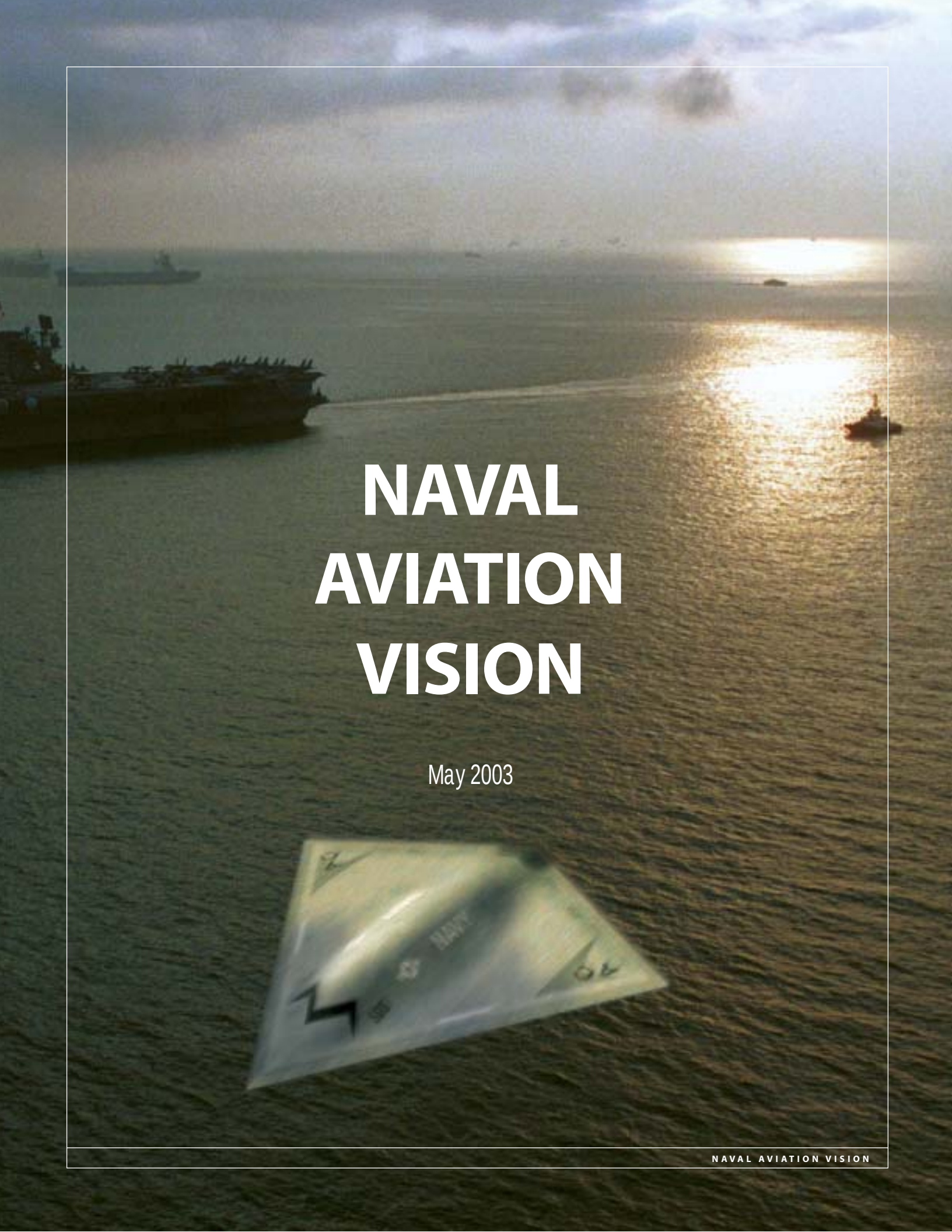
NAVAL AVIATION VISION



NAVAL AVIATION VISION

May 2003

VADM Michael D. Malone, USN

Commander, Naval Air Forces (CNAF)

Out in the Fleet, Naval Aviation serves as "the tip of the spear" in defense of our nation. This means our warfighters continually require new technologies and new techniques, to face ever-changing threats.

This Naval Aviation Vision spells out those future requirements, as we transform from a platform centric to a network centric force. We in the Fleet will bring together these new technologies and advanced doctrinal concepts to create a flexible, responsive force and realize our vision of Sea Power 21.

RADM Michael J. McCabe, USN

Director, Air Warfare (N78)

Naval Aviation faces immense challenges in adapting to post-Cold War strategic realities. Mission requirements continue to grow, while budgets continue to tighten. Transformation will require "reality checks" on existing programs. As we develop next-generation programs, we must "neck down" existing platform and weapons types.

We at N78 are committed to overcoming these challenges. This Naval Aviation Vision represents our commitment to providing the warfighters a smooth transition into Network Centric Operations.

VADM Joseph W. Dyer, USN

Commander, Naval Air Systems Command (COMNAVAIRSYSCOM)

Naval Aviation possesses a proud technological heritage, stretching back to the early days of the 20th Century. This latest edition of the Naval Aviation Vision spells out how we will extend that tradition of innovation well into the 21st Century.

We at NAVAIR will continue to develop and acquire the most advanced aircraft and weapons systems in the world. No matter what challenges our warfighters face in this new era, we will provide them the tools for success.

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Future Naval Aviation: A Scenario

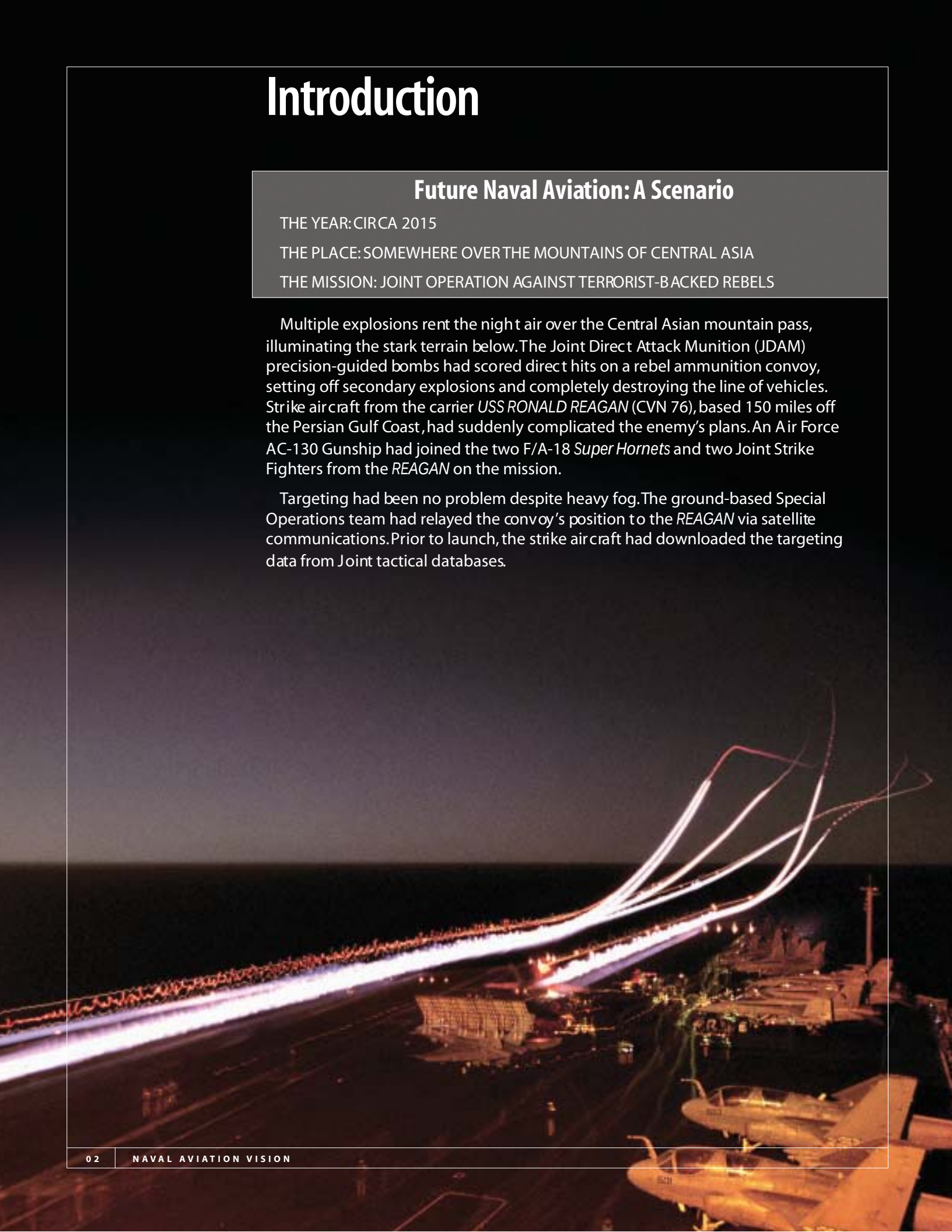
THE YEAR: CIRCA 2015

THE PLACE: SOMEWHERE OVER THE MOUNTAINS OF CENTRAL ASIA

THE MISSION: JOINT OPERATION AGAINST TERRORIST-BACKED REBELS

Multiple explosions rent the night air over the Central Asian mountain pass, illuminating the stark terrain below. The Joint Direct Attack Munition (JDAM) precision-guided bombs had scored direct hits on a rebel ammunition convoy, setting off secondary explosions and completely destroying the line of vehicles. Strike aircraft from the carrier *USS RONALD REAGAN* (CVN 76), based 150 miles off the Persian Gulf Coast, had suddenly complicated the enemy's plans. An Air Force AC-130 Gunship had joined the two F/A-18 *Super Hornets* and two Joint Strike Fighters from the *REAGAN* on the mission.

Targeting had been no problem despite heavy fog. The ground-based Special Operations team had relayed the convoy's position to the *REAGAN* via satellite communications. Prior to launch, the strike aircraft had downloaded the targeting data from Joint tactical databases.



This fusion of data networks, sensors, platforms, and weapons formed the heart of the Navy's FORCEnet architecture. Through FORCEnet, the Carrier Strike Group maintained constant communication with all Joint assets in theater.

Two first-generation unmanned combat air vehicles (UCAVs) flew past the two sections of *Super Hornets* and JSFs, returning from a deep-strike mission further into the mountains. UCAVs had come a long way in the last decade, since the *Predator*'s use in Operations Enduring Freedom and Iraqi Freedom. They had by no means replaced manned aircraft; instead, they had become integrated into the air wing as a complementary force. The UCAVs had received in-flight commands from the lead *Super Hornet* to take out several rebel bases defended by anti-aircraft artillery fire and surface-to-air missiles.

The Special Ops team now freed the two sections to pursue their secondary target—an old Al-Qaeda cave complex now used as a rebel weapons depot. But as the strike aircraft headed for the caves, a command-and-control *Hawkeye* aircraft redirected them to an enemy airfield south of the country's capital. Elements of the Marine Expeditionary Brigade were facing heavy artillery fire in their attempt to take the airfield; they had requested close air support to take out the enemy's guns. Aided by the Marines' targeting lasers, the fighters dropped their laser-guided bombs (LGBs). The LGBs steered to impact by guiding on the laser light reflected from the targets. Columns of flames confirmed the bombs' accuracy.

Their ordnance expended, the enemy guns silenced, the strike aircraft headed back for "home plate" as the sun began to inch over the horizon. En route to the carrier, the *Super Hornets* and JSFs received vectors from the *Hawkeye* to the *Super Hornet* tanker circling off the coast.

The lead *Super Hornet* pilot reflected briefly on the events of the past week. Only last Sunday, the *REAGAN* had been cruising the Persian Gulf, maintaining a forward presence, "showing the flag" to reassure allies and inhibit regional despots. It was vitally important to prevent unfriendly nations from controlling "chokepoints" in the sea lanes such as the entrance to the Gulf.

Then, without warning, Central Asian rebels with suspected terrorist links had seized their country's capital. The group claimed to have weapons of mass destruction, which they would use against a major U.S. city unless all American forces immediately left the Gulf region. Within a matter of hours, the *REAGAN* Carrier Strike Group received direction to respond with overwhelming, effective, and accurate striking force.

The carrier-based air assets, stationed off the Persian Gulf coast, had spent the next week destroying rebel bases as well as enabling Joint access to the theater. The close air support had helped the Joint ground forces quickly retake the capital and restore the legitimate government. The only task left was to find and destroy the last pockets of resistance.

Just after the infamous "September 11th" attacks back in 2001, then-President George W. Bush had said U.S. forces were "…taking justice to the enemy…" The pilot of the *Super Hornet* knew that this operation maintained that tradition. As his section held overhead the carrier, preparing to land, he felt more than a little stirred at being part of such an awesome and flexible force.

A Changed Security Environment

The tragic and despicable events of 11 September 2001 have drastically altered how the United States assesses the global security environment. In their aftermath, we will find it even more difficult to predict the potential sources of military threats, the conduct of future wars, and the form that threats and attacks will take.

Our nation also continues to struggle with the changes brought on by the collapse of the Soviet empire. Though it marked the welcome conclusion to the Cold War, the Soviet Union's downfall also ended the familiar superpower standoff between East and West. We now face a host of potential regional powers and non-state actors such as terrorist networks.

These changes highlighted our entry into an era of asymmetric warfare, a form of conflict that seeks to exploit enemies' weaknesses rather than confront their strengths. Adversaries, aware that they cannot successfully challenge U.S. conventional forces, may rely increasingly on unconventional methods such as terrorism and weapons of mass destruction—or even long-range ballistic missiles launched against the U.S. homeland. Such asymmetric attacks pose perhaps the most serious immediate threat to our nation's security.

