Marine Corps Aerial Electronic Warfare Into the Future

EWS 2003

Subject Area Electronic Warfare

MARINE CORPS AERIAL ELECTRONIC WARFARE INTO THE FUTURE

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19 February 2003

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
2003		**00-00-2003 to 00-00-2003**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Marine Corps Aerial Electronic Warfare Into the Future	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **United States Marine Corps,Command and Staff College, School of Advanced Warfighting,Marine Corps University, 2076 South Street,Quantico ,VA,22134-5068**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**16**	

"In future warfare, the struggle for information will play a central role, taking the place, perhaps, of the struggle for geographical position held in previous conflicts. Information superiority is emerging as a newly recognized, and more intense, area of competition."[1] In the struggle for information on the battlefield, control of the electromagnetic spectrum has proven to be of extreme importance in modern conflicts. As forces enter into battle with more technologically advanced weapons, the reliance on the electromagnetic spectrum will only increase. The United States military, and the Marine Corps in particular, is lagging in developing its electronic warfare capability for the future. This choice may jeopardize its ability to control the electromagnetic spectrum in future conflicts. This negligence has caused the Marine Corps to fail to solidify a viable follow on platform to the aging EA-6B Prowler.

The Marine Corps has been a pioneer in aerial electronic warfare. Marines of Marine Electronic Attack Squadron 3 (VMCJ-3) flew the first jet aircraft dedicated to electronic warfare (EW), the Douglas F3D-2Q Skyknight. It was introduced in 1957 and later upgraded and designated the EF-10B. The Skyknight flew in support of strike aircraft during the Vietnam War and provided the majority

of EW support. In late 1966 the Air Force and Navy were able to field the RB-66 Destroyer and the EKA-3B Skywarrior to augment the Marine capability.[2] The EA-6A Electric Intruder replaced the EF-10B and was the first aircraft built solely to perform the EW mission. "The EA-6A was developed exclusively for the Marine Corps, and, when introduced into combat at Da Nang RVN in November 1966, provided the Corps and our country with the only aircraft dedicated to the electronic warfare mission that had sufficient capability to keep up with the changing equipment and tactics of the North Vietnamese air defense system."[3] The EA-6B followed the EA-6A and has been in service with the Navy since 1972, and the Marine Corps since 1979.

Now that the EA-6B is approaching the end of its service life, the Air Force (having retired its only tactical jammer, the EF-111, in 1994) and the Navy have both made announcements regarding the direction in which their EW programs are heading. The Navy has decided to acquire an electronic attack version of the F/A-18 E/F Super Hornet, designated the EA-18G.[4] The Air Force is moving toward a program consisting of multiple platforms. Being considered are B-52 and F-22 aircraft with jamming pods and unmanned aircraft, with the focus of effort being

an electronic warfare variant of the X-45 Unmanned Combat Aerial Vehicles (UCAVs).[5]

Meanwhile, the Marine Corps has chosen to postpone a decision on the direction of its EW program. Though recent combat operations have put additional and unexpected stress on its airframes and supply system, the Marine Corps intends to fly the Prowler until 2015.[6] There are several options to replace the aging fleet of Prowlers. As already mentioned, the X-45 UCAV and the EA-18G are possibilities currently in different stages of development. Another option for the Marine Corps may be an electronic attack (EA) variant of the Joint Strike Fighter (JSF). Each replacement option has different advantages and disadvantages.

The X-45 UCAV is one of the more controversial options. Some of the issues with this platform include the proposed cost, capabilities, survivability, and the bandwidth required to control the aircraft. The X-45B is the planned second version of the UCAV that is larger than the original X-45A UCAV and will have a base weight of 14,000 pounds with a payload capability of 2000 pounds.[7] It will fly at approximately 200 knots and have some stealth characteristics. Currently plans call for the aircraft to have a derivative of the EA-6B's Improved Capability 3

(ICAP 3) system that has been developed as an upgrade for the EA-6B's electronics suite with the yet to be developed Lightweight Modular Support Jammer as a future option.[8] The proposed employment of the EW UCAV calls for it to loiter over the battlefield waiting for enemy radar system activity, and then to reactively jam it. Cost estimates are around $10 to $12 million, or around one third of the cost of the JSF or EA-18G.[9] Proponents of the UCAV hail it as a low cost, low risk option with capabilities that meet or exceed the capabilities of current EW platforms.

