NAVAL AIR POWER AND NETWORKED WARFARE:

A Revolutionary Transformation

Naval STRIKE FORUM

Naval Air Power and Networked Warfare

Executive Summary

The U.S. Navy's twelve aircraft carriers and ten carrier air wings are the most powerful expression of American military might in the post-communist era. Combined with other sea-based forces, they have the capacity to sustain prolonged and lethal strike operations against distant adversaries even in the absence of foreign bases or allies. The versatility of carrier-based air power is reflected in its heavy use over recent years to enforce global peace.

Naval aviation is currently in the midst of a revolutionary transformation aimed at realizing the full warfighting potential of the information age. By the end of the present decade, a single carrier air wing will be able to launch over 200 strike sorties per day, around the clock and in any weather, precisely targeting over a thousand separate aimpoints deep in an enemy's interior. Moreover, the networking of all the components of a carrier battle group within a single, shared operating environment will enable each ship and plane to achieve unprecedented mission effectiveness. Few countries could withstand the consequences of attacks by such a force for long.

However, the peacekeeping and warfighting benefits of networked naval air power depend on a flow of budgetary resources that lately has been inadequate. Rather than progressing smoothly into the information age, naval aviation is over-committed and under-funded. The shortfall in funding is particularly pronounced in the area of modernization, where the ambitious vision of a digitized fighting force has been repeatedly undermined by the demands of near-term readiness.

The F/A-18 E/F Super Hornet is likely to be the Navy's – and perhaps the nation's – premier strike aircraft for decades to come, so its production and further enhancement must be kept on track. At the same time, the service must give focused attention to modernizing the electronic-warfare capabilities of the carrier-based EA-6B Prowler and upgrading the sensors of the E-2C Hawkeye airborne warning and control aircraft. Failure to modernize all three of these pivotal aircraft would undercut the future effectiveness of naval air power and potentially compromise national security.

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THE LESSONS OF HISTORY

Charles Dickens began *A Tale of Two Cities* with the portentous statement, "It was the best of times, it was the worst of times." He thus captured the complex, sometimes contradictory, forces shaping European civilization on the eve of the nineteenth century. Soon the old order would be swept away by political upheavals culminating in the Napoleonic Wars, and technological innovations such as railroads and the telegraph that would transform the landscape of everyday life.

The revolution that began with the Enlightenment in the late 1700s continues today, transformed into what many now call the "information age." Its tools and ideas have spread far beyond the West, and its pace seems to be continuously accelerating. Culture and commerce now change more in a few generations than they did during the entire millennium following the collapse of the Roman Empire.

But as Dickens saw in *A Tale of Two Cities*, one thing that has not changed is the precarious, ambiguous quality of the human condition. The same century that produced the green revolution also produced the atomic bomb. A period of unprecedented democratization also saw the rise of fascism, to be followed by the brooding menace of communism. No matter how much better the condition of the common man becomes, the specter of catastrophe always lurks nearby.

Perhaps the most positive thing that can be said about the Cold War is that it kept the attention of western societies focused upon this reality. With the threat of external aggression now greatly diminished, the tendency is to forget the tragedies of the past, and to move on to more immediate concerns. For many Americans, Hitler and Stalin are no more real than Nero or Napoleon, actors in an ancient story they barely know.

Unfortunately, it is precisely this loss of historical memory that, as George Santayana pointed out, leads to new tragedies. People – not just everyday folks, but great leaders and intellects – tend to forget that all the hopes and aspirations we feel today for the future were felt before, and that some very dark moments intervened between then and now.

The very darkest occurred in wartime. Whatever demographic, economic, cultural or political challenges the nation may have faced, only war has called into question its ability to survive. The first priority of a sound government must therefore be to assure that the nation can prevail in wartime against any conceivable threat, whether it be a peer adversary, a regional rogue state, or transnational terrorists. That capacity not only assures national survival, but its mere existence deters aggression and thus makes war less likely.

THE FUTURE AT RISK

The current period of American history is neither the best of times nor the worst of times for the nation's military. But it does exhibit the same ambiguity that Dickens detected in Europe in the late eighteenth century. On the one hand, America is by far the greatest military power in the world, and its armed forces have embarked on a revolutionary transformation exploiting information technologies to preserve their advantage. On the other hand, there has been an erosion of U.S. military capabilities over the past ten years relative to global commitments, and the shortfall in forces and resources is now too serious to ignore.

Nowhere is this more apparent than in the Navy, the service that historically has been the most visible, flexible expression of American military power in peacetime. For a variety of geographical, technological and political reasons, the Navy is likely to retain that role for at least the next twenty years. However, whether it can play the role well is another matter.

All three of the Navy's warfighting communities – the surface fleet, submarines, and naval aviation – are being worn down by a rate of contingency operations four times higher than witnessed in the Cold War. The intensity of deployments results partly from the service's shrinkage since 1990, and partly from the implementation of an ambitious national-security strategy that calls for actively participating in the creation of a more stable world order. The strategy makes sense, but it is becoming increasingly difficult to reconcile its operational requirements with trends in military investment and readiness.

This essay is about the challenges faced by naval aviation, particularly the preponderance of naval aviation deployed on the nation's twelve aircraft carriers. More than the Navy's other communities, aviation today reflects the incongruity of resources and requirements. There is little question that carrier-based strike forces will be among the most useful and versatile elements of U.S. military power in the years ahead. But bold visions of "network-centric warfare" are being undermined by the realities of aging airframes, inadequate force structure, and chronic shortfalls in funding. If these problems are not addressed systematically by a new administration, naval aviation's capacity to adequately support national-security strategy will become doubtful.