These geopolitical and military realities will profoundly shape the future security environment. Our adversaries will have new capabilities that previous opponents lacked; we should not expect opponents in 2020 to fight with strictly "industrial age" tools. We must begin to develop our own asymmetric capabilities out of our existing superiorities in conventional warfare. Our advantage will come from our leaders, people, doctrine, organizations, and training—these will enable us to take advantage of technology and achieve superior warfighting effectiveness.

Quadrennial Defense Review (QDR)

The short, introductory scenario shows vividly how Naval Aviation contributes to the U.S. defense strategy, as set forth in the Department of Defense's Quadrennial Defense Review (QDR). As described in the introduction, the Carrier Strike Group and elements of the Marine Air-Ground Task Force (MAGTF) took actions supporting the strategy's four key goals:

- To assure our allies and friends of the United States' steadiness of purpose and its ability to fulfill security commitments;
- To dissuade adversaries from undertaking programs or operations that could threaten U.S. interests or those of our allies and friends;
- To deter aggression and coercion by deploying forces forward, forces which can swiftly defeat attacks and impose severe penalties for aggression; and
- To defeat decisively any adversary, if deterrence fails.

These four fundamental goals, along with the QDR's operational goals, will guide how our nation develops and uses its military. Defense planning will shift from a "threat-based" model to a "capabilities-based" model. This model, growing out of geopolitical and military trends, focuses more on how an adversary might fight rather than on specifics such as whom the adversary might be or where a war might occur.

Adopting this approach requires our nation to transform its entire military establishment, a change that must affect not only capabilities but force structures and institutions as well. The United States will maintain its military advantages in key areas yet must also adapt to new circumstances and develop entirely new capabilities. In this way, we will extend our advantages well into the 21st Century… and beyond.

The Department of the Navy has set forth its plans for transformation in a separate document, titled *Naval Transformation Roadmap: Power and Access…From the Sea*. That publication describes the key concepts, capabilities, initiatives, and programs that will guide the Navy/Marine Corps team as they transform in support of the QDR goals. The concept binding the rest together is "Sea Power 21," the Chief of Naval Operations' construct for the 21st Century Navy. That operational vision includes the three fundamental capabilities of Sea Strike, Sea Shield, and Sea Basing.

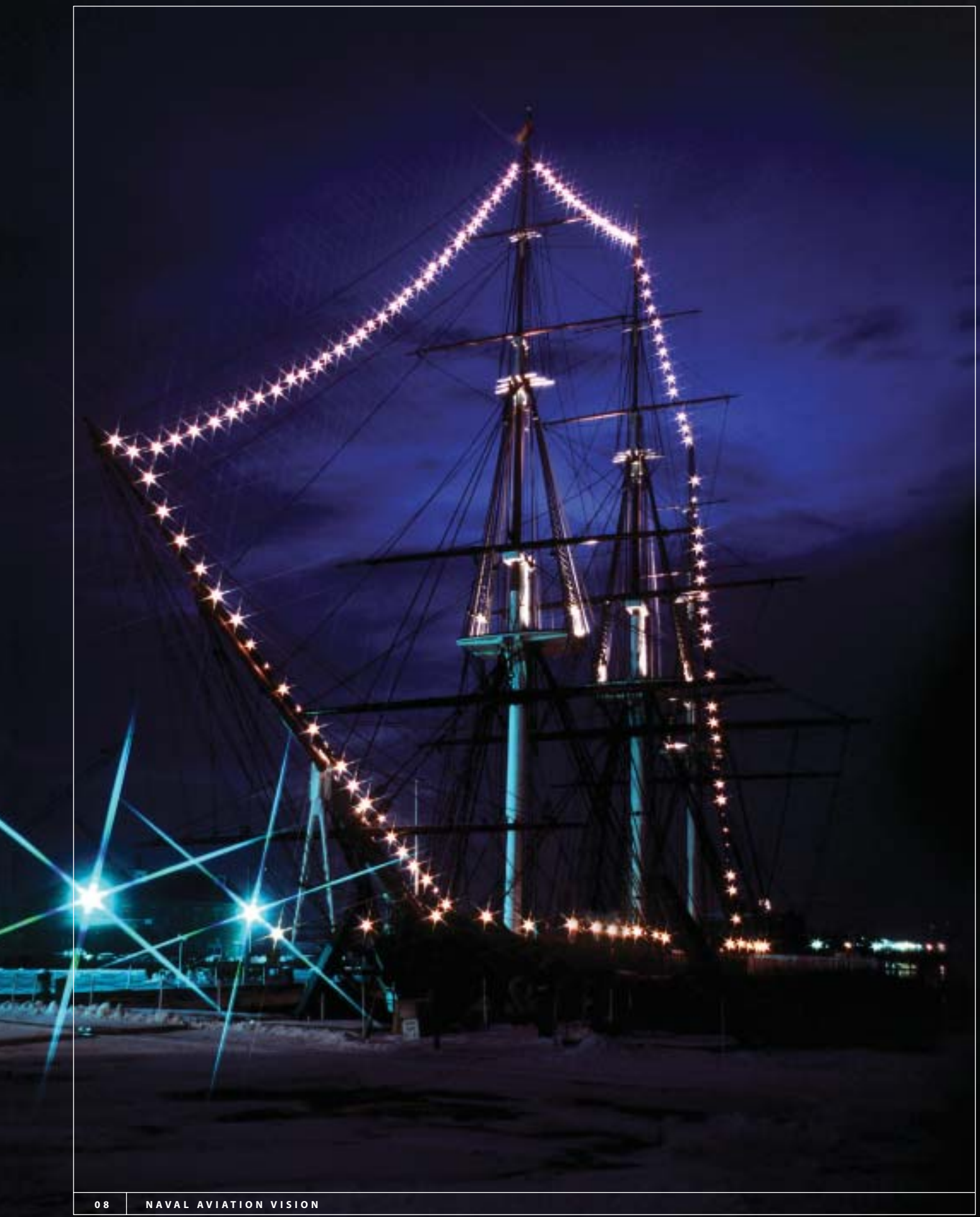
Naval Aviation's role in this Service-wide transformation is spelled out herein. In this document, *Naval Aviation Vision*, we focus particularly on the striking power of the air wing and the aircraft carrier.

Critical to the success of this transformation is the information architecture known as FORCEnet, a single, comprehensive maritime network for the battlespace. More than simply a computer network or data link, FORCEnet represents the seamless connection of all Naval and Joint assets in theater—via their sensors, networks, decision aids, weapons, and supporting systems.

Sea Power 21, exploiting the power of these netted forces, will combine Naval capabilities and those of the other services to achieve dominance of an integrated maritime "battlespace." Within this multi-dimensional space of operations, the Joint Force Commander will project power and protect U.S. forces.

"In order to prepare for the wide array of threats facing us, we have to organize ourselves around a clear, concise, and powerful vision of what the Navy will provide to our nation in the months, years, and decades ahead. This vision must build on the strengths that are inherent for us in the United States of America, not somebody else's, but on ours. And I believe that we possess asymmetric advantages. Oftentimes, we talk about asymmetry and it's always the other guy's asymmetries. I believe that the United States possesses asymmetric advantages, such as information superiority, sea control, mobility, stealth, reach, precision, firepower, and persistence."

Admiral Vern Clark
Naval War College, Newport, RI, 12 June 2002



Enduring Roles of Naval Aviation

Since the United States' earliest days, the Naval Services have fulfilled an enduring role in defense of our national interests. Naval Aviation—in particular thanks to the air wing and the large-deck aircraft carrier—has evolved into a powerful element of this mission. From World War II onward, U.S. Presidents have asked, "Where are the carriers?" when faced with international crises. Our *NIMITZ*-class carriers have answered that call for over 30 years.

Now, upon entering a new century, our highly capable, survivable, and efficient CV-designed carriers and their embarked air wings will be the salient force in the Carrier Strike Force. They will be supplemented by the new CVN 21, the next-generation aircraft carrier. The overwhelming striking power of the Carrier Strike Group and netted warfighting systems will assure sea-based battlespace dominance. It will also continue to offer our nation's leaders the flexible, scalable, and sustainable options they require in the global theater of operations.

Our preparation and vigilance are not without risk or price. It requires great sacrifice to maintain a keen edge on our globally-deployed forces. Yet like their predecessors, our nation's future leaders will rely on the striking power of carrier-based aviation to fulfill these enduring roles:

- **Assurance and Deterrence:** A forward-deployed Navy shows our nation's commitment to allies and friends. Our forces are immediately deployable, able to project power, shape events, deter conflict, and defeat aggression.
- **Command of the Seas:** Our nation's continued existence is tied to the seas; our freedom to use those seas is guaranteed by our Naval forces. These combat-ready forces operate throughout the world's vast oceans to control our seaward approaches, gain and maintain control of forward Sea Lanes of Communication (SLOC), and keep the seas open for friendly use.
- **Power Projection:** We project Naval power over great distances to deter threats. When necessary, we use this power to disrupt, deny, or destroy hostile forces. As U.S. sovereign territory, our Naval vessels can deploy rapidly and flexibly around the globe without concern for territorial boundaries.
- **Homeland Security:** Naval forces serve as a first line of defense for the American homeland, keeping attacks at bay far across the seas. Deployed forward, our forces detect, deter, and interdict attacks by hostile nations and emerging non-state actors.

These roles are fundamental to our Navy and likely will remain so well into the future. Yet transformation means profoundly changing the ways we fulfill these enduring roles. The Navy therefore requires a concept of operations that recognizes and drives these changes. This concept is "Sea Power 21."

Sea Power 21

The Sea Power 21 operational concept, released in Summer 2002, outlines the CNO's vision of how the Navy will function in this new era and establishes a framework for Naval transformation. The concept also explains the Navy's unique contributions in support of our nation's defense strategy and goals.

The capabilities outlined in Sea Power 21 are unique to the Navy, yet the Navy's future lies in collaboration with its sister services. As the CNO has expressed, the Navy will be "… first and foremost, a Navy committed to, and built upon, the principles of jointness."

At its heart, Sea Power 21 encompasses three major concepts:

- **Sea Strike:** Projecting Precise and Persistent Offensive Power
- **Sea Shield:** Projecting Global Defensive Assurance
- **Sea Basing:** Projecting Joint Operational Independence

The Navy will realize Sea Power 21's full potential by using information technology to network our warfighting forces. We will end our reliance on "stovepipe" networks and single-purpose systems, integrating fully into Joint and national systems. We will reduce our emphasis on platform centric operations in favor of Net Centric Operations (NCO); this new approach, enabled by the FORCEnet concept, will link our forces via a global grid of interoperable and overlapping networks. Joint Force Commanders will enjoy optimal access to sensor, engagement, and command nets.

Formalized through doctrine, NCO will enable a precise, agile maneuver warfare. This style of war will be able to sustain access and decisively influence events ashore and at sea anytime, anywhere. With FORCEnet as the catalyst, we will realize Sea Strike, Sea Shield and Sea Basing through transformational warfighting capabilities. These will turn the vision of Sea Power 21 into a powerful reality.

The roadmaps which follow display dramatically how the Navy will increase its capabilities in aircraft carriers, networks, sensors, weapons, and platforms. Yet though technology may express transformation most visibly, the Navy must also transform doctrines, organization, and leadership development. This includes, for example, changing personnel systems: how we recruit and train and support our people.

We must also transform our acquisition and logistics establishment—how we provide and support equipment and facilities we provide to the warfighter. The Naval Air Systems Command (NAVAIR) serves an important enabling role for Sea Power 21 by providing six core technologies to Naval Aviation:

- Sensors
- Aircraft
- Weapons
- Training
- Launch and Recovery
- Communications

To realize Sea Strike's potential, the Navy must also implement initiatives such as Navy/Marine TACAIR Integration, to provide the optimal balance of efficiency and warfighting effectiveness. This requires a holistic approach, taking into account current fiscal realities and operational commitments. It also requires an adaptable organization that can help integrate affordable technology with innovative operational concepts and a fully-netted force. Together, these will enable the Navy to achieve an "in-stride" transformation while meeting current obligations.

Sea Power 21 will include three initiatives to achieve this culture of innovation:

- Sea Trial: To put the Fleet at the heart of innovation
- Sea Warrior: To develop our Sailors' full potential
- Sea Enterprise: To employ business efficiencies to recapitalize our Fleet

Viewed together, these elements describe our Naval forces' full integration into a Joint Team. This integration will dramatically increase our forces' operational reach and connectivity, as well as their precision, speed of decision, and battlespace awareness. In short, the Carrier Strike Groups of the 21st Century will be far more capable than their 20th Century counterparts to resolve international crises quickly and with minimal loss of life.

September 11th highlighted our nation's need for military transformation, but by no means did it begin the process. In fact, the Navy possesses a rich legacy of adapting to new challenges. During the Revolutionary War, the United States designed fast, well-armed sailing ships that challenged powerful British fleets. That innovative spirit continues today, as seen in design ideas for the Joint Strike Fighter, the unmanned combat air vehicle (UCAV), and CVN 21, the next-generation aircraft carrier.

Sea Power 21, the Navy's new operational concept, represents another important step along this continuum of change. It is the Vision of a 21st Century Naval Force with *Presence*, *Power*, and *Persistence*.

Global CONOPS

The Global Concept of Operations (Global CONOPS) will provide the United States with widely dispersed combat power from forward-deployed Naval forces, thus enhancing our nation's ability to protect its vital interests. This concept also enables U.S. forces to respond swiftly to a broad range of scenarios anywhere in the world.

Global CONOPS will employ a flexible force structure, which can be resized to meet the needs of each task as well as the mission requirements of the Joint Force Commander. Under Global CONOPS, the Navy will employ:

- Carrier Strike Groups (CSG) that provide the full range of operational capabilities. These groups will remain the core of our Navy's warfighting strength.
- Expeditionary Strike Groups (ESG) consisting of Amphibious Readiness Groups (ARG) augmented with strike-capable surface warships and submarines. ESGs will provide Sea Strike capabilities in lesser-threat environments. Aviation assets such as Joint Strike Fighters and V-22s will help realize the ESG's warfighting potential.