The argument for the reduced cost of a UCAV is valid when the money spent on aircrew training flights (all UCAV operator training would be in a simulator), reduced combat search and rescue (CSAR) requirements, and the reduced footprint of a proposed UCAV squadron are taken into account. These savings may easily be negated, however, as the cost of the technology to make it a viable platform puts the cost per vehicle at around $50 to 60 million.[10] As the price increases, so does the likelihood that it will be viewed as no less disposable than a manned vehicle which will negate its advantage over manned aircraft.

The proposed capabilities for the UCAV pose problems for the integration of the UCAV into the air battle. Currently the EA-6B accompanies the strike package and jams

from a position that puts the protected aircraft between the jammer and the enemy radar. This geometry is required to effectively shield the strike aircraft. Because the JSF will routinely operate at supersonic airspeeds, the UCAV will be unable to resolve geometry solutions due to its slower speed. EW counter-counter measures employed by modern enemy radar systems negate the value of barrage jamming that does not employ this geometric solution. The UCAV's slow speed and loiter tactics will forfeit the advantage to the enemy. To make the UCAV faster, a more expensive platform will be necessary.

The loiter tactic also raises some concerns. In an environment with a well-integrated air defense, the probability that a UCAV would escape detection is slim, especially since any stealth capabilities disappear the moment it begins to emit jamming energy. And without a set of eyes in a cockpit to see and then react to a missile launch, the UCAV becomes a sitting duck, unable to maneuver against anything shot at it. The only aircraft that the Iraqi air defense assets have managed to shoot down in the eleven years of Operations Northern and Southern Watch are Predator UAV's.

Other technological hurdles to overcome are the amount of bandwidth required to control an EW UCAV and

electromagnetic interference (EMI) caused by the energy put out while jamming. Depending on the electronic on-board decision aid capability developed, control of an EW UCAV by an operator on the ground will require a large amount of bandwidth to transmit the information that the UCAV is sensing in real time as well as control inputs.[11] The connection between the control base and the UCAV will also have to be relatively robust to withstand interference from the energy that is produced while jamming. For example, when jamming in a Prowler, the jamming energy causes the aircraft to lose its Global Positioning System (GPS) signal, severely degrades radio communications, and can similarly affect other aircraft up to a mile away. If a means of protecting the UCAV's link is not found, it could be forced into an autonomous mode while jamming and unable to receive any human inputs.

The EA-18G is another option to consider as a follow on to Marine Prowlers. The United States Navy has chosen this option to replace its Prowlers. The Navy plans to have two thirds of its Prowler fleet transitioned to EA-18Gs by 2009.[12] The EA-18G will put ICAP 3 (scheduled to be fitted into Marine Prowlers in 2007) and the current jamming pods on the F/A-18F airframe.[13] This offers a rapid solution to the question of how to continue to perform the

EW mission with an aircraft that is rapidly aging. It puts systems that are already funded onto a platform that can carry them into the next thirty years. Upgrades can be incorporated as they are developed to keep pace with the emerging technology without leaving any gaps in capabilities.

