much of the SEAD mission has been taken up by the F-16CJ (sometimes called F-16 HTS or F-16 Block 50) and remaining joint-service EA-6B Prowlers, an airframe that is set to retire in 2015.[11] The F-16CJ Wild Weasel utilizes its HARM Targeting System (HTS) to suppress enemy air defenses, a mission once held by the F-4G. In effect, the lethal SEAD mission now rests solely on the shoulders of the F-16CJ, though in fewer numbers than the F-4G. But the CJ-model has its limitations on pinpoint target location, with the HARM producing a large circular area of probability often too general to target, particularly with a moving SAM.[12] Additional difficulties with the F-16CJ arise with their lack of numbers in the inventory. During a recent deployment to Kosovo for the NATO air campaign against The Former Yugoslavia, the commander of 20th Fighter Wing at Shaw AFB, South Carolina, noted that the fighter wing of F-16CJs made up 40 percent of the entire Air Force SEAD assets.[13] JFCs continued to show their concern for enemy IADS in Operation Allied Force when "allied air planners demanded twice the number of EA-6Bs per sortie as they did in Iraq just three months prior."[14] This large number of aircraft requests was largely attributed to the fear of mobile SAM sites, primarily the SA-6, in Yugoslavia.

However, future planners may not have the luxury to request redundant airframes for SEAD to support an air campaign with competing demands continuing on the Arabian Peninsula during the ongoing Operations Northern and Southern Watch – or worse yet, another simultaneous MTW. If for no other reason, the JFC must realize the need to harness the current available technology for networking all of his SEAD assets to make best use of this force.

One specific case to illustrate the obvious need to information and sensor fusion was the shoot down of Captain Scott O'Grady covered so thoroughly by the media during the early days of the air campaign in Bosnia-Herzegovina. Hours before he was shot down, a RC-135 Rivet Joint had detected the threat system in the area, but the information flow was cumbersome, not enabling a hasty order of battle update and funneling to pilots in the area.[15]

Players in a J-SEAD Networked World

With technological advantages moving at an extraordinary pace, while hotspots around the world continue to challenge the United States and its allies, JFCs must look at new ways of dealing with the enemy IADS threat. Indeed, most of the pieces are in place to make networked J-SEAD a reality.

While the F-16CJ provides the HTS capability to the J-SEAD mission, other players (or sensors) bring varied but valuable tools to make the overall J-SEAD mission a success. The EA-6B Prowler, a multi-service aircraft of the Navy and Marine Corps, is the workhorse for the jamming of enemy air defense radar. Set to be retired in 2015, recent actions in the Balkans during Operation Allied Force have caused the Secretary of Defense to add an addition squadron to the fleet, while further developing plans for a follow-on aircraft to fly

the jammer role. General Anthony Zinni, Commander of U.S. Central Command, once said that if no EA-6B is available for the flight package, there is no air operation, calling the aircraft the "linchpin in the application of American airpower."[16]

Other important sensors in the J-SEAD arena include the RC-135 Rivet Joint surveillance aircraft with sophisticated communication and datalink hardware on-board, enabling it to be a centerpiece in the J-SEAD mission until full networking is realized (a sort of quarterback for the team). The E-8C Joint Surveillance and Target Radar System (JSTARS), which can assist the J-SEAD mission with tracking mobile targets and relaying valuable targeting information to other aircraft. Unmanned aerial vehicles remain a largely untapped resource for J-SEAD, but one that future testing is sure to include. Other sensors, to include national assets (satellites, U2s, etc.) could be linked into a networked J-SEAD when available to give a better common picture of enemy IAD.