- Missile-defense Surface Action Groups that will increase stability by providing security to allies and Joint forces ashore.
- Specially-modified *Trident* submarines that will provide covert striking power from cruise missiles and the insertion of Special Operations Forces.
- A modern, enhanced-capability Combat Logistics Force that will sustain the widely dispersed Fleet.

These groups will operate independently around the world to counter transnational threats. They will join together to form Expeditionary Strike Forces when engaged in regional conflict.

This dispersed, netted, and operationally agile Fleet, as part of the Joint Force, will deliver the combat power needed for the U.S. to sustain homeland defense, as well as to fulfill its "1-4-2-1" military commitment. Under this commitment, Naval forces will defend the U.S. Homeland (1), provide forward deterrence in *four* theaters (4), swiftly defeat *two* aggressors at the same time (2), and deliver decisive victory in *one* of those conflicts (1).

In every war plan, the Navy will center on the employment of sovereign sea-based forces—these forces will project offensive and defensive power across a unified battlespace. Just as importantly, this 21st Century Fleet will be positioned around the world, ready to counter unexpected threats from any quarter of the globe.

Sea Strike

Sea Strike projects precise and persistent offensive power against key enemy targets. The Carrier Strike Group and its embarked air wing are uniquely suited to this mission. Together, they create a powerful and highly survivable force for conducting effects-based operations. As opposed to attrition warfare, effects-based warfighting philosophy seeks to directly influence an adversary's reason and beliefs. It seeks to generate the right effect on the right target at the right time and defeat the adversary's strategy early in any conflict.

Exploiting knowledge superiority, the Carrier Strike Group can expand the battlespace, provide real-time battlespace awareness, conduct covert operations, and deliver high-volume and lethal fires to the enemies' critical vulnerabilities. Sea Strike will capitalize on early war-termination opportunities that would be lost under a solely attrition-oriented style of warfare.

The FORCEnet architecture will make this possible by linking our geographically dispersed forces in theater—including sea-based sensors, unmanned aerial vehicles (UAVs), manned platforms, and air-launched munitions. This seamless linking provides theater commanders with powerful advantages: the long "dwell time" of UAVs and their sensors, the versatility and speed of manned platforms, and the reach and precision of guided, air-launched weapons.

Sea Strike operations also allow commanders to exploit the positional advantage that the maritime environment offers, with reduced dependence on tactical land bases. We will seize the initiative, disrupt enemy timelines, and pre-empt adversaries' options. These will create rapid, decisive operations that ensure mission success.

In support of the Sea Strike concept, we will employ the transformational capabilities of:

- Persistent Intelligence, Surveillance, and Reconnaissance (ISR);
- Time Sensitive Strike (TSS);
- Electronic Warfare (EW)/Information Operations (IO);
- Ship to Objective Maneuver (STOM);
- and Covert Strike (not described below).

Persistent ISR

Persistent Intelligence, Surveillance, and Reconnaissance (Persistent ISR) will deny sanctuary to potential adversaries by means of networked Joint and national capabilities. Future carrier air wings will provide the Joint Force Commander with extensive ISR capability through a combination of UAVs, helicopters, strike aircraft, electronic-warfare aircraft, and command-and-control aircraft. These air wing assets will provide the mission flexibility and survivability of networked sensors and platforms to survey the battlespace. In this way, we can build a knowledge base of enemy activities, capabilities, and vulnerabilities.

We will augment organic capabilities by sensor data sources collected, assessed, and analyzed from national, Joint, and Naval ISR. These tiered systems will provide

Joint forces accurate and real-time information, from which we can gain precise battlespace awareness. This analysis will allow us to anticipate and limit adversary actions, rapidly focus fires, and operate inside the enemy's decision timeline. We will be able to do this at any time of day or night and in any weather.

Friendly sea- and shore-based aviation forces will make use of this battlespace awareness to exploit enemy weaknesses. We will foreclose enemy options and debilitate the adversary's fundamental command-and-control systems. In this way, we will ensure success through rapid, decisive operations.

To achieve these capabilities, however, we must enhance legacy networks and systems while developing and acquiring powerful new ones. We will develop highly interoperable systems that eliminate the "stovepipes" of the past and support the concepts of Sea Power 21. The following are some of the systems particularly important to Naval Aviation.

The Expeditionary Sensor Grid

The Expeditionary Sensor Grid is a multi-tiered, warfighter-centered architecture that supports U.S. forces' asymmetric warfare of the 21st Century. The Grid comprises numerous and heterogeneous sensors throughout the battlespace—in the air, underwater, on the sea surface, and on the ground. The Grid notionally integrates these sensors to complement current and planned systems at both the national and theater levels.

Component sensors will include tiered unmanned aerial vehicles (possibly armed UCAVs), offboard surface and subsurface warfare sensors, unattended ground/sea sensors, Naval ground forces (USMC and Navy Special Warfare units), and platform-mounted sensors on forward-deployed Naval units.

To build battlespace awareness in real time, we must significantly increase not only our sensing power but also our ability to process information. The Expeditionary Sensor Grid will aid this effort, allowing us to do things currently difficult due to technological challenges—such as getting in close to defeat stealth features. In addition, the Grid will deliver improved mobility, cover, concealment, and deception.

The Grid also ensures that tactical warfighters have sensors at their disposal; this will provide the responsiveness we need for the 21st Century's rapid, decisive operations.

The Joint Fires Network (JFN)

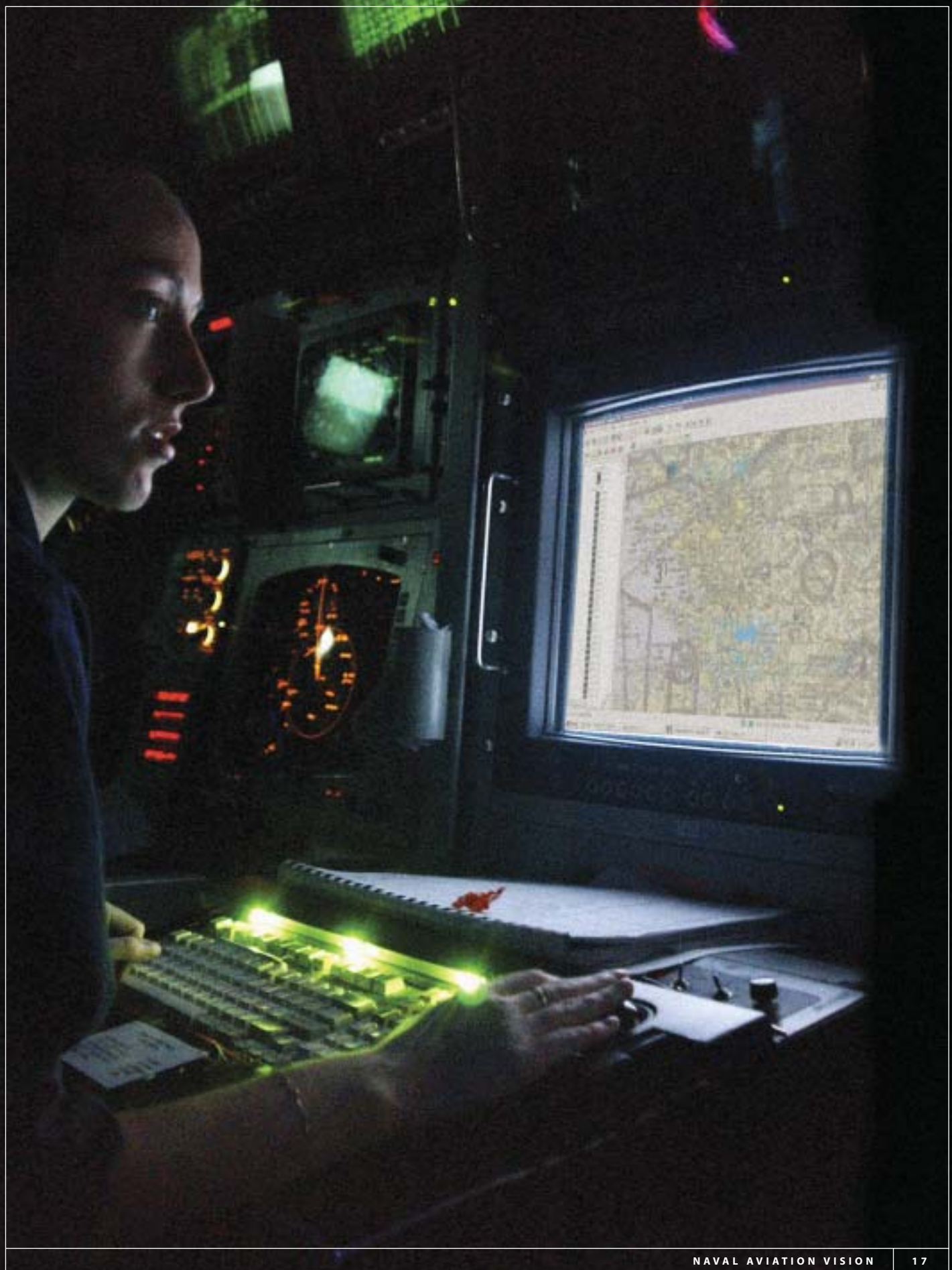
This is the end-to-end architecture for Time Critical Targeting (TCT)/Time Sensitive Strike (TSS). JFN merges numerous functions: intelligence, surveillance, reconnaissance, and targeting (ISRT); mission planning; and situational awareness.

JFN includes timely interfaces to sensors and weapons systems. Its core capabilities derive from the convergence of Joint Command and Control (JC2)—formerly known as Global Command and Control System-Maritime (GCCS-M)—with Joint Sensor Image Processing System-Navy (JSIPS-N). JC2 meets the Joint and Service requirements for a single, integrated, and scalable command-and-control system. This system receives, displays, correlates, fuses, and maintains geolocational track information on all forces in a theater—whether friendly, hostile, or neutral; whether on land, on the sea, or in the air. JC2 also integrates the data with available intelligence and environmental information.

The Navy is developing a multi-functional fusion tool, one that operates in real time and can process information from multiple sensors. It is designed to accept ISR inputs from various Joint assets—these inputs feed mission planning and fire control/combat systems. The system provides TCT/TSS capabilities to units afloat and to the Joint Forces Maritime Component Commander. It can also be used across multiple warfare areas and tasks.

Naval efforts fuse organic intelligence data with information from the broader national and Joint intelligence activities. These efforts are being pulled together with the Distributive Common Ground Station-Navy (DCGS-N), the Marine Air-Ground Intelligence System (MAGIS), and the JFN. Together, these vastly expand the accuracy and speed of actionable tactical intelligence.

The new DCGS-N family of systems features common components, open architecture design, and adherence to interoperability standards. It also offers excellent "reach back" connectivity to Joint intelligence facilities. This family of systems will support tremendous improvements in interoperable tasking, processing, exploitation, and dissemination for the Joint Force.



Advanced Tactical Data Links Systems (ATDLS) Link-11/16/22

Link-11 is the common tactical data link for all U.S. Navy and allied ships not equipped with Link-16, the Department of Defense's primary Joint Tactical Data Link. The Navy is implementing Link-16 in most of its link-capable platforms.

The ATDLS program delivers Link-16 hardware to the Fleet and funds planned improvements. Link-22, a multi-national tactical data link, will implement the Tactical Data Link Joint Message Standard (TDLJMS) (J series). Aviation platform solutions, such as the Multi-functional Information Distribution System-Low Volume Terminal (MIDS-LVT), will provide a tactical information distribution system equivalent to the Joint Tactical Information Distribution System (JTIDS).

Additional ISR Capabilities

The Roadmap section of this document describes these additional important systems and networks:

- The Joint Service Imagery Processing System (JSIPS) & JSIPS-N(Navy)
- The Naval Mission Planning Systems (NavMPS)
- The Common Data Link-Navy (CDL-N)
- Cooperative Engagement Capability (CEC)

In addition to using the Expeditionary Sensor Grid, we will also significantly increase Naval Aviation's ISR capabilities by fielding the next generation of Multimission Maritime Aircraft (MMA) as well as UAVs. These UAVs will possess advanced sensors that can be reconfigured for each mission.

The MMA's transformational bottom-up design will tailor integration of its onboard mission suite with UAV- and satellite-based systems and sensors. The platform will upgrade its ASW and ISR features—crucial features of Sea Strike—through continual improvements in networks, sensors, and communications. Other unmanned ground and underwater vehicles will provide critical close-in ISR capabilities. Naval ISR systems will benefit greatly from the deployment of a family of Navy and Marine Corps UAVs; equipped with various sensors, these will be networked via the Tactical Control System. This integration will extend the reach, coverage, and persistence of the Naval ISR systems in providing information to the Joint Force.

Time Sensitive Strike (TSS)

Time Sensitive Strike brings precise, lethal effects from Carrier Strike Groups, Expeditionary Strike Groups and surface combatants to bear in decisive quantities on important targets. Sea-based strike groups will use onboard sensor and weapons systems to deny sanctuary to the enemy and enhance warfighters' battlespace awareness.

These platforms will be highly survivable in the hostile battlespace, due to designed-in survivability and the incorporation of self-defense systems. This will provide our warfighters with more opportunities to seek out and destroy enemy targets.

Moreover, our warfighters will be the responsive and pervasive force that strikes one of our toughest battlespace challenges: time-sensitive mobile targets. These can include mobile ballistic or cruise missile launchers or advanced, mobile surface-to-air missile (SAM) batteries. We will focus largely on reducing the "kill-chain time"—that is, the time between when our forces detect and then attack these mobile targets. We will achieve a timescale measured in minutes and ultimately seconds of target detection, by changing the sensor-to-shooter interface.