The EA-18G will have about 85% of its parts in common with the F/A-18 E/F, reducing the maintenance effort required. Like the F/A-18F, it has a crew of two, a reduction by one half from the current Prowler crew. The ICAP 3 system promises to be more user-friendly, helping reduce task saturation, though it will still be demanding on the person running the EW mission in the backseat. The EA-18G will be a carrier capable aircraft that could dovetail into the Memorandum of Agreement (MOA) signed by the Navy and Marine Corps regarding Tactical Aircraft (TacAir) integration.[14] The MOA seeks to maximize the usage of the Navy and Marine Corps carrier-based aviation assets through better integration of Marine squadrons into the Carrier Air Wings. If the Marine Corps decides to adopt the EA-18G to replace the Prowler it will be able to continue to share assets with the Navy to include training facilities and maintenance supply lines.

The final option as a follow on to the EA-6B for the Marine Corps is an electronic attack version of the JSF. The Marine Corps has announced that it is interested in an EA variant of the JSF, but has not allocated any funding to the development of this platform. Several references have been made in the press to it being considered as an option.[15] Lockheed Martin claims that an EA JSF could be operational within ten years[16] though that seems optimistic without the near term decision and commitment that is required in order to make its acquisition feasible.[17]

Since the Marine Corps has stated its intentions to transition to an all-JSF force, the development of a JSF variant that can perform the EW mission is a logical step. Another part of that intention is that the force will be a fleet of short take-off and landing (STOVL) JSFs. There is currently only a single seat in all the JSF variants. The reactive nature of the EW mission requires a high level of system interface while flying that a single pilot would be unable to accomplish in addition to his or her aviation demands. In the STOVL JSF, the lift fan is located directly behind the pilot's seat, which appears to preclude modifying it to gain another seat. If the Marine JSF is unable to be modified to a two seat variant, and significant technological advances in receivers and

computers do not occur, the JSF's usefulness as an EW platform will be severely limited.

Proponents of the JSF argue that to be able to protect an all stealth strike package comprised if JSFs, the EW platform supporting them must have stealth characteristics as well,[18] as the EW version of the JSF would have. Again the response is that once any platform begins to emit jamming energy, it loses its stealth capability. The two capabilities do not mix and the requirement is not one that can be fulfilled.

If the Marine Corps intends to maintain Electronic Warfare as one of the Six Functions of Marine Aviation[19] it requires an airborne platform that will be able to prosecute the EW mission without any lapses. The EA-6B Prowler, the only platform currently in the Marine Corps that executes that mission, is reaching the end of its service life. Plagued by problematic engines, weakening wing sections, and a decrease in the mean time between failure of parts that are no longer manufactured, the Prowler needs to be replaced before the original target date of 2015.

The UCAV should not be considered as a replacement to the EA-6B as the technology to make it a viable platform will not be available until after the Prowler is retired.

Funding is another factor that makes it difficult to bring a UCAV online quickly enough to replace the Prowler. Finding the money to devote to developing the technology required in a tight defense budget is unlikely for the near future.

The proposal of an EW version of the JSF is also a replacement that will not be operational before the Prowler reaches the end of its service life. As with the UCAV, it requires more development and funding to make it a viable platform. Issues that need to be resolved include adding another seat and incorporating the receiver and jamming equipment into the airframe.

The EA-18G is the most realistic of the three options. It will allow uninterrupted EW support while new technology is being developed and will maintain the electronic warfare knowledge resident in the Prowler community from disappearing with the Prowler. Flowing it into the TacAir Integration Plan recently signed by the Navy and Marine Corps will help reduce some of the operational costs. Of the three platforms, only the EA-18G will be able to be in service before 2010. It uses equipment that is closer to being fielded, and while it may not be as advanced as the other options, it is the option that can be fielded the most quickly. It may be looked upon as a temporary fix and

therefore a waste of money, but if it prevents the Marine Corps from dropping a capability it pioneered, the money will have been well spent.