THE IMPORTANCE OF NAVAL POWER

In 1907, President Theodore Roosevelt signaled America's emergence on the world stage by dispatching the Great White Fleet on a globe-girding voyage. It is an irony of recent history that the American Century whose coming was foreshadowed by the Great White Fleet should conclude in 1999 with the aircraft carrier named after Roosevelt launching dozens of strike sorties daily against targets in former Yugoslavia.

The U.S. Navy of today is infinitely more capable than it was in Roosevelt's day. But the fact that it has recently engaged in combat in the Balkans – an idea nearly inconceivable in 1907 – says much about why the Navy needed to become more capable. At the dawn of the twentieth

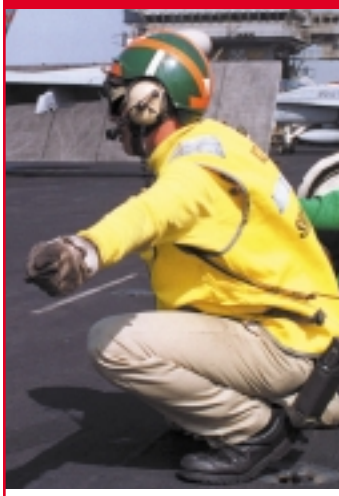
century, U.S. security policy consisted mostly of keeping Europeans out of the Western Hemisphere. A hundred years and two world wars later, few Americans still believe it is possible to insulate their neighborhood from dangers arising in Eurasia. America's culture and economy have become globalized, as have its security interests.

Because most of what matters in the world – 75 percent of the population, a similar share of technology and commerce – is within a few hundred miles of the ocean, the Navy has always been a key tool in protecting and projecting U.S. power. For most of the last century, the Navy's most important role was controlling the sea lanes, the main means of transit between the world's great powers. A new mission of nuclear deterrence emerged at mid-century, but as long as America faced a peer competitor in Eurasia – Germany, Japan, Russia or whomever – it was inevitable that mastery of the seas would remain the Navy's leading conventional mission.

With the waning of communism at century's end, though, new missions emerged focusing on the littoral. The locus of national-security strategy shifted from containing a peer competitor to preventing the emergence of a new one. That meant being able to shape events ashore, sometimes on a continuous basis. Each of the Navy's warfighting communities has been transformed by the advent of littoral warfare. Two-thirds of attack-submarine requirements are now driven by surveillance and intelligence-gathering needs in the littorals (many originating at the national level). The next generation of surface combatant is the first to be designed primarily as a "land-attack" warship. And naval aviation is in the midst of a revolution in strike warfare.

The Navy's technological vision for facilitating littoral warfare in the new century is called "network-centric warfare." It is a bold plan for integrating the burgeoning technological potential of each warfighting community into an unified, preferably seamless force. But it will take many years and huge resources to implement this vision, and the operational demands of being the world's only superpower will not wait. The entire service thus finds itself running at an unprecedented level of peacetime intensity at precisely the same moment that it should be investing in the fruits of the information revolution. The budgetary tension between the need for near-term readiness and long-term investment has become intolerable.

This trend too is affecting all three of the Navy's warfighting communities. The recent range and intensity of overseas commitments suggests that there is roughly a twenty-percent shortfall in conventional force structure across the service – in attack subs, in surface combatants, and in aircraft carriers. However, the shortfall in naval aviation is more complex and probably more serious than in the other communities, owing to the fact that carrier-based strike assets are likely to make a disproportionate contribution to U.S. combat operations in the years ahead.



THE ADVANTAGES OF NAVAL AIR POWER

The notion that naval aviation has some special relevance to emerging warfighting requirements is controversial both within the Navy and among the other services. However, there are compelling reasons for recognizing the disproportionate importance of naval air.

The Air Force is heavily dependent on overseas bases for its wartime effectiveness. But the number of foreign bases to which that service has access has declined over 80 percent since the height of the Cold War, and all of the thirty or so bases that remain are subject to political constraints on their use. In many areas of the world such as Southeast Asia, the Indian subcontinent and southern Africa, the Air Force does not have assured access to a single near-by base. The base-access issue is likely to grow worse in the future as the interests of the U.S. and its allies diverge. Indeed, experience suggests the prolonged presence of U.S. forces at foreign bases can contribute to such a divergence by becoming a political embarrassment for the host government.

Even when usable bases are available in a theater of operations, a resourceful adversary may be able to damage or destroy them. Air Force advocates often remark upon the potential vulnerability of aircraft carriers, but at present land bases are more vulnerable to preemption in wartime because their location is fixed and their defense is difficult. Not only will future enemies have many options for directly attacking overseas bases, including weapons of mass destruction, but because U.S. use of the bases depends on the goodwill of the host government, enemies will have the additional option of undermining base access by threatening or overthrowing that government.

It thus is unrealistic to assume future access to bases in many regions. One solution to the Air Force's access problem is to rely on long-range bombers that can sustain operations from more distant locales, perhaps even from the U.S. However, the service has only purchased 21 B-2 bombers with the requisite combination of range, precision and survivability, and that will not be enough to sustain a major bombing campaign over protracted periods.

About 90 percent of the long-range bombers expected to be available to the Air Force over the next twenty years will require support jammers and/or escort fighters in order to transit hostile airspace, which in turn will require nearby basing. Aircraft carriers potentially could provide such support when land bases are unavailable, but the jammers and fighters on any nearby carriers would probably be fully occupied supporting the carriers' own strike aircraft.