The shooters also play an important role in the execution of J-SEAD. From the attack aircraft with precision guided munitions to the Army ATACMS and AH-64 Apache Longbows, the JFC has a wealth of weapons at his disposal, all with their own capabilities and limitations. Strike aircraft, like the F-15E Strike Eagle, can fire at targets passed to them within range, while the Army can employ the Corps Artillery's ATACMS, with range beyond 300 kilometers. The Apache Longbow has been used recently in tests at the National Training Center in Fort Irwin, California, where the gunship's targeting sensors and munitions performed well against the electronic warfare range. This new capability for the Apache adds robustness to the J-SEAD mission, where the Army has long been a smaller player in the mission.[17]

In essence, all of the sensors (F-16CJ, UAVs, EA-6B, Rivet Joint, JSTARS) and shooters (aircraft with precision munitions, Army ATACMS, AH-64D Apache Longbows, etc.) are on-hand to assist the JFC in making J-SEAD truly joint. Additionally, these sensors can communicate via a digital data link (Improved Data Modem, or IDM), allowing for interconnectivity, multiple-interface and tailorable data formatting. The IDM is installed on many aircraft involved with J-SEAD, including F-16CJs, EA-6Bs, Rivet Joint, AH-64D Apache Longbows, JSTARS and current experimentation with IDM on UAVs.[18] With all of these sensors linked digitally on a sensor network, shared information on the battlefield from various locations, and allowing a HARM targeting parameter from a sensor to pass to shooters (Army rockets/missiles, fighter aircraft, etc.) in the area to destroy or neutralize the target.

Additional assets that are often available to the joint force commander, though not likely controlled by him, are the national Signal Intelligence (SIGINT) assets. The Office of Naval Research is working on linking these national assets to the above proposed sensor grid through a new electronic surveillance system named Precision SIGINT Targeting System (PSTS). This program will link the tactical aircraft to national SIGINT collectors, giving the JFC even better situational awareness of the SAM threat in his AOR. PSTS is a 'system of systems,' interlocking network of datalinks joining existing airborne ES assets and ground stations under a massive umbrella.[19]

Other, more sophisticated targeting systems and precision weapons are in development (too numerous and beyond the scope of this paper) to further add to the sensor-to-shooter network proposed in NCW and applied directly to J-SEAD. For the future JFC to be successful, he must harness all available sensor technology and provide the ability to fuse

the information from numerous sensors, while providing an atmosphere of shared targeting information to the shooters on the gird/network (or battlefield, more specifically).

J-SEAD Experimentation

Though it appears that J-SEAD is already networked, the contrary is the case. While most of the assets can communicate, and the technology is available, no doctrine or tactics, techniques and procedures have been set out to execute networked J-SEAD. The recent Secretary of Defense Annual Report to the President and Congress concluded that without significant augmentation of current and planned SEAD capabilities, "U.S. air forces would gradually lose the dominant control of airspace they currently enjoy – in fact, by 2010, attrition of U.S. platforms could increase substantially."[20]

Because of the limited SEAD assets and need for a new vision of J-SEAD, the Office of the Secretary of Defense (OSD) commissioned a Joint Test and Evaluation (JT&E) team, headquartered at Nellis AFB, Nevada to study the problem and test possible solutions. Through numerous Green Flag exercises, all services could contribute platforms (sensors or shooters) and allow for testing different models for the future. A December 1999 briefing by the JT&E team to the Air Combat Commander highlighted that two 1999 planned and scheduled J-SEAD tests in conjunction with Blue Flag and Green Flag exercises were cancelled due to real world operational commitments. However, data from J-SEAD experimentation and testing in 1998 proved that the current J-SEAD timelines are excessively based on the threat mobility and reaction capability, combined with existing operational ROE. The study spread the blame between the delays in timely effects on targets among Intelligence/Surveillance/Reconnaissance (ISR), analysis, and command and

control.[21] Future testing approaches and priorities include messuring the completeness of enemy IADS order of battle, accuracy of locating IADS elements and timeliness of acting on reports of IADS elements and their locations.[22]

A J-SEAD assessment of Kosovo Lessons Learned did point out that sensor-to-shooter might have significant potential, requiring on-call taskable/retaskable assets and a reduction or elimination of C2 delays. Essentially, the assessment alluded to a possibility of networking the J-SEAD assets, as proposed in this paper. Additionally, the warfighters in Kosovo Lessons Learned said that targeting information to J-SEAD shooters as soon as possible is needed – the very thing that a network-centric approach to J-SEAD would accomplish.[23]