The ideal option for a replacement to the aging EA-6B Prowler currently in service with Marine Tactical Electronic Warfare Squadrons would be a new platform built solely for electronic warfare with development having started several years ago. Despite the demonstration of the importance of controlling the electromagnetic spectrum in recent conflicts such as Operation ALLIED FORCE and the increased dependence on the electromagnetic spectrum by more technologically advanced weapons and communications systems, little attention has been paid to advancing Marine Corps EW capabilities. With the aging of the Prowler fleet and the lack of a definite follow-on aircraft, the next best option is to choose from what is available. While the EA-18G only provides a better airframe to house the updates planned for the EA-6B, it will bridge the gap between the retirement of the Prowler and the implementation of advanced technologies on the battlefield to be found in UCAVs and future aircraft. The EA-18G will prevent the Marine Corps from losing its airborne electronic warfare capability, enabling it to wage the information-based warfare of future conflicts.

[1]Arguilla, Ronfeldt p. 90
[2]<www.geocities.com/rf4bphantom/history4.htm> and
<www.geocities.com/fr4bphantom/skyknight.htm>.
[3]Weides, et al, <www.awattack.com/vmcj1.htm>.
[4]Donnelly, 7.
[5]Fulghum, "USAF Tags X-45 UCV As Penetrating Jammer," 26.
[6]Hebert, <http://www.InsideDefense.com>.
[7]Kopp, 22.
[8]Fulghum, 26.
[9]Chapman, 61.
[10]Asker, 25.
[11]Wall, "X-45A Flies Into Turbulent Future," 26.
[12]Donnelly, 7.
[13]Keeter, "Industry's Electronic Attack Options Take Shape; Services
Prepare to Brief DoD," 1.
[14]Gildea, 1.
[15]Keeter, "Aldridge OKs Three-Part Plan to Follow EA-6B," 1.
[16]Keeter, "Pilot: EA-18 Not JSF Variant Makes Stronger Case for EA-6B
Replacement," 1.
[17]Stanford, 1.
[18]Keeter, "Industry's Electronic Attack Options Take Shape; Services
Prepare to Brief DoD," 1.
[19]MCRP 5-12D, 3-1.

Works Consulted

Anonymous. "Marine Corps Aviation Reconnaissance Squadron History: VMCJ-3: 1955-1965." 12 Dec 2002 <http://www.geocities.com/rf4bphantom/history.htm>.

Anonymous. "Marine Corps Aviation Reconnaissance Squadron History: VMCJ-3: 1955-1965:Douglas F3D-2Q (EF-10B) 'SkyKnight'". 12 Dec 2002 <http://www.geocities.com/rf4bphantom/skyknight.htm>.

Anonymous. "Navy and Marine Corps sign TacAir Integration memos." Marine Corps Gazette. Oct 2002: 4.

Arquilla, John and David Ronfeldt, ed. In Athena's Camp: Preparing for Conflict in the information Age. Santa Monica, CA: Rand, 1997.

Asker, James R. "Unaffordable Aerial Vehicles." Aviation Week and Science Technology. 29 Apr 2002: 25.

Byrum, Bruce, BGen. (Ret.), USMC. "U.S. Naval forces and unmanned aerial vehicles." Naval Forces. 2001: 50.

Callahan, Shawn P. "Refocus Marine TacAir." Marine Corps Gazette. May 1999: 51-53.

Chaisson, Kerman. "Solutions to self-jamming sought." Journal of Electronic Defense. Mar 2002: 16.

Chapman, Robert E. II. "Unmanned combat aerial vehicles: Dawn of a new age?" Aerospace Power Journal. Summer 2002: 60-73.

Cortes, Lorenzo. "AESA Allows Super Hornet To Perform Tactical Electronic Attack, Navy Official Says." C4I News. 5 Dec 2002: 1.

Cortes, Lorenzo. "BAE Systems Sees Future Opportunity For Electronic Arrack With AJCN." C4I News. 9 Jan 2003: 1.

Donnelly, John M. "Navy to Fund Electronic-Warfare Super Hornet." Defense Week. 23 Dec 2002: 7.

Fulghum, David A. "Lasers, HPM Weapons Near Operational Status." Aviation Week and Science Technology. 22 Jul 2002: 173.