In the absence of land or carrier-based support, the Air Force might still be able to use its non-stealthy bombers by equipping them with long-range standoff weapons that allow the planes to hit targets without entering hostile airspace. But these weapons (air-launched cruise missiles) are too expensive to use for covering most of the targets in a major air campaign. The Air Force inventory of such weapons is currently measured in the hundreds, but tens of thousands might be needed – 40,000 aimpoints were attacked in six weeks during Operation Desert Storm – leading to munitions costs in the tens of billions of dollars.

It thus is easy to imagine circumstances in which the Air Force could not operate effectively with its proposed mix of strike assets. That would leave the nation largely dependent upon sea-based forces to conduct most strike operations, since these are far less dependent on land bases. All three of the Navy's warfighting communities could make a contribution to strike warfare against land targets, employing either manned aircraft or missiles. However, manned aircraft flying from carriers are intrinsically more versatile and cost-effective for conducting large-scale operations, as well as many smaller-scale operations.

The main strike system used by surface combatants and submarines against land targets is the Tomahawk cruise missile. Tomahawk is an impressive system, but it relies upon preprogrammed (and accurate) targeting data to successfully attack enemy assets. The combination of preprogramming and slow speed normally means Tomahawk is only effective against fixed targets such as buildings. It is not well suited to attacking mobile, hidden or buried targets. Moreover, each Tomahawk costs hundreds of thousands of dollars, resulting in high munition costs for even moderately large strike campaigns. Because of the missile's high cost, the Navy's entire inventory of Tomahawks today would be insufficient to attack even a tenth of the aimpoints struck in Operation Desert Storm.

Naval aviation can compensate for most of the deficiencies apparent in other sea-based systems used for attacking land targets. First of all, the precision munitions delivered by carrier-based aircraft cost a small fraction of what a cruise missile costs, because they are glide bombs that do not require autonomous means of propulsion or guidance. Second, since the pilot typically pinpoints intended targets immediately prior to weapons release, manned aircraft are much more effective at searching out mobile or concealed targets. Third, a strike aircraft can carry a mix of precision munitions, enabling it to attack several different types of targets on a single sortie, even when the location of targets was unclear prior to takeoff. Fourth, a manned aircraft can conduct dynamic damage assessment, in many cases determining immediately whether a target has been destroyed or needs to be hit again. Finally, a manned aircraft can carry out numerous additional missions such as jamming, reconnaissance or fighter escort, sometimes in combination with strike missions.

Carrier-based aircraft thus offer a combination of versatility and cost-effectiveness not presently available in unmanned strike systems deployed at sea, while circumventing the operational constraints imposed by politics and geography on land-based aircraft. In the past, these advantages have been undercut by limitations of range and accuracy. However, naval aviation is currently in the midst of a technological transformation that will largely eliminate such drawbacks.

A REVOLUTION IN STRIKE WARFARE

The transformation of carrier-based strike forces began in the aftermath of Operation Desert Storm, when it became apparent that the aircraft and munitions used during the Cold War to protect battle groups at sea would not be well-suited to an era of littoral warfare. Although fully half of the Navy's carriers participated in Operation Desert Storm, the performance of naval aviation in the air war revealed disturbing shortfalls in technology and tactics. The aviation community spent the balance of the 1990s rethinking its approach to strike warfare.

The first step in the transformation was a reorganization of carrier air wings. The aging A-6 Intruder medium attack aircraft and A-7 Corsair light attack aircraft were retired, to be replaced by the F/A-18C/D Hornet multimission strike aircraft and a variant of the F-14 Tomcat fighter modified for precision day and night bombing dubbed the "Bombcat." The second step was to replace gravity bombs with precision-guided munitions capable of destroying a range of targets in a single sortie. The most noteworthy such munitions now entering the fleet are the Joint Direct Attack Munition (JDAM) and Joint Standoff Weapon (JSOW), satellite-guided glide bombs that are highly accurate and affordable, but also releasable far enough away from intended aimpoints so that strike aircraft need not transit hostile airspace in the immediate vicinity of targets.

The third step in the transformation, now beginning to unfold, will be to replace the F-14 and earlier versions of the F/A-18 with the much more capable F/A-18E/F Super Hornet. Super Hornet will have 40 percent more unrefueled range than earlier F/A-18s, 25 percent greater munitions-carrying capacity, three times more ability to bring unexpended munitions back to the carrier, much greater survivability, and more internal volume for future growth or modification. Unlike the stealthy A-12 attack plane cancelled in the early 1990s, the F/A-18E/F was conceived as a hybrid combination of low-observables technology, advanced electronic-warfare techniques and improved performance characteristics that collectively would greatly enhance carrier air's ability to strike littoral targets.

The fourth step in the transformation of naval air power will be to develop a replacement for the aging EA-6B Prowler electronic-warfare aircraft, the nation's sole remaining airborne support jammer. The most likely replacement for Prowlers based at sea is a variant of the Super Hornet equipped with the next-generation ICAP-III jamming system. ICAP-III will achieve initial operational capability aboard Prowlers at mid-decade, but the replacement airframe for the Prowler is unlikely to be deployed before 2010. Prowlers have been equipped with high-speed antiradiation missiles for the lethal suppression of enemy air defenses, thereby making them strike aircraft in their own right.

The fifth step in the transformation will be to consolidate carrier fixed-wing support aircraft into a single airframe with multiple variants based on the current C-2 Greyhound and E-2C Hawkeye turboprops. This change – which includes retirement of the S-3 Viking aircraft – will probably be accompanied by continuing enhancement of the sensors and communications on the Hawkeye designed to make it more versatile in various surveillance and engagement roles (see below).