Though the JT&E team at Nellis doesn't directly suggest the application of network centric warfare to J-SEAD, it does propose to study the concept of a fusion cell; a man-machine interface of all available ISR information. The amorphous cell would support current operations and intelligence analysis while generating a single, fused picture of enemy activity.[24] Where the fusion cell concept falls short in applying the full effects of NCW is the linear approach the cycle is setup in. This is, targeting information collected by airborne assets (or sensors in my argument) does not have a direct line to either this fusion cell, or even better, to the execution grid of shooters on the network. Without this true network through such devices as IDM and possibly Link-16 (Joint Tactical Information Display System) in the future, the timeliness of J-SEAD will never be realized.

Direct Network Applications to J-SEAD

Although the proposal of linking NCW and J-SEAD, originally suggested in Alberts' book on NCW[25], and furthered in this paper, seems rather technical, it is really a matter of changing one's concept of J-SEAD from platform-based warfare to network-based warfare. While the network-based concept has some challenges that need to be worked (preferably through testing and experimentation), the basic concept of sensor and shooter grids connected on one information grid (or network) has obvious application to J-SEAD. Instead of looking at the F-16CJ, EA-6B, AH-64, RC-135, E-2C, ABCCC, AWACS, JSTARS, UAV, MLRS/ATACMS, HARM and the countless other acronyms in the SEAD family as individual platforms, one must think of them as pieces to the networked puzzle of J-SEAD, each with roles to play in the mission.

The platforms could share targeting information over a real-time communications network, improving combat effectiveness. For example, a sensor network to perform J-SEAD would allow for multiple sensor to locate targets with better accuracy, similarly to triangulation on a map, then pass that fused targeting data to a shooter (i.e. an F-14 in the air near the target, or an ATACMS within range of the target) for firing. Much can be done now to implement most of the concepts of network centric warfare to J-SEAD with the basic datalinks available using IDM and airborne command and control nodes like ABCCC and Rivet Joint.

As with the sensor grid, the shooter grid could be a set of peripherals and applications operating within the overall information grid. "The shooter grid can increase the combat power of high-end engagement operations by decreasing the time required to pair large

numbers of geographically distributed precision shooters with targets which have time-varying values."[26]

Many services are hesitant to proceed with this concept, largely due to their historical inclinations of "doctrine first, systems later," while others fear the loss of control over their systems that make up the sensors and shooters. In fact, the services often disagree on how J-SEAD is pronounced – "jay-seed" or "jay-see-add." While that may seem trivial, it is a perfect illustration how the services view J-SEAD and their role in the mission. One example is the continuing debate between the Army and Air Force on control of fires from ATACMS, which in part affects the implementation of networking J-SEAD. Progress was made in Operations Desert Storm/Shield on integrating many of the different services, but much is still to be done before J-SEAD can truly be called joint.[27] The best way to begin to solve this dilemma is further refinement of the joint doctrine governing both C4ISR and J-SEAD that requires the services to link together and fight as one under the JFC. Without this doctrinal base integrating the concepts of networking with J-SEAD, the integration of J-SEAD assets, to include the future networking, will be ad hoc at best.

A Network Sure to Crash – A Counter-Argument

Many would argue that an attempt to network all the varied sensors and shooters of J-SEAD would only make it more vulnerable to network attack through cyber warfare. A potential adversary could essentially shut down our 'system of systems,' making it nearly impossible for us effectively prosecute a J-SEAD plan. By attacking the node center, or even jamming the digital transmissions, the networked J-SEAD could be brought to a standstill. In fact, this cyber warfare argument is made by many in the U.S. Armed Forces today, who

believe that the services are relying too heavily on computers in future warfare. They argue that the more the services become a digitized force, the further they stray from the basic ideals of warfare and humans making decisions face-to-face on the battlefield.