Transformational efforts in Time Sensitive Strike will improve warfighter performance in two important areas. First, we will reduce the time needed to strike targets. We will achieve this through improved ISR and better autonomous targeting for attack platforms. Secondly, we will be able to engage a far greater number of targets, within a broader range of threats, due to dramatic increases in precision and volume brought about by the JFN.

Our efforts to improve rapid-response time will benefit from better intelligence preparation of the battlespace (IPB). This intelligence preparation helps focus ISR collection efforts in several ways. We focus on the most likely enemy operating areas, then dynamically cross-cue the collection sensors to fuse rapidly the data collected by networked sensors.

Combat experience in Operation Enduring Freedom has revealed that up to 80% of aircrews, at the time they launched from the carrier, did not know what their targets would be. This percentage reflects the rapidly increasing tempo of 21st Century operations and is likely to continue to increase, thus requiring ever more capable airborne systems for mission planning. Our ISR systems will be able to relay data into the JFN. Decision aids will then help controllers to match fleeting targets with on-call, quick response shooters. Advanced data links will provide shooters with the timely information they need for quickly locating and striking a target.

We can substantially improve the kill-chain time. This will happen as we improve the information flow and the information content (i.e., decision-making capacity) from ISR sensors to tactical controllers both in the air and in the strike group. We focus on improving this flow and content by upgrading sensors and then sensor systems; this includes those dealing with radio frequency (RF), electro-optical, and infrared energy. Hyperspectral sensor technology can also significantly increase information content, thus potentially enhancing the speed of decision-making.

The Broad Area Maritime Surveillance (BAMS) UAV, EP-3E *Aries*, and the MMA will significantly enhance their connectivity over a range of links for command and control, communications, and intelligence. In addition, we will improve mission software to link offboard and onboard sensors. This will create a fused tactical picture of the battlespace, sent in real time to warfighters.

Future systems will also include penetrating sensors. These include systems such as the Ground Weapons Locating Radars, *Predator* and *Dragon Eye* UAVs, and the Navy Unmanned Combat Air Vehicles (UCAV-N). All of these can operate with the Joint Fires Network. The Navy has also slated design improvements for the next-generation CVN 21 carrier that will make it easier to integrate UAVs and UCAVs into the future battleforce.

Naval Aviation can also compress decision time by improving our ability to detect and engage enemy targets. This will be the role of the Advanced Electronically Scanned Array (AESA) radar, installed on the F/A-18E/F and Joint Strike Fighter. The AESA system will allow attack platforms to "hunt and kill" fleeting targets in areas identified in the IPB process.

Besides AESA, we will gain additional autonomous-targeting capability thanks to the Advanced Targeting Forward Looking Infrared Radar (ATFLIR) and the SHAred Reconnaissance Pod (SHARP). These systems require little or no assistance from offboard sensors and tactical controllers; this reduces the time normally required to coordinate among sensors, controllers, and shooters.

Similarly, next-generation electro-optical systems will increase the distance at which rotary-winged aircraft can locate and recognize targets. Such improvements will allow aircraft to locate and recognize targets out to the maximum range of onboard weapons. The Airborne Electronic Attack (AEA) aircraft, for example, will be able to cover the full spectrum of electronic threats. The AEA can also strike—thus significantly improving each strike sortie's effectiveness.

Naval forces are undergoing a revolution in aggregate striking power, against both fixed and mobile targets. This has occurred for three reasons. First, next-generation reliable sea-based strike aircraft, such as the F/A-18E/F and the Navy and USMC variants of the JSF, possess greater payload and precision-strike capabilities. Second, these sea-based aircraft will be able to launch more sorties from the CVN 21 than from existing carriers. Third, the integration of Navy and Marine Corps tactical aviation will enhance our interoperability and mission effectiveness.

Advances in precision-guided weaponry—such as laser-guided bombs and the Joint Direct Attack Munition (JDAM)—have made it possible for Naval planners to speak of the destruction of multiple targets per sortie rather than of sorties per target. The Navy will also benefit from the introduction of new aircraft, missile systems, and precision air-launched weapons—these include the Joint Advanced Air-to-Surface Standoff Missile (JAASSM) and Joint Standoff Weapons System (JSOW).

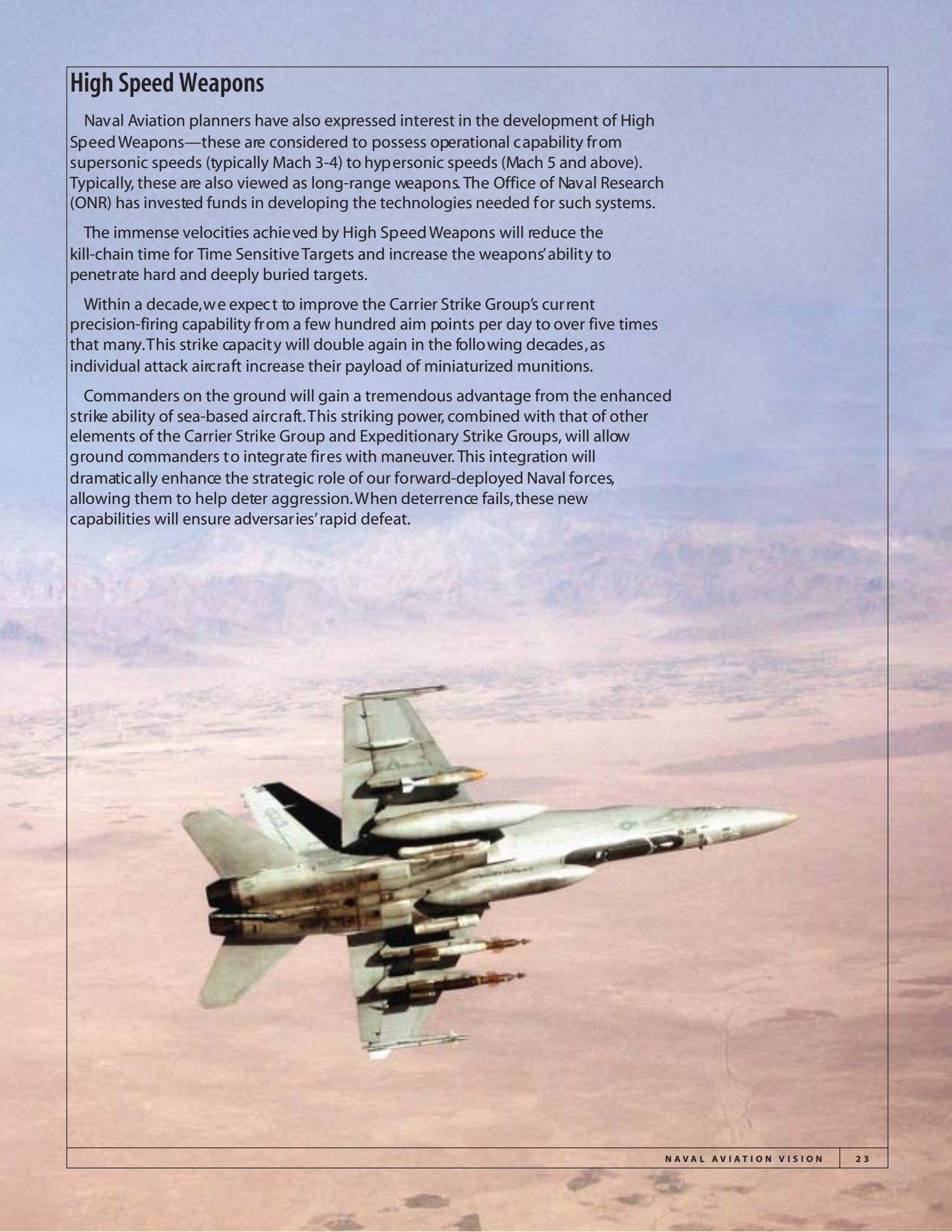
High Speed Weapons

Naval Aviation planners have also expressed interest in the development of High Speed Weapons—these are considered to possess operational capability from supersonic speeds (typically Mach 3-4) to hypersonic speeds (Mach 5 and above). Typically, these are also viewed as long-range weapons. The Office of Naval Research (ONR) has invested funds in developing the technologies needed for such systems.

The immense velocities achieved by High Speed Weapons will reduce the kill-chain time for Time Sensitive Targets and increase the weapons' ability to penetrate hard and deeply buried targets.

Within a decade, we expect to improve the Carrier Strike Group's current precision-firing capability from a few hundred aim points per day to over five times that many. This strike capacity will double again in the following decades, as individual attack aircraft increase their payload of miniaturized munitions.

Commanders on the ground will gain a tremendous advantage from the enhanced strike ability of sea-based aircraft. This striking power, combined with that of other elements of the Carrier Strike Group and Expeditionary Strike Groups, will allow ground commanders to integrate fires with maneuver. This integration will dramatically enhance the strategic role of our forward-deployed Naval forces, allowing them to help deter aggression. When deterrence fails, these new capabilities will ensure adversaries' rapid defeat.



Electronic Warfare (EW)/Information Operations (IO)

Warfare in every dimension of the battlespace—and even within many weapons systems—requires external information. Commanders and their forces have many requirements for information, including navigation, meteorology/oceanography, mapping/charting, communications, and evaluated information-intelligence.

Because of the importance of C4I (command, control, communications, computers, and intelligence), commanders also seek to degrade or interrupt an adversary's information support systems and structure.

Information Operations (IO) seek to exploit, deceive, and disrupt adversaries' information systems, computer networks, and electronic emitters. To this end, IO employs electronic warfare, computer network defense and attack (CND/CNA), psychological operations (PSYOP), military deception, and operational security.

Forward-deployed IO capabilities, especially those provided by carrier-based and maritime support platforms, will provide line-of-sight access to the enemy's electromagnetic spectrum. These capabilities will give commanders a wider range of tactical options early in a crisis and will play a key role in controlling crisis escalation and preparing the battlefield for subsequent attack.

Information operations will mature into a major warfare area. The enabling technologies—sensors, weapons, and platforms—will also mature. Some of our current efforts include "smart" systems for electronic reconnaissance and jamming, refinement of CND/CNA and PSYOP concepts, and development of Navy-specific requirements.

Ship to Objective Maneuver (STOM)

Ship to Objective Maneuver projects the Expeditionary Strike Group's combined arms assault force from ships at sea directly against operational objectives—some of which may be located far inland. This represents the application of enduring concepts from the Marine Corps' transformational "Operational Maneuver from the Sea" doctrine. Future Marine forces will be able to maneuver in tactical formation from the moment they depart the enhanced sea base until they reach their key objectives.

STOM will reduce Naval forces' historic vulnerability during their support of beachhead operations, as the sea base will provide the primary support for Marine operations. Specifically, support will come from stable-in-theater staging bases located outside the Joint operating area. In this way, STOM will greatly increase Naval expeditionary forces' tactical flexibility and operational tempo (OPTEMPO).

Advanced tilt-rotor technology aircraft, such as the MV-22 *Osprey*, will also greatly enhance expeditionary forces' ability to deliver troops, equipment, and supplies from sea base to shore. Enhancements include greater speed, survivability, and combat range. Stealthy tactical-combat aircraft, including the Navy-Marine Corps variant of the JSF, will also dramatically improve Naval operations from mobile bases at sea and ashore. These aircraft and surface units will support ground maneuver by providing precise and high-volume fires at long range. New vehicle concepts now being explored, such as the canard rotor/wing (CRW), may provide revolutionary and transformational capabilities to our Navy/Marine Corps forces.

Sea Shield

Sea Shield will protect our national interests with layered global defensive power based on control of the seas, forward presence, and networked intelligence. It will use these strengths to enhance homeland defense, assure access to contested littorals, and project defensive power deep inland.

As with Sea Strike, these integrated operations will be based upon information superiority, total force networking, and an agile and flexible sea-based force.

Sea Shield will defeat adversaries' anti-access and area-denial attempts, regardless of whether the threats come from enemy aircraft, missiles, small surface combatants, mines, or submarines. Highly capable and survivable aircraft, both fixed- and rotary-winged, will extend and dominate the battlespace. They will be based at sea and augmented by numerous unmanned platforms and maritime support aircraft. This combined power will enable Naval forces to defend the Sea Lanes of Communication (SLOC) and establish combat power ashore to secure facilities and receive follow-on prepositioned sealift and airlift assets.

These assets also extend precise and persistent Naval defensive capabilities overland. This includes protecting the Joint forces and allies who hold initial operational objective points inland. The Sea Shield concept also includes the protection of the U.S. homeland. Key capabilities include:

- Theater Air and Missile Defense (TAMD);
- Littoral Sea Control;
- Homeland Defense;
- and Force Entry Enabling (not described below).

Theater Air and Missile Defense (TAMD)

TAMD projects a protective "umbrella" against all forms of aircraft, as well as against ballistic or cruise-missile threats. The protection can extend over the horizon at sea or deep inland, and from ground level to the upper atmosphere (exoatmosphere).

The Cooperative Engagement Capability (CEC) will network the digital radar data from the E-2C *Advanced Hawkeye* (formerly known as the Radar Modernization Plan or RMP) and surface units throughout the battleforce. When we network CEC with MAGTF capabilities and the new over-the-horizon surface-to-air (SM-5) missile, we create an integrated and seamless air defense. This defense can lethally engage long-range cruise missiles and aircraft from hundreds of miles' range over land and over water.

This ability to form a Single Integrated Air Picture (SIAP), using Joint track data, will profoundly affect tactical air power. We will tremendously improve not only tactical decision speed and accuracy at extended ranges, but also our opportunities for engagement.