The final step in the transformation will be the introduction of carrier-based Joint Strike Fighters, beginning in the next decade. JSF is intended to be a fully stealthy multimission strike platform with range and survivability significantly superior to the Super Hornet. However, the naval variant of JSF is part of a costly and complex joint acquisition effort shared with the Air Force and Marine Corps that may not unfold as presently planned. This final step is thus the least certain, and not regarded within the service as essential to realizing the benefits of the revolution in strike warfare.

In addition to the above steps in modernizing airframes and munitions, naval aviation will at the same time be engaged in the more pervasive process of implementing "network-centric warfare." This effort is the Navy's response to the information revolution, a series of technological initiatives that will interconnect all warfighting assets in a unified web of sensors and communication links. The ultimate goal of network-centric warfare is to assure that all elements in the force structure are used in the most effective way through the instantaneous fusion and dissemination of comprehensive, accurate, relevant information.

Even before all technology insertions associated with network-centric warfare are accomplished, the typical carrier air wing of 2010 will be a vast improvement over the units that fought in Operation Desert Storm. A single carrier air wing consisting of fifty F/A-18E/F Super Hornets and various other aircraft will be able to launch over 200 strike sorties per day, around the clock and in any weather, precisely targeting over a thousand separate aimpoints deep in an enemy's interior. And each of the sorties will have the potential to precisely destroy multiple targets, whether they are fixed or mobile, concealed or buried. Having already demonstrated a threefold improvement in effective striking power in the Kosovo air war, naval aviation now plans to

achieve a tenfold advance beyond its performance in Desert Storm by decade's end. This is, by any reasonable definition, a true revolution in strike warfare.

CLOUDS ON THE HORIZON

With so many promising trends in warfighting potential unfolding simultaneously, naval aviation certainly doesn't sound like an organization on the verge of crisis. It is, though, because a reduced force is being worn down by too many commitments overseas and too little investment at home. The force structure is too small to readily accommodate the current range of global deployments, and as a result, each element is being used up at a faster pace than expected. The impact of high operating tempo on force effectiveness is exacerbated by a failure to recapitalize key assets in timely manner combined with chronic shortfalls in maintenance funding.

Since the height of the Reagan defense buildup in the mid-1980s, the number of aircraft carriers has fallen from fifteen to twelve while the number of carrier air wings has declined from thirteen to ten. The Navy's inventory of aircraft, both land- and sea-based, has shrunk 27 percent. At the time these cuts were made, they seemed like reasonable responses to the diminished threat resulting from the demise of communism. However, in subsequent years the frequency with which naval aviation was called upon to respond to foreign contingencies surged to four times its typical Cold-War level.

For example, over the last two years five carrier air wings have participated in enforcement of Operation Southern Watch, the Iraqi no-fly zone; two provided the preponderance of strike power in Operation Desert Fox against Iraq; and one bombed targets during Operation Allied Force in the Balkans. Since the end of Operation Desert Storm in 1991, carrier aviation has flown 74,000 separate sorties just to enforce the no-fly zone. During the same period, about nine-tenths of all ordnance delivered by the Navy against land targets came from carrier-based aircraft.

Meanwhile, the age of Navy aircraft has steadily risen as the service deferred investment in new airframes in order to preserve readiness. The average age of operational aircraft now exceeds 17 years, and is expected to reach 20 years at mid-decade despite production of the Super Hornet. One of the unfortunate ironies of delayed modernization is that each of the planned airborne nodes in network-centric warfare – the EA-6B Prowler, the E-2C Hawkeye, and the land-based EP-3 Aries – traces its origins to the Eisenhower Administration. The Navy is thus implementing the information revolution on airframes conceived at the dawn of the Cold War, half a century ago.

The fact that an average Prowler is now nearly 20 years old and that an average Hawkeye is 17 only tells part of the aging-aircraft story. Equally worrisome is the fact that such planes are being operated at much higher tempos than originally anticipated, resulting in premature metal fatigue, corrosion, and other symptoms of wear. The same problems are apparent in earlier versions of the F/A-18 Hornet, which are reaching their safe limits for catapult launches and arrested landings due to heavy utilization.

The same high operating tempo that is wearing down naval aviation's war machines is also wearing down its personnel. Flight crews and support personnel now spend much more time at sea and away from home than they usually did during the Cold War, resulting in retention problems and family tensions. During Operation Allied Force, virtually every available Prowler crew was deployed abroad, either participating in the Balkan air war, protecting aircraft enforcing the no-fly zone over Iraq, or covering other commitments. The absence of slack in the force to cope with any new emergencies was readily apparent.

One consequence of excessive operating tempo and the wear it causes in airframes is that it becomes increasingly expensive to maintain planes in workable order. This not only endangers readiness, but it also creates obstacles to modernization because funds earmarked for procurement are reprogrammed for maintenance. Thus, the very circumstances that underscore the need for new aircraft make it more difficult to obtain them. One senior defense official characterizes this insidious tradeoff as a "death spiral," because the more new planes are needed, the harder it is to afford them. An examination of the three aircraft most critical to the Navy's future effectiveness underscores the complexity of the challenge.

THE F/A-18E/F SUPER HORNET: THE TIP OF THE SPEAR

The F/A-18E/F Super Hornet is the centerpiece of the revolution in strike warfare. Without Super Hornet's increased range, payload, survivability and other features, naval aviation would be sorely tested to preserve its relevance in an era of littoral warfare. Because earlier efforts at modernization such as the A-12 and A/X attack planes failed at a time when Cold-War aircraft were beginning to show their age and limitations, the Navy had no real alternative to evolving its F/A-18 Hornet into a more capable plane. The program seems to have progressed well, producing a versatile aircraft able to perform day and night precision strikes in any weather, close air support, air-defense suppression, reconnaissance, aerial refueling, fighter escort and air-superiority missions.