Information superiority and digitization are a necessity to fight on the battlefields of today where units are often dispersed over great distances. Additionally, the enemy front lines are rarely directly in front of us, but often all around us (a fluid battlefield calling for better situational awareness), and the munitions of today call for better linking across the battlefield. While the danger to cyber warfare is real, that in itself should not prevent us from harnessing the technology to provide information superiority. With the upper hand on battlefield awareness, we can get inside the enemy decision loop/cycle and cause him to change his plan before he wants to.

More specifically to a networked J-SEAD, the attacking of the network would degrade the ability of the JFC to perform JSEAD, but the platform-based TTP currently used would be an ample substitute under the conditions of a damaged network. The same argument could be made that cyber warfare could degrade nearly any operational function on today's battlefield, but that does not equates to abandoning the many advantages of digitization, and more specifically networked J-SEAD.

Other arguments are made that creating a network for J-SEAD will take the human out of the equation. In fact, the network can be set using Attack Guidance Matrices and High Payoff Target Lists similar to Army artillery doctrine to assist the network in determining priorities and necessity to suppression or destroy the SAM. Another, and possible more preferred solution to this argument, would be to establish a sensor network coordinator that balances the competing requirements and monitors the changing IADS situation on the

battlefield. Either solution provides a work-around to the concern that a human will have no input to the system.

Conclusion

Network Centric Warfare has far-reaching applications to J-SEAD. With the competing demands for limited J-SEAD assets, both sensors in the sky and shooters on the ground and sky, the JFC would benefit from a networked grid of his sensors and shooters to effectively execute his J-SEAD campaign. By networking, the JFC can harness multiple and simultaneous capabilities of service platforms. Essentially, one platform will be able to transmit targeting information needed for another platform to launch a weapon against that target, despite the two platforms being great distances apart. As the available sensors expand in number with new technology -- unrealized potentials of the UAV, better coordinated use of national sensor assets, new precision guided munitions for sensor/shooter aircraft (i.e. Joint Direct Attack Missile for the F-16CJs), and others – the need for a network-centric approach to J-SEAD will be even more important. Lessons learned from Operation Allied Force has caused some to call for the establishment of a SEAD/Electronic-Attack Planning Cell at the operational level to ensure optimal use of the assets mentioned as players in the J-SEAD world.[28]

The JFC must adopt the concept on networked J-SEAD to be effective on the battlefield. Though the full realization of network centric warfare application to J-SEAD has some technological challenges ahead, much of the hardware needed (i.e. IDM) is available now to the sensors and shooters. This partial networking can add combat effectiveness to the J-SEAD mission for the JFC, conserving valuable resources and time while accomplishing

the mission. By combining the sensor grid with the shooter grid, the JFC has truly applied the operational concepts of Joint Vision 2010 and improved his force's combat effectiveness.