TAMD also allows us to transform our force doctrine. Commanders could, for example, reallocate manned aircraft from defensive air-patrol duties to strike missions. Another option would be to reallocate *Aegis* guided-missile destroyers away from close-in force defense, redeploying them to distant stations for ballistic missile defense or precision surface-fire strikes. The CVN 21 and the next generation of surface ships would further enhance this ability for extended-range air defense, through the development of the Volume Search Radar.

Sea-based ballistic missile defense (BMD) systems will exploit the existing infrastructure of Naval radars and missile launchers to provide flexibility for theater and homeland missile defense operations. We will defend against theater-range missiles by linking our sea-based interceptor missiles with a space- and air-based sensor network as well as with command-and-control systems.

Directed Energy (DE) Weapons

Advancements in high-power microwaves (HPM) and lasers have created a new class of weapons systems—Directed Energy (DE) Weapons. Such weapons no longer exist just in the realm of science fiction—they are already a reality.

DE systems will precipitate a revolution in future engagements, employments, and concepts of operations (CONOPS). Lasers can focus precisely on a target to provide surgical strike capability at very long ranges, regardless of whether the laser is based on the ground, at sea, in the air, or in space. Once aimed, lasers affect the target from the outside by damaging the physical structure.

Conversely, high-power microwaves flood target areas with energy; this allows for the engagement of multiple targets at the same time. High-power microwaves affect the target from the inside through electrical disruption.

These differences notwithstanding, lasers and high-power microwaves share some important traits. Each type travels to the target at the speed of light, each can achieve graduated effects (deny, disrupt, degrade, and destroy), and each can be used to minimize collateral damage.

Littoral Sea Control

Littoral Sea Control assures the prompt access and freedom of maneuver of Joint forces from the sea base. We will defeat anti-access capabilities such as "swarming" small surface craft, quiet diesel submarines, and sea mines through a combination of surface, subsurface, and aviation assets. The command and control of such missions will be vastly improved through netted assets that link our attack forces to the sensors, decision aids, and displays.

Anti-Submarine Warfare (ASW)

The objective of ASW is to gain maritime superiority by rapidly finding, destroying, or (where necessary) avoiding enemy submarines. The modern diesel submarine, far quieter than its predecessors, works well in the role of area denial. We can expect our adversaries to use such quiet submarines in the littorals, where the shallow waters are noisy and cluttered.

To transform ASW, we seek to develop new operational concepts that leverage advanced technologies to improve wide-area surveillance, detection, localization, tracking and attack capabilities.

Manned and unmanned aircraft—by virtue of their speed, area of coverage, versatility, and payload—will continue to be indispensable against the submarine threat. For example, the P-3C Anti-Surface Warfare Improvement Program (AIP) and the future Multimission Maritime Aircraft (MMA) will participate in multiple ASW and anti-surface warfare (ASUW) roles to assist the battle group commander. The Navy is developing the Advanced Low Frequency Sonar to increase dramatically the acoustic capabilities of ship-based MH-60R helicopters. The Navy could detect exposed enemy periscopes by deploying the Automatic Radar Periscope Detection System, which can be carried on aircraft as well as on surface ships. Over the longer term, our research efforts seek to develop active and passive electro-optical techniques for integration into manned aircraft or UAVs.

Mine Countermeasures (MCM)

Effective MCM ensures that U.S. Joint and combined forces can negate mines used by enemies to hinder the free movement and supplies by sea or from the sea base of our forces and keep the seaways open. Our transformational efforts will work to develop new systems for mine detection and clearance, including systems organic to forward-deployed combat ships. To detect and neutralize mines, both dedicated and organic MCM will employ various unmanned vehicles. These sophisticated, networked craft will patrol the surface, the air, and underwater. Other new MCM technologies that may support future Naval operations include advanced detection systems on patrol aircraft and UAVs. These will locate and identify sea and land mines by using multi-spectral electro-optics or laser detection.

Next-Generation Magnetic and Acoustic Minesweeping Systems

Carried into combat by MH-60S *Knighthawk* helicopters and UAVs, the next-generation magnetic and acoustic minesweeping systems will be able to operate in very shallow waters and the surf zones. These new capabilities, organic to deployed Naval forces, will work in conjunction with other MCM assets; collectively they increase our Navy's ability to maneuver in potentially mined areas during combat.

Homeland Defense

Sea Shield extends homeland security to the fullest extent through a national effort that will integrate forward-deployed Naval forces with the other military services, civil authorities, and intelligence and law-enforcement agencies.

Working with the newly established Northern Command, we will identify, track, and intercept dangers long before they threaten our homeland. These operations will extend the security of the United States far seaward, taking advantage of the time and space afforded by Naval forces to shield our nation from impending threats. Naval aircraft such as the Multimission Maritime Aircraft (MMA), the E-2C *Hawkeye*, and the Broad Area Maritime Surveillance (BAMS) UAV, in addition to ships and submarines, could provide comprehensive situational awareness to cue intercepting units. Additional concepts involve installing advanced sensors on blimps and other lighter-than-air (LTA) vehicles.

Other missions include Theater Air and Missile Defense (TAMD), with Naval and Joint forces intercepting enemy missiles in the boost or mid-course phases. Still another mission could involve Joint operations with civil and law-enforcement agencies to detect and interdict suspect vessels.

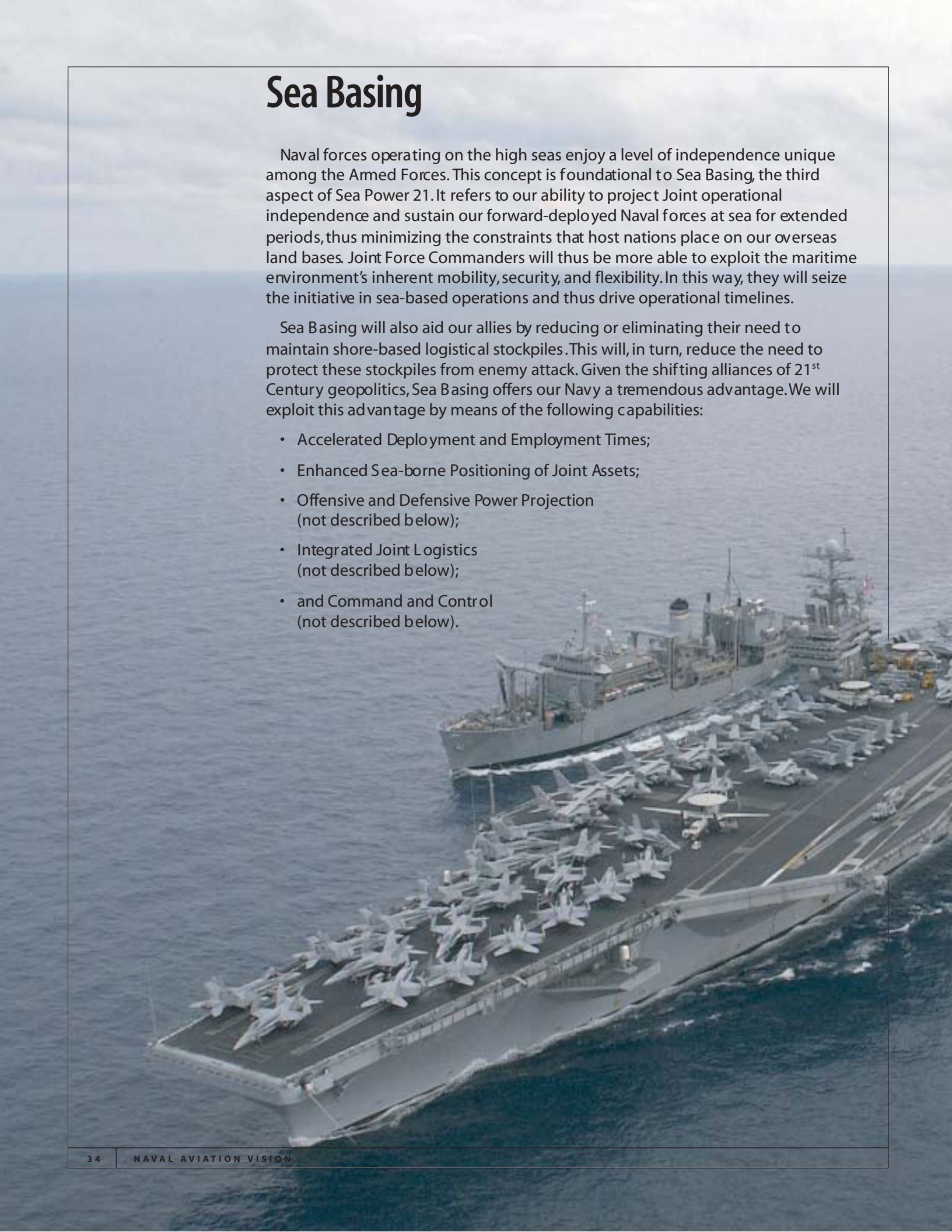
We are also exploring ways to process and display the vast quantities of intelligence data related to the maritime battlespace. To create actionable "Maritime Domain Awareness," we must develop automated systems that will assimilate, correlate, and display the data—then share the information with the relevant authorities. This information could, for example, ensure timely interdiction of suspicious vessels and aircraft.

Sea Basing

Naval forces operating on the high seas enjoy a level of independence unique among the Armed Forces. This concept is foundational to Sea Basing, the third aspect of Sea Power 21. It refers to our ability to project Joint operational independence and sustain our forward-deployed Naval forces at sea for extended periods, thus minimizing the constraints that host nations place on our overseas land bases. Joint Force Commanders will thus be more able to exploit the maritime environment's inherent mobility, security, and flexibility. In this way, they will seize the initiative in sea-based operations and thus drive operational timelines.

Sea Basing will also aid our allies by reducing or eliminating their need to maintain shore-based logistical stockpiles. This will, in turn, reduce the need to protect these stockpiles from enemy attack. Given the shifting alliances of 21st Century geopolitics, Sea Basing offers our Navy a tremendous advantage. We will exploit this advantage by means of the following capabilities:

- Accelerated Deployment and Employment Times;
- Enhanced Sea-borne Positioning of Joint Assets;
- Offensive and Defensive Power Projection (not described below);
- Integrated Joint Logistics (not described below);
- and Command and Control (not described below).



Accelerated Deployment and Employment Times

Sea Basing will markedly compress deployment and employment times. The forwardly-deployed Navy of the 21st Century, with decreased reliance on ports and land-based airfields, will reduce force-protection requirements and be able to project ground combat power from the sea within days rather than weeks or months. Our integrated combatant and auxiliary Naval forces will become a single netted force, thereby making Naval expeditionary warfare faster and more effective.

We will achieve significantly higher closure speeds in delivering ground troops from the secure Sea Base either to the dispersed forces ashore or directly to the objective. To do this, we will rely on vertical-lift aircraft such as the MV-22, as well as on rotary-winged aircraft and high-speed surface vessels. Sea Basing will allow us rapidly to deliver and assemble a ground force even the size of a Marine Expeditionary Brigade. The Navy is also considering ways to combine advanced technology with "old" concepts such as sea planes and wing-in-ground-effect (WIG) vehicles.

Sea Basing will also involve development of a new generation of combat logistics ships; their higher capacity will enhance our ability to resupply and sustain the sea-based forces.

Enhanced Sea-borne Positioning of Joint Assets

Sea Basing is based upon an enduring reality—that the maritime world offers commanders the most mobile and secure area for operations. The Joint Force Commander can expand the battlespace beyond enemy reach by moving assets over the oceans and seas—thus establishing an optimal position for critical command and control, fire support, and logistics.

Furthermore, this advantage allows the Expeditionary Strike Force to maneuver out of harm's way, simultaneously giving time to protect and repair combat equipment and replenish at sea. The strike group can then resume combat operations from the most advantageous position.

FORCEnet—The Catalyst for Making Sea Power 21 a Reality

"FORCEnet is the operational construct and architectural framework for Naval Warfare in the Information Age which integrates Warriors, sensors, networks, command and control, platforms and weapons into a networked, distributed combat force, scalable across the spectrum of conflict from seabed to space and sea to land." (CNO's Strategic Study Group – XXI definition)

FORCEnet is the Navy's means for transforming Sea Power 21 from operational concept to operational reality. Dispersed human decision-makers, exploiting current and new technologies, will leverage military capabilities and achieve information dominance across the entire mission landscape. This will involve close coordination with Joint, allied, and coalition partners.

FORCEnet comprises a vast architecture of networked systems, networks, and interfaces. It is the glue that binds the information nodes of the 21st Century naval force. Warfighters will gain access to information via a series of secure and transparent interfaces. When joined with the operational capabilities of Sea Power 21, FORCEnet will help U.S. forces gain and maintain dominance across the entire battlespace—from seabed to space, from sea to land.

The battlespace is our base of operations, one that moves with the force and can be positioned anywhere in order to project power. By extending "zones of superiority" over landing forces, Naval and Joint Force Commanders protect those forces as they accomplish their missions and establish their own defensive zones. By enhancing the combined power of units working together, FORCEnet effectively extends our battlespace's range and geographic influence.

FORCEnet will improve decision-making at every command level, both in speed and quality. Greater situational awareness will increase commanders' ability to dissuade, deter or decisively defeat any enemy. Power projection, characterized by distributed precise fires, will mass on targeted threats in the littoral regions. We will achieve a persistent sensor-to-shooter capability, maximizing fire results while minimizing our personnel's risk of enemy attack. This distributed combat power—across platforms, warfighters, and systems—will help commanders sustain Naval assets efficiently and "in stride."

Naval Aviation ordnance will increase its precision and lethality as FORCEnet nets missile sensors and guidance systems. The distribution of smart-weapon sensor information will improve battle damage assessment (BDA) and our ability to re-strike. Increased efficiency of ordnance delivery also will dramatically reduce the vulnerability of our manned and unmanned assets.