Super Hornet is 25 percent bigger than the F/A-18C/D, even though it has 42 percent fewer parts. The combination of a larger wing plus 33 percent more internal fuel-carrying capacity increases its range up to 40 percent, enabling it to both strike deeper and achieve much greater combat endurance. Combat radius can be further extended through the provision of external fuel tanks or by allocating a portion of Super Hornets on a mission to aerial-refueling roles. Naval air power is thus able to address targets with Super Hornet that previously would have been far beyond its reach.

The plane is also considerably more survivable than its predecessors, owing to four different factors. First of all, it has been designed with extensive low-observable ("stealth") features in its forward aspect. Second, it will be equipped with advanced electronic countermeasures for degrading or deceiving enemy sensors and weapons. Third, it carries a new generation of air-to-ground and air-to-air munitions that allow it to attack targets without operating in their immediate vicinity. Finally, its increased range and endurance permit the use of tactics that further diminish aircraft vulnerability to hostile fighters and air defenses.

When the various performance enhancements of the F/A-18E/F airframe are wedded to a new generation of precision all-weather munitions, the result is a truly formidable strike fighter. A single Super Hornet can carry seven Joint Direct Attack Munitions or four Joint Standoff Munitions or six High-speed Antiradiation Missiles or various other specialized munitions, all of which can be mixed and matched to provide optimum flexibility for specific missions. The Advanced Medium-Range Air-to-Air Missile (AMRAAM) and AIM-9X missile will make Super Hornet as lethal in air-to-air engagements as it is in surface-attack missions.

The 1997 Quadrennial Defense Review reduced planned production of Super Hornets from 1,000 planes to 548 in anticipation of Joint Strike Fighter acquisition. If JSF development is delayed, the number of Super Hornets purchased could rise as high as 785. If JSF were cancelled, over a thousand Super Hornets would probably be built, including an electronic-warfare variant. Congress recently committed to a cost-saving multiyear purchase of 222 F/A-18E/Fs during the years 2000-2004. The plane has passed all operational evaluations with flying colors, and is expected to deploy in 2002.

To date, the Super Hornet program has been a good-news story for naval aviation – which needed one after so many false starts on next-generation airframes over the last 20 years. However, in order for the F/A-18E/F to achieve its full potential as a participant in network-centric warfare, it must undergo several important technology insertions over the coming decade. Because funding for such investments is scarce, it is not clear whether these insertions will occur as planned.

The most important such upgrade is the Link-16 voice and data communications system, also known within the Navy as the Multifunction Information Distribution System (MIDS). MIDS is a secure communications link to compatible Navy, Air Force and NATO assets that allows the rapid exchange of warfighting information such as aircraft status and target locations. Without MIDS, the Super Hornet will be hobbled in network-centric warfare by an inability to participate in the timely and detailed sharing of information gathered from many different sources. This would adversely affect aircraft performance, diminishing the prospects of successfully accomplishing time-critical missions. Current plans call for the system to begin appearing in Super Hornets in 2003.

A second critical upgrade is the Active Electronically Scanned Array (AESA), a multimode radar intended to begin replacing the Super Hornet's existing APG-73 radar in 2006. AESA will enable Super Hornet to detect air targets two to three times further away, while also providing a standoff imaging capability for ground targets. Because of its capacity to operate simultaneously in multiple modes, AESA makes the F/A-18E/F a much more versatile aircraft. In a single sortie it can conduct air-superiority, strike and reconnaissance missions, sharing the information it gathers with other Navy and joint platforms. Moreover, because AESA is steered electronically rather than mechanically, it is more reliable, more affordable, and reduces the aircraft's radar cross-section.

Additional planned upgrades to Super Hornet include the Advanced Targeting Forward-Looking Infrared (ATFLIR) sensor, the Shared Reconnaissance Pod (SHARP), the Integrated Defensive Electronic Countermeasures (IDECM) suite, the Joint Helmet Mounted Cueing System (JHMCS) and a Combined Interrogator/Transponder (CIT) for identifying friendly aircraft in combat. Like Link-16 and AESA, most of these enhancements still lie in the future.

Because they collectively represent a big investment at a time when Navy budgets are under considerable stress, it is questionable whether they will be implemented as planned.

It is important for Congress and the Pentagon to recognize that Super Hornet may be the nation's premier strike system for at least the next 20 years, and perhaps longer. It therefore is essential that the aircraft be equipped with the various electronic enhancements necessary to participate fully in network-centric warfare, since that is likely to be the nation's preferred approach to warfighting in the years ahead.

THE EA-6B PROWLER: SPECTRUM DOMINANCE

If the F/A-18E/F Super Hornet is the centerpiece of the revolution in strike warfare, the EA-6B Prowler is its most critical airborne enabler. The Navy formally describes Prowler's mission as "airborne electronic attack," but a more precise description is that it establishes control of the electromagnetic spectrum in wartime by jamming or destroying enemy radars and communications. This combination of electronic- and information-warfare capabilities makes the EA-6B an indispensable asset in modern warfare, as it demonstrated most recently in Operation Allied Force.