NOTES

[1] Chairman of the Joint Chiefs of Staff, Joint Vision 2010, (Washington, D.C.).
[2] Fred P. Stein, Observations on the Emergence of Network Centric Warfare, Evidence Based Research, Inc., 2.
[3] William A. Hewitt, Planting the Seeds of SEAD, Maxwell AFB, (Air University Press, Maxwell AFB), 1993.
[4] Ibid.
[5] Joint Pub 3-01.4, JTTP for Joint Suppression of Enemy Air Defenses (J-SEAD), July 1995, v.
[6] James R. Brungess, Setting the Context: Suppression of Enemy Air Defenses and Joint War Fighting in an Uncertain World, (Air University Press, Maxwell AFB), June 1994, 208.
[7] David S. Alberts, John J. Garstka and Frederick P. Stein, Network Centric Warfare: Developing and Leveraging Information Superiority, 2d ed. (Revised), (CCRP Publication Series), 1999, 88-9.
[8] Vice Admiral Arthur Cebrowski and John Garstka, "Network-Centric Warfare: Its Origin and Future," Proceedings, U.S. Naval Institute (http://www.usni.org), January 1998, 2.
[9] Alberts et. al., 157-186.
[10] See the recent The White House, A National Security Strategy for a New Century, December 1999 for further information on national strategy for fighting current major theater warfare, basically unchanged in the past few years from the two MTW mission.
[11] Federation of American Scientists, "Electronic Combat Systems," FAS Military Network (http://fas.org/man/dod-101).
[12] Federation of American Scientists, "F-16 Fighting Falcon," FAS Military Analysis Network (http://www.fas.org/man/dod-101/sys/ac/f-16.htm).
[13] Senior Airman Brian Jones, "Shaw prepares F-16s for SEAD mission," *ACC News Service* (http://www.acc.af.mil/news), April 13, 1999.
[14] Zachary Lunn, "The Deadly Game of SEAD," Journal of Electronic Defense (JED Online, http://www.jedonline.com/jed), May 1999.
[15] Lunn, pg. 6.
[16] Michael J. Coury, LCDR, USN, "Allied Force Lessons Learned," Journal for Electronic Defense, http://www.jedonline.com/jed), January 2000.
[17] Zachary Lum, "KILLINT, EW on the Offensive," Journal of Electronic Defense (JED Online, http://www.jedonline.com/jed), July 1997, 1.
[18] Unknown author, "Digital Polyglot," Symetrics Online (http://www.symetrics.com), October 1999.
[19] Lum, 8.
[20] William S. Cohen, 1999 Annual Report to the President and Congress, Washington D.C. (http://www.ditc.mil/execsec/adr1999), Chapter 11.
[21] JSEAD JT&E, Briefing to GEN Jumper, ACC Commander, December 11, 1999.
[22] Colonel Westenhoff, JSEAD JT&E Background Paper, 28 July 1999, 2.
[23] Jumper Brief, 18-19.
[24] Ibid., 25.
[25] Alberts, 82.
[26] Stein, 6.
[27] US Army Aviation Center, U.S. Army Aviation in Operation Desert Storm, Fort Rucker, Alabama, 1992, 35, 78.
[28] Kernan Chaisson, "Prowler Changes Based on Kosovo Lessons Learned," Journal of Electronic Defense, JED Online (http://www.jedonline.com/jed/new/jan00/wash/html).

BIBLIOGRAPHY

Alberts, David S., John J. Garstka and Frederick P. Stein. Network Centric Warfare: Developing and Leveraging Information Superiority, 2d ed. (Revised). Washington, D.C.: CCRP Publication Series, 1999.

"Army Air Assault Called Vulnerable." Rotor & Wing Magazine. August 1999. <http://www.21cav.org/articles/airassault.htm> (15 January 2000).

Barnett, Thomas P.M. "The Seven Deadly Sins of Network-Centric Warfare." U.S. Naval Institute Proceedings. 1999.

"Briefing to GEN Jumper, ACC Commander. " J-SEAD JT&E, 11 December 1999.

Brungess, James R., Lt. Col., USAF. Setting the Context: Suppression of Enemy Air Defenses and Joint War Fighting in an Uncertain World. Maxwell AFB, AL: Air University Press, June 1994.

Cebrowski, Arthur, Vice Admiral, USN, and John Garstka. "Network-Centric Warfare: Its Origin and Future," Proceedings, U.S. Naval Institute, January 1998. <http://www.usni.org> (23 August 1999).

Cebrowski, Arthur, Vice Admiral, USN. "Network-Centric Warfare: An Emerging Military Response to the Information Age." 1999 Command and Control Research and Technology Symposium. 29 June 1999. <http://www.nwc.navy.mil/pres/speeches/ccrp2_.htm> (4 February 2000).

Chairman of the Joint Chiefs of Staff, Joint Vision 2010, (Washington, D.C.).

Chaisson, Kernan. "Prowler Changes Based on Kosovo Lessons Learned." Journal of Electronic Defense, JED Online <http://www.jedonline.com/jed/new/jan00/wash/html> (7 December 1999).

Cohen, William S., 1999 Annual Report to the President and Congress, Washington D.C. <http://www.ditc.mil/execsec/adr1999> (18 January 2000).

Coury, Michael J., LCDR, USN, "Allied Force Lessons Learned," Journal for Electronic Defense, January 2000. <http://www.jedonline.com/jed> (25 January 2000).