FORCEnet will also enable Naval Aviation to connect more effectively with Joint architectures. This will bring together Joint command-and-control (C2) elements and weapons systems in a robust, secure, and scalable way.

In seeking to integrate Naval networks and systems, FORCEnet always focuses on our Fleet, seeking to place these integrated capabilities into the hands of the warfighters—the "point of the spear." Initiatives such as the Navy-Marine Corps Intranet (NMCI) and Information Technology for the 21st Century (IT21) will ensure

that all afloat and shore commands stay in constant two-way communication with the rest of the Navy. Most importantly, FORCEnet will ensure that existing and future systems are fully interoperable and highly flexible, able to support dynamic C2 on current Joint and coalition missions.

This emphasis on the warfighter means that aircraft cockpits and crew stations will change as well, gaining additional combat power through advanced avionics and other technology. Naval Aviators and crews will immerse themselves within a common operating environment (COE), via a common operating picture (COP). This environment will provide aircrews with the accurate and up-to-date information needed for effective and decisive action.

Other gains will come to in-flight mission planning, rehearsal, or re-strike planning. These will improve our ability to maintain the tempo of battle while continually and persistently destroying elusive time critical targets. FORCEnet will also vastly improve our capabilities in electronic warfare (EW) and littoral anti-submarine warfare (ASW), as well as in information operations (IO).

FORCEnet will enable Naval Aviation combat forces, in concert with other Naval and Joint forces, to achieve battlespace dominance across the full range of military operations. Naval Aviation will play a central role in maintaining this unrivaled superiority over the long term.

Processes & Initiatives for Sea Power 21

Sea Warrior

Sea Power 21 will require a force of Naval professionals who are more knowledgeable, skilled, and technically astute than today's workforce. Sea Warrior will meet that requirement through enhanced assessment, assignment, training, and education. We will compete successfully for tomorrow's workforce by ensuring that our human resources policy focuses on all Navy personnel—whether professional, active duty, reserve, or civilian.

The Revolution in Navy Training has entered a new phase with the establishment of the Naval Personnel Development Command (NPDC), which stood up at Naval Station Norfolk in January 2003. NPDC will oversee creation and implementation of a new system of Naval education, one that institutionalizes and builds on initiatives such as Sailor Advocacy and Task Force EXCEL (Excellence Through Our Commitment to Education and Learning). The Command will continue working with the Fleet to expand existing partnerships with academia and private industry.

Sailor Advocacy / Project SAIL

This initiative fundamentally changes how the Navy handles career management and detailing, giving Sailors a stronger voice and greater control over career decisions. Supported by command leadership and mentoring relationships, it also relies on teaming between individual command retention teams and experienced single points of contact at the Naval Military Personnel Command (NMPC).

Project SAIL (Sailor Advocacy Through Interactive Leadership) encompasses several programs that will help Sailors match their preferences and abilities to realistic and fruitful career choices. "Intelligent software agents" work within a web-based architecture to provide personnel with all needed information, including real-time job descriptions and locations. Users can even apply online for available positions. Other features allow users to exchange e-mail with detailers to obtain additional information, plan careers, and negotiate assignments. Through this high-technology initiative, we will be able to do a better job of matching the right person with the right job at the right time.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Revolution in Training

The Navy established Task Force EXCEL as the catalyst for the CNO's Revolution in Training. This revolutionary concept will optimize mission accomplishment as well as Sailors' personal and professional advancement. Through Task Force EXCEL initiatives, the Navy will maintain a continuous stream of successful leaders for the 21st Century and beyond.

Task Force EXCEL initiatives will incorporate rating-based Sailor Continuums that will change promotion and detailing by serving as career roadmaps, identifying all opportunities for training and education. A rating continuum will incorporate professional development, personal development, qualifications and certifications, leadership, and performance. This initiative will dramatically increase the use of onboard training/simulation packages, as well as computer-based distance-learning programs. Professional development efforts will integrate relevant industry-related credentials and appropriate college-level credits. The Navy has already begun to develop continuums for the enlisted aviation ratings AD, AS, AM, AW, and AZ.

Task Force EXCEL initiatives will draw on the science of learning to prepare Sailors and Marines to operate in the network centric warfare environment of the 21st Century. A key asset in this effort will be research in human performance, both in basic research and technology-base development.

In support of Task Force EXCEL initiatives, the Navy will make training performance-based. Researchers will use job performance aids, electronic education or "e-learning," combat-systems adjustments, manpower adjustments, and personnel selection. The goal will be to determine exactly what knowledge, skills, and abilities our personnel require, then combine these findings with our existing knowledge of human learning and performance. The individually tailored training created through this process will support each Sailor's optimal job success.

Sea Power 21 will require complex weapons systems; these will, in turn, require better-trained Sailors to operate them. Better training will require more advanced simulation and training technology. The Navy will pursue promising research and development efforts in the following areas to make Task Force EXCEL successful:

- **Modeling and Simulation:** Acquire better techniques to represent dynamic human performance and to automate instruction. These include improvements to the behavioral realism of computer-generated forces, the development of intelligent agents to support training, and better training in virtual environments.
- **Instructional Strategies:** Develop scenario-based and on-the-job training, as well as strategies for mentoring, coaching, and knowledge management.
- **Advanced Distributed Learning:** Develop the learning technologies and assessment tools for individuals and large distributed teams.
- **Performance Enhancement:** Improve readiness and computer support for advanced job assistance; such technologies will include interactive electronic technical manuals and intelligent tutoring. This will involve developing techniques to measure training effectiveness and human performance, as well as assisting in the design of human-centered systems.
- **Basic Research/Laboratory and Field Research:** Undertake basic research to acquire foundational knowledge in human systems applications. Through laboratory and fieldwork, training systems will be designed and procured using new and innovative technologies.

SEA WARRIOR IMPACT

- Continual professional growth and development
- Improved selection and classification
- Interactive, web-based, incentivized training
- Networked, high-impact training

SOURCE: *CNO's article "Sea Power 21: Projecting Decisive Joint Capabilities," U.S.N.I. Proceedings, October 2002.*

Naval Aviation Training Strategic Advisory Group (NATSAG)

NATSAG serves as the Operational Advisory Group for Naval Aviation Training, to identify and act on crucial issues that cut across disciplines. These issues include science and technology efforts, integrated Fleet training, aircrew, technical training, manpower, and training-range issues. The NATSAG process formalizes the way we set priorities and resource requirements, as well as how we resolve near-term training issues. NATSAG's efforts relate strongly to Naval Aviation's current vision, mission, goals, and objectives. This includes developing a clear training continuum for each officer and enlisted member of Naval Aviation—pilots, Naval Flight Officers (NFOs), aircrew, and maintenance personnel.

Additional objectives include:

- To introduce advancements in technology, education and simulation;
- To identify and prioritize "street to Fleet" training continuum requirements for aircrew and maintenance personnel;
- To identify and prioritize Science and Technology (S&T) issues;
- To introduce and refine strategies, master plans and roadmaps that foster performance-based training and support optimal readiness.

Ongoing NATSAG efforts in support of Sea Warrior initiatives include:

- **Naval Aviation Production Process Improvement:** This will reduce training time, thereby meeting the Fleet's requirements for trained pilots and NFOs.
- **Aviation Maintenance Training Continuum System (AMTCS):** Using electronic classrooms and web-enabled electronic courseware, this system delivers training to all aviation-maintenance personnel "from the Schoolhouse to the Fleet."
- **Chief of Naval Aviation Training 21 (CNATRA 21) Roadmap:** This leverages technology to ensure that the Navy continues to possess the best training aircraft and simulators.
- **Fleet Aircrew Simulator Training (FAST) Plan:** This will deliver networked, tactically relevant simulators to the Fleet.

Naval Air Reserve

Sea Warrior ensures that the Naval Air Reserve capitalizes on our personnel's training and experience. This will provide a force-level surge capability for escalated homeland defense and forward deployments. Our fully integrated Reserve forces will seamlessly parallel and complement active units to augment personnel and hardware as quickly as possible. Naval Air Reservists' knowledge and skills will also expand our home forces' capacity for flight and ground instruction, enabling Naval Aviation to meet the increased demand for trained warfighters.

The Reserves will continue to serve as a proven source of flexibility—one which offers support capability at reduced cost, relieves stress on active personnel tempo, and can be mobilized for wartime and contingency operations. Like FORCEnet, Naval Reserve capabilities potentially encompass the entire breadth of Navy operations. This operational and organizational agility will help bridge uncertainty as the Navy realizes its vision for the future.


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Sea Trial

Sea Trial streamlines and integrates the Navy's experimentation process, putting the Fleet at the heart of innovation. This initiative aims to speed prototyping, enrich concept development, and coordinate experimentation more fully. We will "push" forward the basic research, science, and technology, and "pull" from documented warfighting requirements in order to develop and acquire new systems. Our research, science, and acquisition communities will monitor and support promising technologies, then incorporate these technologies into advanced systems that we will deliver to our warfighters in the Fleet.

The Fleet's Role

The Fleet leads Sea Trial: under the guidance of the Commander, U.S. Fleet Forces Command (CFFC), the Navy Warfare Development Command (NWDC) will serve as Project Coordinator. By integrating the Fleet with technological and conceptual centers of excellence, we will significantly advance the Navy's ability to project combat power.

These centers of excellence include the systems commands, or SYSCOMs, as well as the testing and evaluation facilities. NAVAIR's Warfare Centers, for example, possess extensive facilities for demonstrating the promise of new aviation technologies. Reconfiguration of test aircraft and weapons, as well as high-fidelity modeling and simulation, allow the Fleet to see a wide array of future capabilities.

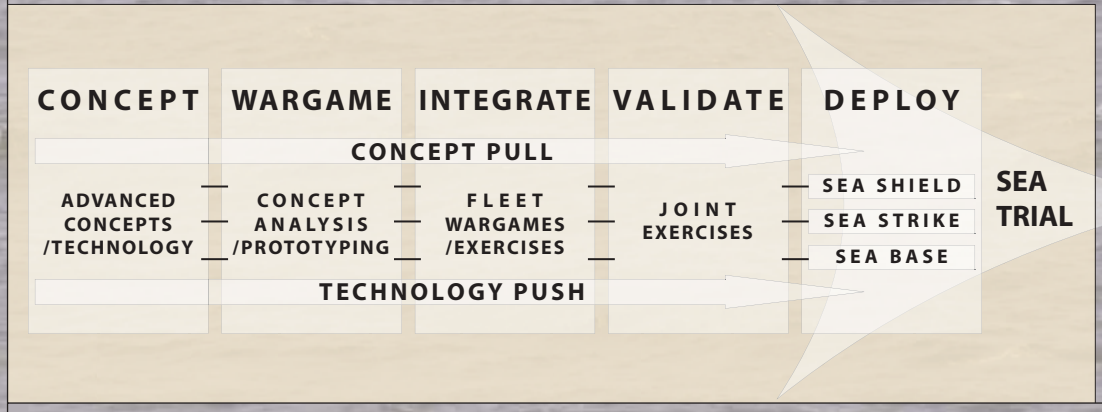
SEA TRIAL IMPACT

- Fleet-led, enduring process of innovation
- Accelerated concept and technology development
- Enhanced headquarters / Fleet alignment

SOURCE: *CNO's article "Sea Power 21: Projecting Decisive Joint Capabilities," U.S.N.I.* Proceedings, *October 2002.*

The Warfare Centers' airspace and weapons ranges also support early Fleet experimentation, demonstration, and validation of systems, weapons, and aircraft still under development. These test articles, for example, participate in Fleet Battle Experiments (FBE).

Naval Aviation will support Sea Trial in a variety of ways, both within the Navy and through Joint programs. Within the Navy, this will include funding Office of Naval Research (ONR) programs. Our partnerships include Joint programs with the Defense Advanced Research Projects Agency (DARPA), and Joint-service technology and acquisition programs. Ongoing rapid prototyping and technology insertion efforts will continue through the Advanced Technology Review Board process; this provides a formal means to review capabilities, requirements, and technology approaches.



Research Partnerships

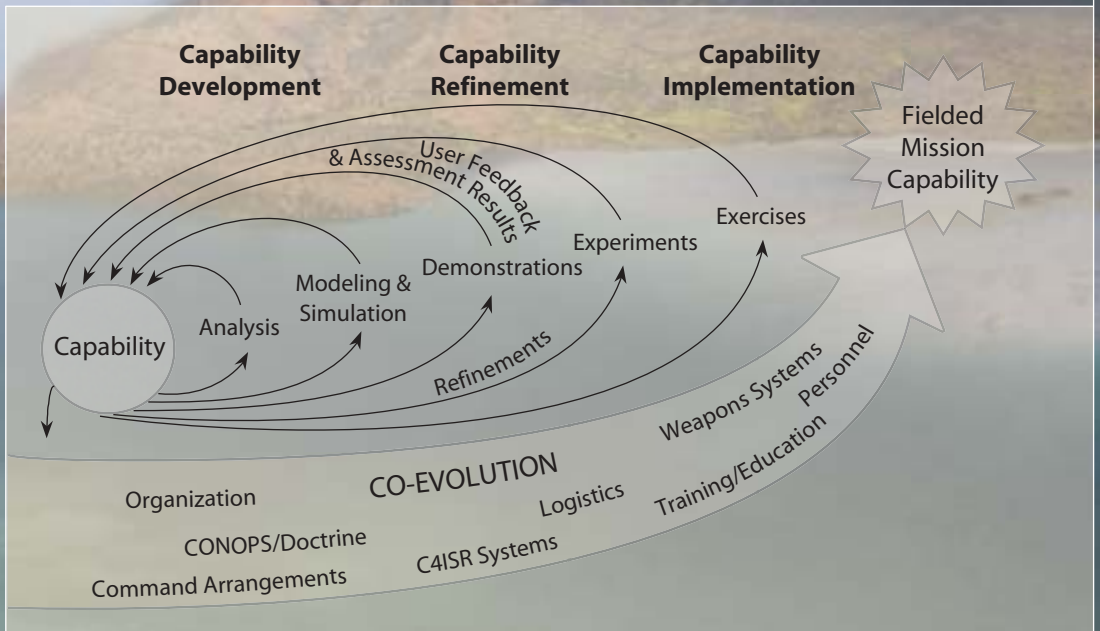
ONR established the Future Naval Capabilities (FNC) program to balance near-term and long-term requirements. Under this new process, the Department of the Navy applies approximately half of its Science and Technology (S&T) budget to over 200 programs that address the Fleet's near-term operational requirements. Aviation Program Managers, acting as transition sponsors, are closely linked to individual FNC programs to ensure that the Fleet receives these capabilities more quickly.