The Air Force retired its dedicated jamming and defense-suppression aircraft in the 1990s, in the expectation that stealthy airframes would have less need for electronic-warfare support. The EA-6B thus became the nation's sole remaining airborne support jammer, responsible for protecting not just Navy aircraft but also those of the other services and allied nations. There are currently 20 Prowler squadrons, of which ten are integrated into carrier air wings and ten are land-based. The ten on land consist of four Marine expeditionary squadrons, four "joint-mission" expeditionary squadrons, one reserve squadron and one training squadron. A ninth expeditionary squadron is expected to be established in the near future.

Prowler has turned out to be more important to national strategy than policymakers expected. Aside from the fact that stealthy aircraft have not entered the force structure at the rate anticipated a decade ago, operational experience has demonstrated a need to provide electronic countermeasures for low-observable airframes in certain parts of the electromagnetic spectrum. As a result, the Prowler community has been stretched to the breaking point trying to cover diverse forces engaged in numerous contingencies with barely a hundred deployable aircraft.

The last EA-6B was delivered in the early 1990s, and at current rates of utilization the 124 available aircraft will probably not be able to cover all contingencies and commitments beyond 2010. The services plan to begin replacing Prowler with a "follow-on support jammer" midway through the next decade, but that effort is subject to the findings of a joint analysis of alternatives where no consensus is yet apparent. It thus seems likely that the EA-6B will continue in active duty until 2020.

Because development of a follow-on jammer has been repeatedly deferred, and electronic technology is advancing at a rapid pace, the EA-6B has been in a state of continuous evolution for the last two decades. The latest upgrades to on-board electronics will make Prowler a much more effective jammer of enemy sensors and communications, while also allowing it to play more subtle roles in information warfare. For example, the ICAP-III electronic-warfare suite due for initial operational capability in 2004 will for the first time be able to react selectively to enemy defense radars rather than having to jam all the frequencies on which they might be operating. Other upgrades will greatly enhance suppression of enemy communications, targeting of antiradiation missiles and connectivity with joint and coalition assets.

The role of the EA-6B in asserting dominance of the electromagnetic spectrum during wartime clearly makes it a key player in network-centric warfare. The question is whether the necessary upgrades to existing electronic systems will be kept on track while the services finally settle on a replacement airframe. With regard to the upgrades, the most pressing requirements are to improve detection and jamming response times for hostile emitters, to increase countermeasures against low-frequency radars posing a threat to stealthy aircraft, and to bolster performance against the latest generations of surface-to-air missiles.

The Navy has initiated all of the upgrades necessary to keep Prowler viable against emerging threats through 2015, most notably ICAP-III, various transmitter improvements, and the introduction of Link-16 connectivity. However, there are very few policymakers who understand the myriad pieces of the upgrade program or how they interact with each other. The effort could easily be undermined by competing priorities or political indifference. The possibility that friendly forces might lose their capacity to effectively suppress enemy air defenses should focus all participants in the on-going analysis of alternatives on how dangerous further delays in modernization would be.

Each service seems to have a different preferred solution for the follow-on support jammer. From an operational-compatibility and support-cost perspective, it is hard to fault naval aviation's preference for a Super Hornet variant (the F/A-18G "Growler"). But whether the Air Force embraces that same approach or not is less important than avoiding any additional delays in implementation. If the services can't finally resolve to modernize their only dedicated support jammer, that does not bode well for more ambitious undertakings such as network-centric warfare.