Fulghum, David A. and Robert Wall. "USAF Tags X-45 UCAV As Penetrating Jammer." Aviation Week and Science Technology. 1 Jul 2002: 26.

Gildea, Kerry. "Marine Commandant Nominee Makes Pitch For TacAir Integration Plan." Defense Daily. 30 Sep 2002: 1.

Harrison, Richard K. "JSF and UCAV aren't the answer for the Navy." United States Naval Institute, Proceedings. Dec 2002: 59.

Hebert, Adam J. "Marines To Stick With EA-6B As Medium-Term Jammer Through At Least 2012." InsideDefense 25 Jul 2002 <http://www.insidedefense.com/>.

Horner, Chuck and Hal Gershanoff. "First person singular." Journal of Electronic Defense. Jan 1999: 74.

Kandebo, Stanley W. "SEAD, Other Ground Attack Capabilities Planned for UCAVs." Aviation Week and Science Technology. 2 Oct 2002: 30-31.

Keeter, Hunter, "Industry's Electronic Attack Options Take Shape; Services Prepare To Brief DoD." Defense Daily. 26 Apr 2002: 1.

Keeter, Hunter. "Aldridge OKs Three-Part Plan To Follow EA-6B." C4I News. 20 Jun 2002: 1.

Keeter, Hunter. "Pilot: EA-18, Not JSF Variant, Makes Stronger Case For EA-6B Replacement." Defense Daily. 6 May 2002: 1.

King, Peter H. "In New Era Of War, Pilotless Planes Soaring." Los Angeles Times. 22 Dec 2002: A7.

Kopp, Carlo. "Robot Ravens?" Journal of Electronic Defense. Sep 2002: 22-23.

Kromhout, Gert. "From SEAD to DEAD." Military Technology. Dec 2002: 8-15.

Levenson, David S., et al. "SEAD: Operation Allied Force and beyond." Journal of Electronic Defense. Jan 2000: 51-56.

Mustin, Jeff. "Future employment of unmanned aerial vehicles." Aerospace Power Journal. Summer 2002: 86-97.

Odom, Earl. "Future missions for unmanned aerial vehicles: Exploring outside the box." Aerospace Power Journal. Summer 2002: 84-85.

Price, Alfred. War in the Fourth Dimension: US Electronic Warfare Vietnam War to Present. Bodmin, Cornwall: MPG Books, Ltd., 2001.

Rivers, Brendan P. "JSF going global, but will its EW suite?" Journal of Electronic Defense. Aug 2002: 26.

Stanford, James, LtCol, USMC. "EJSF." PowerPoint presentation in email to author. 15 Nov 2002.

Wald, Charles. "Air Force Wants Multi-Platform Approach To EW." Defense Daily. 8 Mar 2002: 1.

Wall, Robert. "Navy Sets Course For Endurance UAV." Aviation Week and Science Technology. 23 Dec 2002: 7-8.

Wall, Robert. "Pentagon Bets On Joint UCAV." Aviation Week and Science Technology. 16 Dec 2002: 41.

Wall, Robert. "X-45A Flies Into Turbulent Future." Aviation Week and Science Technology. 27 May 2002: 26-27.

Weides, John D., Col. (Ret.), USMC and Col. (Ret.) J. David Weber USMC. "VMCJ-1 Story-Evolution of the EA-6A." 12 Dec 2002 <http://www.awattack.com/vmcj1.htm>.

Wilson, George C. "Pilots! Unman your airplanes!" National Journal. 1 Dec 2001: 3692-3693.

Wolfe, Frank. "Jumper: Concept of Operations Biggest Challenge for UCAV." C4I News. 18 Jul 2002: 1.

U.S. Marine Corps, MCRP 5-12D, Organization of Marine Corps Forces. Quantico, VA: Marine COrps Combat Development Command, 1998.