ONR also conducts exploratory and advanced development research in multiple fields of research. These include aeronautics; avionics; air vehicle propulsion; solid and air breathing propulsion for missiles, gun propulsion, projectile guidance and control for missiles and guns; warheads; fuse, safe, and arm devices; fire control; and targeting.

The Advanced Concept Technology Demonstration (ACTD) process, run jointly by DARPA and ONR, allows the Fleet to evaluate advanced technologies that offer significant advantages to Naval warfighters. First, the Fleet can test mature technologies for operational performance and their ability to address immediate military problems. Second, these demonstrations provide a basis to evaluate and refine operational requirements, develop a corresponding CONOPS, and ultimately produce a sound understanding of the technology's military usefulness. Finally, the ACTDs seek to provide "residual" operational capabilities as an interim solution prior to procurement.

Co-Evolution and Spiral Development

The illustration below displays how Naval Aviation will make operational reality out of the Naval capabilities that support Sea Strike, Sea Shield, Sea Basing, and FORCEnet. This approach emphasizes "co-evolution," or simultaneous development of the ways in which we organize, equip, and fight. This approach also emphasizes "spiral development"; researchers seek incremental advances that will build upon one another, thereby achieving greater results.



This will improve technology insertion, eliminate systemic problems with interoperability, and focus on improving combat capabilities. The process includes development of associated command concepts; doctrine; tactics, techniques, and procedures (TTP); organizational arrangements; personnel; information flows; systems; material; education; training; and logistics.

Through the Sea Trial initiative, the Fleet will be able to capitalize more effectively upon the unique expertise and capabilities found in the Navy's systems commands and testing-and-evaluation centers. By creating a closer link between technologies' development and their operational implementation, Sea Trial will enable tomorrow's Fleet to maintain its dominance in a rapidly changing world.

The NAVAIR Ranges

NAVAIR's Ranges are uniquely organized to support the Sea Trial concept, serving to enable the testing and experimentation process. They also foster the development and insertion of advanced Naval Aviation technologies and concepts. Under a unified national command structure, the Atlantic and Pacific RDT&E ranges provide the Fleet's planning personnel with a single point of entry for training and experimentation.

These engineering capabilities give the Fleet a vision of the possible and support the Fleet's Sea Trial and Joint Environment Experimentation across multiple warfare areas. Modeling and Simulation (M&S) facilities allow creation of "virtual environments," while the open-air ranges permit testing and evaluation (T&E) in live situations. The Atlantic and Pacific Ranges host Fleet Readiness, Training and Qualification exercises, including all phases of the interdeployment training cycle. The Ranges' facilities and other assets, including High Performance Computing, support major Fleet Battle Experiments such as Millennium Challenge 02, providing networked sensors, test communications, Time Space Position Information (TSPI), threat systems, and exercise-data collection.

With direction from the Commander, Fleet Forces Command (CFFC), NAVAIR Range engineers are working with Fleet Exercise and Experiment planners to develop the Training Range Strategy (TRS), which will become the Roadmap for all future Fleet Exercise planning. NAVAIR is working with the Navy's sister services to eliminate redundant range infrastructure and thereby free more funds for warfighting. Initiatives such as the Chesapeake Regional Range Cooperative (CRRC) have not only reduced total operating costs but also significantly increased NAVAIR Range use.

Sea Enterprise

SEA ENTERPRISE IMPACT

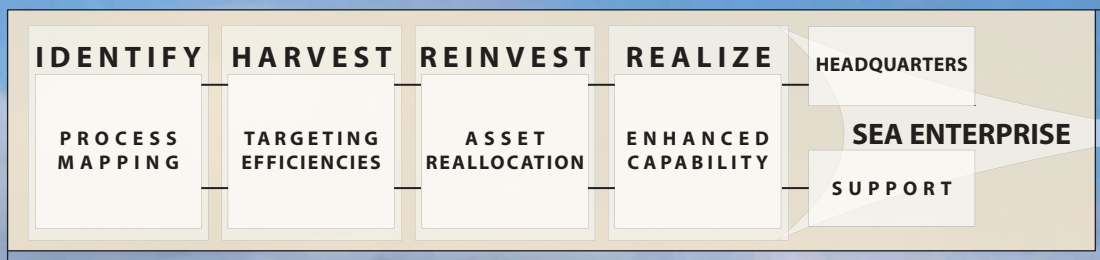
- Greater process efficiencies
- Divestment of non-core functions
- Organizational streamlining
- Enhanced investment in warfighting capability

SOURCE: *CNO's article "Sea Power 21: Projecting Decisive Joint Capabilities," U.S.N.I.* Proceedings, *October 2002.*

Sea Enterprise will enhance warfighting effectiveness by instituting better business practices throughout the Navy, in support of Defense Dept. goals for military transformation. The Navy will enhance spiral development as it aligns its organization, refines requirements, harvests efficiencies, and reinvests savings. In assessing its organization, the Navy will employ process-mapping techniques and other lessons from the business revolution. These assessments will target and prioritize areas for improvement then fund them accordingly. Such changes will strengthen Naval Aviation's culture of productivity, as well as help to balance future investments against current operational needs.

Increased inter-service integration also holds great promise. The Navy and Marine Corps' tactical aviation (TACAIR) integration plan, for example, will save both services billions of dollars, enhance interoperability, and integrate personnel more fully. We will share technologies and systems wherever possible—the Navy is already working with the Coast Guard on the latter's Deepwater Integrated Systems Program, with the Air Force in the development of new munitions, with the Army in the development of high-speed vessels, and with the Marine Corps on a new combined intelligence structure.

Long-term plans for aircraft recapitalization require Naval Aviation to make best use of scarce resources. To avoid the high operating costs associated with the aging Fleet, we must replace legacy platforms at a rate of 210 aircraft and 10 ships per year. This rate of replacement will maintain near-term readiness at levels permitting rapid crisis response. We will achieve this by implementing initiatives from Department of Defense agencies such as the Business Initiatives Council (BIC). These initiatives include divestiture or disinvestments of legacy systems and expensive platforms, such as the F-14 *Tomcat* and the S-3 *Viking*, that are no longer critical to the Navy's mission or transformation. New aircraft designs, such as the V-22 *Osprey* and the Joint Strike Fighter (JSF), will have far lower operating costs than the legacy systems they replace.



Naval Aviation acquisition must transform in order to gain new capabilities more quickly. In addition to divestiture and new development, this requires aggressive action to reduce overhead, streamline processes, improve networking, and scrutinize procurement and contracting plans. Our approach to change must be "holistic," taking into account both current fiscal realities and our operational commitments. Guided by an adaptable organization, we will combine our "fully netted" forces with affordable technology and innovative operational concepts.

Our strategies include:

- Force-level planning and analysis options to optimize aircraft affordability.
- Warfare analysis to determine the mission effectiveness of proposed alternative investments.
- Analysis to identify operations and support (O&S) cost drivers and to identify cost-effective profiles for modernization and recapitalization.
- Fleet-responsive review and analysis of logistics processes.
- Initiatives such as Navy/Marine TACAIR Integration to provide the optimal balance between efficiency and warfighting effectiveness.
- Achieving the right investment portfolio of Sea Strike, Sea Shield, Sea Basing, and FORCEnet capabilities. This includes understanding the investment/risk tradeoffs of buying more of one capability and less of another.

The Sea Enterprise revolution is ongoing—we will continue to improve Naval Aviation's efficiency and performance. This initiative will enable economies in acquisition, research, and Fleet/field support (including non-operational activities). The Navy will thereby focus more resources on its main mission: building the dominant Fleet envisioned in Sea Power 21.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214

Roadmaps

The following section contains roadmaps and descriptions of aircraft carriers, networks and systems, sensors, weapons, and platforms that incorporate technologies key to making Sea Power 21 an operational reality. Naval Aviation's recapitalization and modernization plan will emphasize replacement of legacy platforms and systems with new technologies.

The roadmaps and descriptions alike have resulted from extended and careful discussions within Naval Aviation. They represent the combat experience of the Fleet warfighters, the strategic planning of the Air Warfare Division (N78), and the technological expertise of NAVAIR. The roadmaps also reflect the Navy's close partnership with industry, which will continue to grow, ensuring that increasingly efficient advanced warfare technologies will remain available into the future. The Navy will also ensure its acquisition policies, doctrines, and leadership remain flexible, in order to focus on the Fleet and its needs. In this way, Naval Aviation will realize the full promise of Sea Power 21.

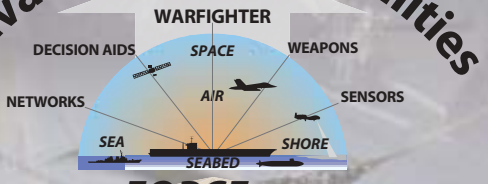
SEA POWER 21

Sea Strike
- Time Sensitive Strike
- Persistent ISR
- EW/IO
- STOM
- Covert Strike

Sea Shield
- Theater Air & Missile Defense
- Littoral Sea Control
- Homeland Defense
- Force Entry Enabling

Sea Basing
- Accelerated Deployment & Employment Time
- Enhanced Sea-borne Positioning of Joint Assets
- Offensive and Defensive Power Projection
- Integrated Joint Logistics
- Command and Control

Naval Aviation Capabilities



FORCENET

PLATFORMS
- CVN-21
- EA-18G
- F/A-18E/F
- JSF
- UCAV-N
- BAMS UAV
- E-2 Advanced Hawkeye
- E-6B
- MMA
- MH-60R/S
- KC-130J
- MV-22
- CH-53E
- AH-1Z
- UH-1Y

WEAPONS
- JASSM
- JSOW, AARGM/QB
- JDAM, HART
- DAGR/LOGIR
- JCM
- AMRAAM P3I
- AIM-9X

NETWORKS
- Wide Band Network (WBN)
- JSIP-N/Follow-On
- CDL-N
- JMPS
- CEC/JCTN
- TBMCS
- JC-2, IT-21, NMCI
- LINK 4/11
- JWACS SIPRNET/NIPRNET

SENSORS
- ATFLIR AESA Phase II
- SHARP P3I
- AEA Digital Sys
- MMA
- JMOD II
- SH-60R MMRS (SAR/PD)
- RMP P3I
- AQS-22

Aircraft Carriers

The aircraft carrier is the bedrock of Naval Aviation and the centerpiece of U.S. forward-deployment strategy. Since the days of Franklin D. Roosevelt, U.S. Presidents have repeatedly responded to international crises with the query, "Where are the carriers?" From World War II onward, aircraft carriers and their embarked air wings have enabled forward presence and ensured global access.

In the last ten years alone, large-deck carriers have been called upon to respond to, and engage in, over 20 separate international crisis situations. These have ranged from deterring Iraqi aggression in support of Operation Northern and Southern Watch to air strikes in Bosnia as part of Operation Deliberate Force. More recently, in Operations Enduring Freedom and Iraqi Freedom, carrier-based air wings flew strike and other missions against Taliban and Al-Qaeda terrorist forces in Afghanistan and targets associated with Saddam Hussein in Iraq.

The flexibility, self-sustainability, and overwhelming striking power of the large-deck carrier have been repeatedly validated in the crucible of real-world operations around the globe. The wisdom of the large-deck carrier's design, and its inherent capabilities, give these carriers the persistence, power, and presence to be fundamental to our national defense strategy.

Over the past 45 years, numerous studies have repeatedly shown the large-deck carriers' affordability and operational advantages. Our nuclear-powered carriers are highly survivable due to their speed (in excess of 30 knots), size, and construction. They are difficult to target, have the large space needed to absorb the energy from hits, and incorporate more survivability enhancements than any other type of ship.