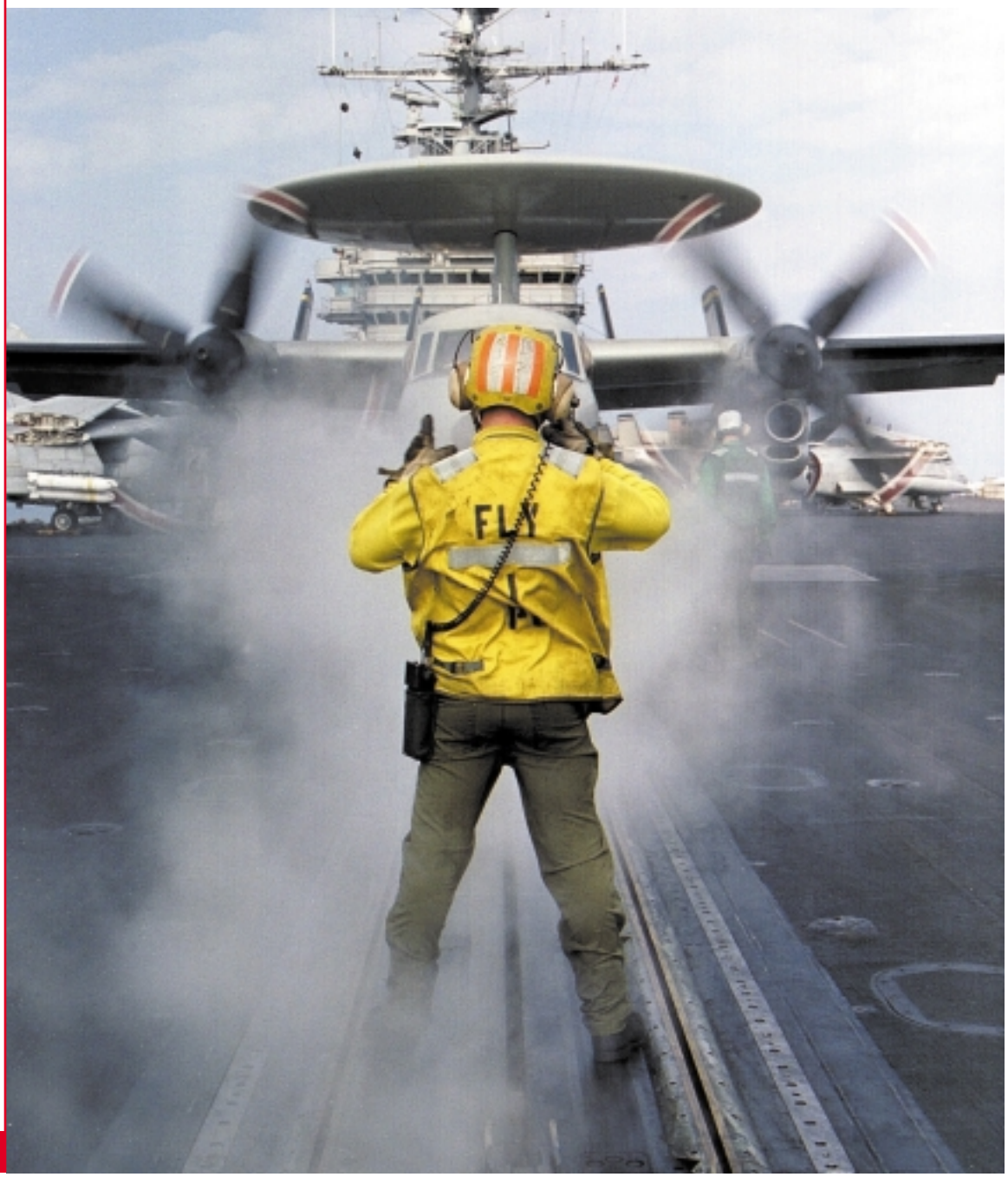
THE E-2C HAWKEYE: KEY NODE IN NETWORK-CENTRIC WARFARE

Every carrier air wing includes a squadron of E-2C Hawkeyes that provide surveillance of the surrounding airspace and control of friendly aircraft operating in that airspace. The twin-engine turboprop is equipped with an APS-145 surveillance radar capable of simultaneously tracking up to 2,000 separate targets operating in six million cubic miles of airspace. The Hawkeye's five-person crew, which includes two pilots and three mission-system operators, can also control over 20 aerial engagements between friendly and adversary aircraft.

The basic configuration of the airframe has changed little since the first E-2C flew in 1971, but on-board electronics have been continuously renewed to assimilate new technologies and missions. The latest version, dubbed Hawkeye 2000, is equipped with satellite communications, an upgraded mission computer, and "Cooperative Engagement Capability" (CEC) for sharing and fusing air threat data from a variety of off-board sources. CEC is frequently referred to as a precursor of network-centric warfare, and Hawkeye is the first carrier-based aircraft to be equipped with the system.

The Navy is procuring 21 Hawkeye 2000s in a multiyear contract due to end in 2003. Once final delivery under that contract occurs in 2006, the service plans to have a total active inventory of 75 aircraft – 21 Hawkeye 2000s and 54 earlier versions. There are at present no plans for further production of the airframe, which is expected to remain in the fleet until at least 2025. Proposals for retrofitting earlier versions to the Hawkeye 2000 configuration and further upgrading on-board electronics have been blocked by budgetary constraints.

Therein lies a serious obstacle to realizing the vision of network-centric warfare. Because it incorporates both long-range surveillance and battle-management capabilities, Hawkeye is a logical airframe to serve as the carrier air wing's key node in network-centric warfare. However, its radar was developed primarily to protect carrier battle groups at sea, and it does not function well in littoral airspace, over land, or in the presence of electromagnetic interference (such as jamming). It also is not an adequate sensor for tracking tactical missile threats such as theater-range ballistic missiles and cruise missiles. Moreover, Hawkeye lacks many of the communications features necessary to establish seamless connectivity with other platforms participating in network-centric warfare.



In order to assure Hawkeye is a full participant in network-centric warfare (not to mention littoral warfare), two basic modifications appear necessary. First, all of the active airframes need to be equipped with the same communications capabilities destined to be inserted into other key warfighting assets. That means at a minimum Link-16 (MIDS) connectivity and Cooperative Engagement Capability. Without these upgrades, the carrier air wing's main airborne surveillance and battle-management asset will be unable to share in the "single integrated picture" that is a core feature of networked warfare.

Second, the Hawkeye's radar must be modified or replaced to facilitate effective operations in littoral regions, over land, and in the presence of electromagnetic interference. A proposed "Radar Modernization Program" would do that, greatly enhancing the accuracy, timeliness and relevance of surveillance information provided to the air wing and other friendly forces. It would also bolster Hawkeye's capacity to identify friendly aircraft in wartime using "noncooperative" techniques, while improving radar reliability. Unfortunately, the modernization program is in limbo due to scarce funding.

A third tier of modifications would be desirable in light of emerging threats and missions. That would be to equip the Hawkeye with an advanced infrared search-and-track system, and a synthetic-aperture radar capacity for tracking moving surface targets. In combination with the radar-modernization program, the infrared search-and-track system would greatly facilitate interception of tactical missiles, which may be the most important future threat to sea-based platforms. The synthetic-aperture radar would be able to detect and track a wide range of surface vehicles of interest in littoral warfare, including the vehicles from which tactical missiles are launched.

It is not certain that all of these capabilities can be integrated in an airframe with the space and weight constraints of an E-2C. But the continuous advances seen in processing power, equipment miniaturization, and use of lightweight materials strongly suggest a focused development program would yield positive results. In the meantime, it really is essential that the Hawkeye's connectivity and primary sensor be upgraded to reflect the requirements of network-centric warfare. There is little alternative to continuing the E-2C's evolution.