"Digital Polyglot," Symetrics, Inc. October 1999 <http:/www.symetrics.com/products/polygot.htm> (2 December 1999).

"EA-6B Prowler." FAS Intellegence Resource Program. <http://www.fas.org/irp/program/collect/ea-6b_prowler.htm> (18 January 2000).

"Electronic Combat Systems." FAS Military Network. <http://www.fas.org/man/dod-101/sys/ac/equip/ec.htm> (2 December 1999).

"F-16 Fighting Falcon." FAS Military Analysis Network <http://www.fas.org/man/dod-101/sys/ac/f-16.htm> (22 January 2000).

Hewitt, William A., Planting the Seeds of SEAD. Maxwell AFB, AL: Air University Press, 1993.

"Improved Date Modem (IDM)." Innovative Concepts, Inc. 1999. <http://www.innocon.com/idm/html> (4 February 2000).

"Joint Suppression of Enemy Air Defenses (JSEAD) – AFSOR." Federal Information Exchange, Inc. <http://web.fie/com/htdoc/fed/afr/rom/any/proc/10179601.htm> (18 January 1999).

"Joint Suppression of Enemy Air Defenses (JSEAD) – FY98 Activity." OSD DOT&E. <http://www.dote.osd.mil/reports/fy98/jte/98sead/html> (18 January 2000).

Jones, Brian, Senior Airman, USAF. "Shaw prepares F-16s for SEAD mission," ACC News Service <http://www.acc.af.mil/news> (15 December 1999).

Lum, Zachary. "KILLINT, EW on the Offensive." Journal of Electronic Defense (JED Online). July 1997. <http://jedonline/jed/html/new/jul97/cover.html> (10 January 2000).

_____. "Hardcore Hard Kill: Seeds of a New SEAD." Journal of Electronic Defense (JED Online). February 1997. <http://jedonline/jed/html/new/feb97/cover.html> (10 January 2000).

_____. "The A to Z of Lethal SEAD." Journal of Electronic Defense (JED Online). July 1998. <http://www.jedonline/jed/html/new/jul98/cover.html> (9 January 2000).

_____. "The Deadly Game of SEAD." Journal of Electronic Defense. May 1999. <http://www.jedonline.com/jed/html/new/may99/cover.html> (18 December 1999).

"Situational Awareness is Critical in the Cockpit." Symetrics, Inc. <http://www.symetrics.com/products/awarness.htm> (4 February 2000).

Stein, Fred P. Observations on the Emergence of Network Centric Warfare. Evidence Based Research, Inc., date unknown.

The White House. A National Security Strategy for a New Century. Washington, D.C., U.S. Govt. Print. Off., December 1999.

Thompson, Loren B., Ph.D. "Follow-On Jammer: The Answer is Obvious." Wings of Gold. Summer 1999.

"UAV Battlelab Develops New SEAD Concept." Knowles Report. 15 September 1999. <http://www.knowlesreport.com/sample.htm> (18 January 2000).

Urbon, Bruce. "Precision SIGINT Targeting System (PSTS) Advanced Concept Targeting System (ACTD) Program Description." Office of Naval Research. <http://www.onr.navy.mil/sci%5Ftech/inter/psts.htm> (18 January 2000).

U.S. Joint Chiefs of Staff. JTTP for Joint Suppression of Enemy Air Defenses (J-SEAD) (Joint Pub 3-01.4) Washington, D.C.: 25 July 1995.

U.S. Army Aviation Center. U.S. Army Aviation in Operation Desert Storm. Fort Rucker, Alabama, 1992.

U.S. Congress. House of Representatives. Armed Services Committee. Statement for the Record by LTG John L. Woodward, USAF, Director for C4 Systems, Joint Staff. 23 February 1999.

Westenhoff, Colonel, US Army. JSEAD JT&E Background Paper. 28 July 1999.

Zimm, Alan D., Commander, USN (Ret.). "Human-Centric Warfare." U.S. Naval Institute Proceedings. May 1999 <http://www.usni.org/proceedings/articles99> (17 January 1999).