AN ESSENTIAL TRANSFORMATION

The Navy's vision of network-centric warfare is so compelling that it is gradually being assimilated by the other services. For the first time in history, information technologies may enable military commanders to achieve comprehensive situational awareness and optimum employment of forces. Clausewitz's concept of "friction" – wartime confusion – may not be obsolete, but it clearly is losing some of its salience for U.S. forces.

However, realizing the network-centric vision will require that considerable resources be spent in a focused way over many years. It also will require the Navy and the nation to make some hard choices about which platforms, organizations and doctrines are really relevant to the future. Remaining focused and making hard choices are not prominent features of democracies in peacetime.

Naval aviation has the advantage of being able to demonstrate its relevance every day, because it is continuously engaged overseas in the protection and projection of U.S. power. But this intensity of engagement can easily become a disadvantage in realizing the network-centric vision, because there is constant pressure to transfer funding from investment ("modernization") to consumption ("readiness"). Barring a major increase in overall spending, naval air will have to accept some shortfalls in readiness or force structure if it is to achieve the full promise of the information revolution. That may not be an appealing option, but it is the kind of risk wise leaders are supposed to take in periods of diminished danger.

The one option that should not be embraced is to continue deferring investment in new technology in order to meet near-term readiness needs. If that trend continues, the Navy may reach a low ebb at precisely the moment when a truly urgent threat arises. It makes more sense to take a risk now rather than when the new danger emerges.

The technology investments described above will make naval air power the most flexible and responsive strike force in the world for a generation to come. Failing to make those investments won't just undermine the network-centric vision, it will endanger the freedom and security of Americans not yet born. In an age of unprecedented change, it does not take long to traverse the distance between the best of times and the worst.

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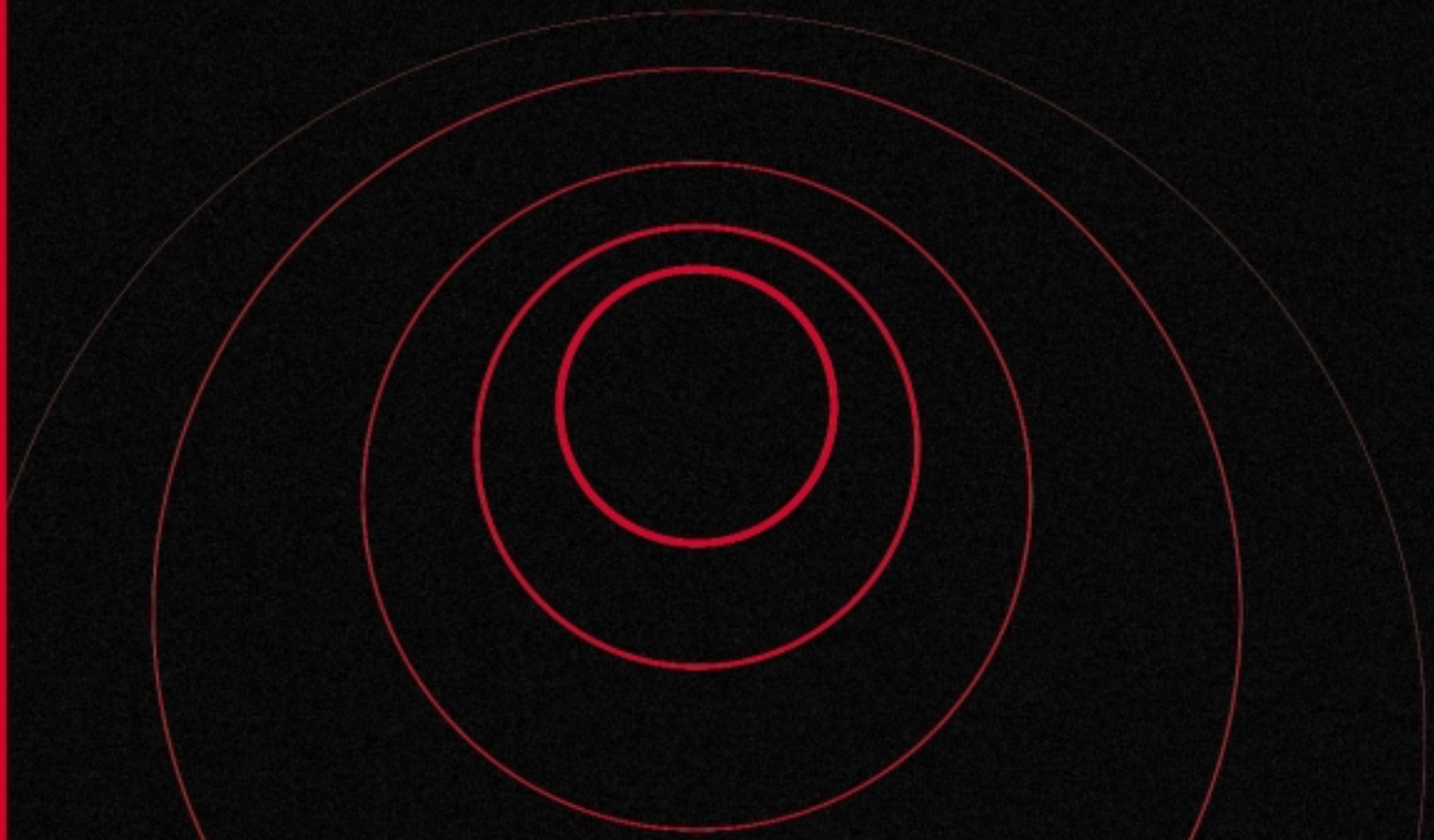

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