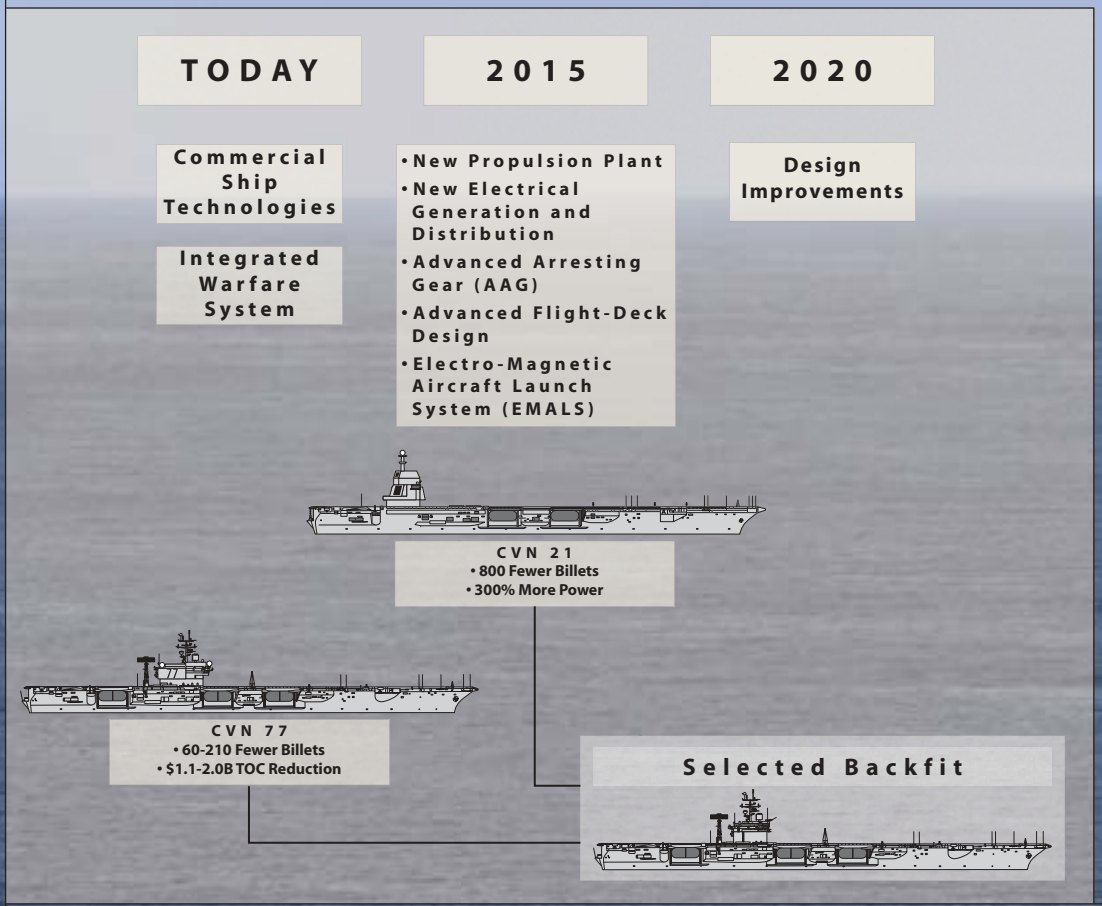
The large-deck carrier also outperforms smaller carriers by a wide margin in all key capabilities—strike, sustainment, employability (speed, endurance, safety, and survivability), and enablers. These enablers are the electronic attack, airborne early warning, organic ISR, and other combat capabilities that reside in the carrier air wing.

In short, our large-deck carriers represent far greater capability than small-deck carriers, at a fractional increase in cost. A clear lesson, learned and relearned over the past 50 years, is that the U.S. will need the large-deck carrier as long as there are oceans.

As a result of extensive analysis, the Navy has determined that it requires at least 12 carriers (with an optimum force of 15) to provide the forward presence and surge capability needed for 21st Century operations. The current force is built largely around the nuclear-powered *NIMITZ*-class aircraft carrier, first launched in 1975. The Navy has eight *NIMITZ*-class carriers in service and will add two more to the Fleet over the next six years. The first will be CVN 76, to be commissioned as *USS RONALD REAGAN* in 2003. The second, CVN 77, has been designated the *GEORGE H.W. BUSH* and is scheduled for commissioning in 2008.

The *GEORGE H.W. BUSH*, the last of the nearly 40-year-old *NIMITZ*-class design, will incorporate numerous design improvements to reduce manpower as well as increase our Sailors' quality of life. In line with the Navy's goal of seeking business efficiencies, many of these improvements come from recent developments in commercial shipping.

While CVN 77 will modernize the large-deck carrier, its design cannot support its intended preeminence in the 21st Century Carrier Strike Group and the Global CONOPS. The *NIMITZ*-class design, developed in an age of inexpensive manpower and before the information-technology explosion, has been stretched to the limit. Service Life Allowances in numerous areas constrain the class's future growth—these include weight and center of gravity, electric load margin, aircraft capacity, material handling, and future weapons requirements.



Construction on CVN 21 is slated to begin in 2007. This represents the next step in the Navy's evolutionary carrier strategy. CVN 21 will incorporate an enhanced reactor design and electrify all ship auxiliary systems outside of the main propulsion plant, eliminating steam/hydraulic and pneumatic piping, all while reducing lifecycle costs. The CVN 21 program's approach to design and spiral development reduces risk by introducing new technologies and capability at an affordable pace. CVN 21 will restore growth and electrical margins no longer available in the 40-year-old *NIMITZ* design and will support Naval Aviation's transformational capabilities.

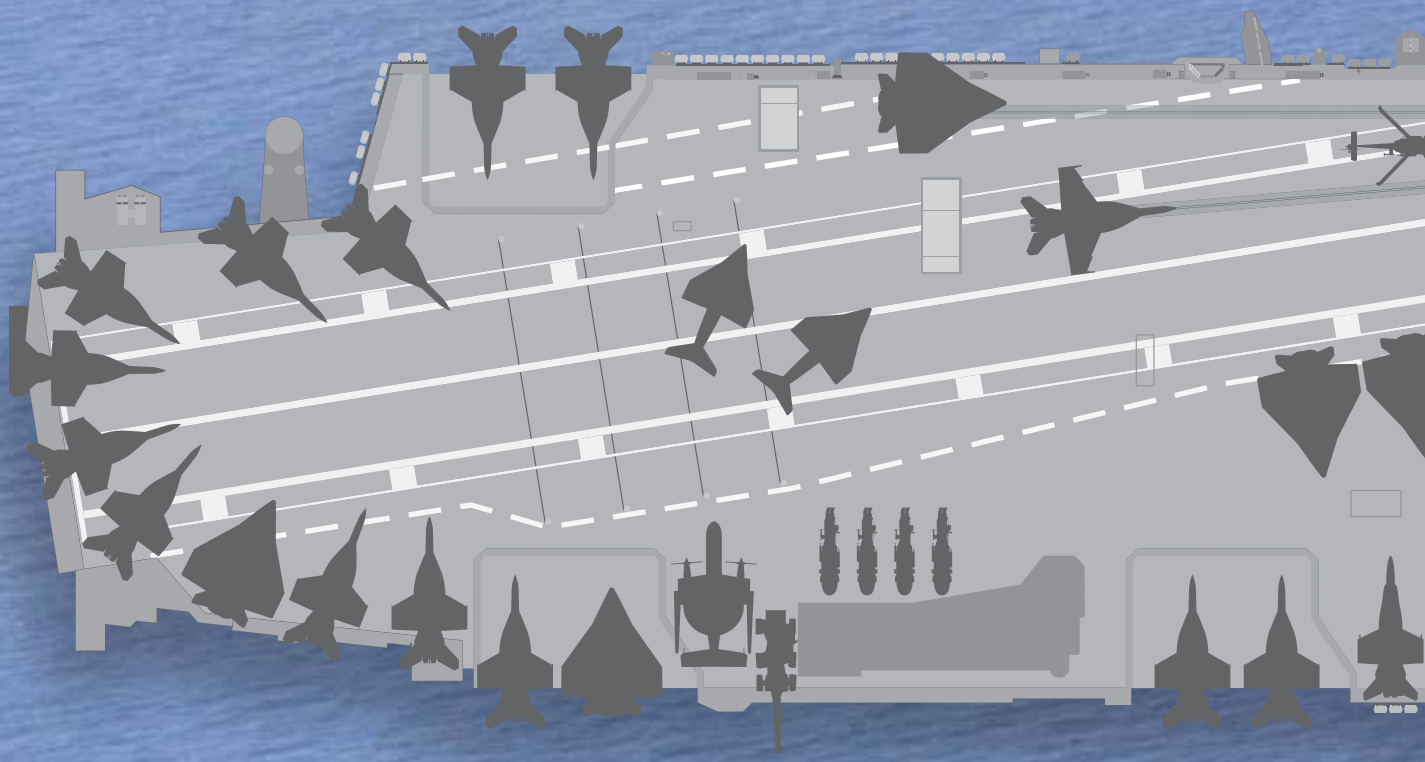
Some of the most important improvements in the CVN 21 series relate to power generation. The improved reactor and zonal electric distribution system increase electric power generation capacity by 300% over the *NIMITZ* design. The electrification of the CVN 21 class enables transformational systems such as the Electro-Magnetic Aircraft Launch System (EMALS). The new carriers will also include an advanced arresting gear system, a redesigned hull, and a more efficient flight deck. These changes will further reduce supercarriers' costly manning requirements, to about 60% of the crew complement of a *NIMITZ*-class carrier.

Significant research and development effort still remains to obtain required capabilities for flight operations and survivability, thus ensuring that this futuristic warship takes full advantage of cutting-edge technologies coming available between now and Fleet introduction.

Often described as four and one-half acres of sovereign U.S. territory, the aircraft carrier has repeatedly proven its worth in carrying out national policy around the globe. From the Battle of Midway to combat operations in Afghanistan and Iraq, the carriers have repeatedly been first on the scene and consistently ready to fight upon arrival. The carriers have remained relevant and effective thanks to their increasing sophistication and that of their embarked air wings. Advanced CVN 21 carriers, armed with aircraft such as the *Super Hornet*, Joint Strike Fighter, and Unmanned Combat Air Vehicles, will continue to maintain the United States' primacy of the seas into the foreseeable future.

Future Air Wings

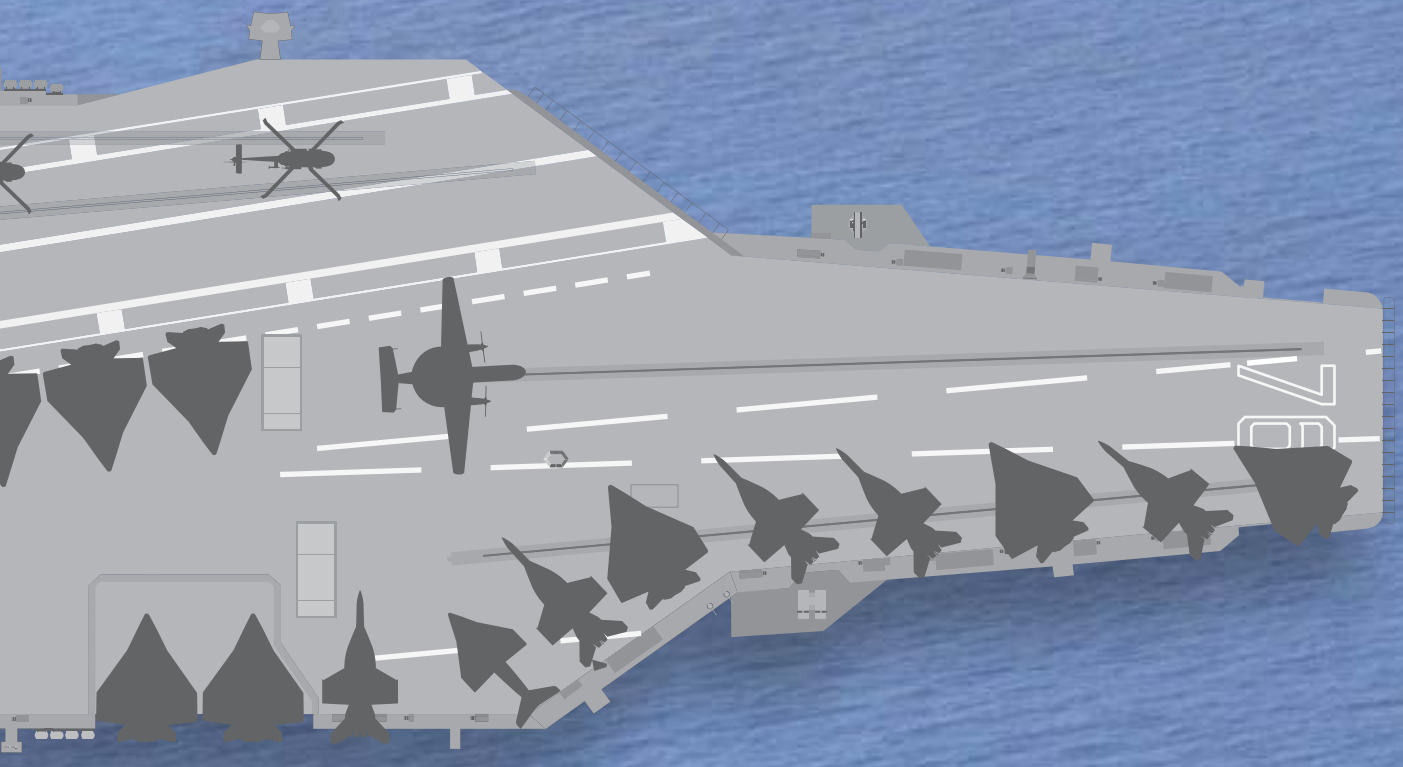
As we anticipate the era 2020-2025, we foresee that the next-generation aircraft carriers will require next-generation air wings. This will require aircraft whose technological evolution matches that of the CVN 21 carriers. By mid-century, the aircraft carrier and its air wing will be operating in a type of network centric environment that we can only begin to imagine today.



We expect the types and numbers of the platforms in the notional air wing of the future to comprise:

- 44-50 strike fighters (F/A-18, JSF)
- 12 Unmanned Combat Air Vehicles, Navy (UCAV-N)
  - Intelligence, Surveillance, and Reconnaissance (ISR)
  - Strike/Suppression of Enemy Air Defenses (SEAD)
- 4-6 next-generation Airborne Electronic Aircraft (AEA)
- 4-6 E-2C *Advanced Hawkeye* aircraft
- 10 MH-60R/S helicopters

Additionally, two C-2A Carrier Onboard Delivery aircraft will support the air wing and approximately 12 MH-60R/S helicopters will be deployed on other ships of the Carrier Strike Group. Working together, the CVN 21 carrier and its next-generation air wing will be a dominant force in the world of tomorrow—no matter what or where the threat may be.



Networks and Systems

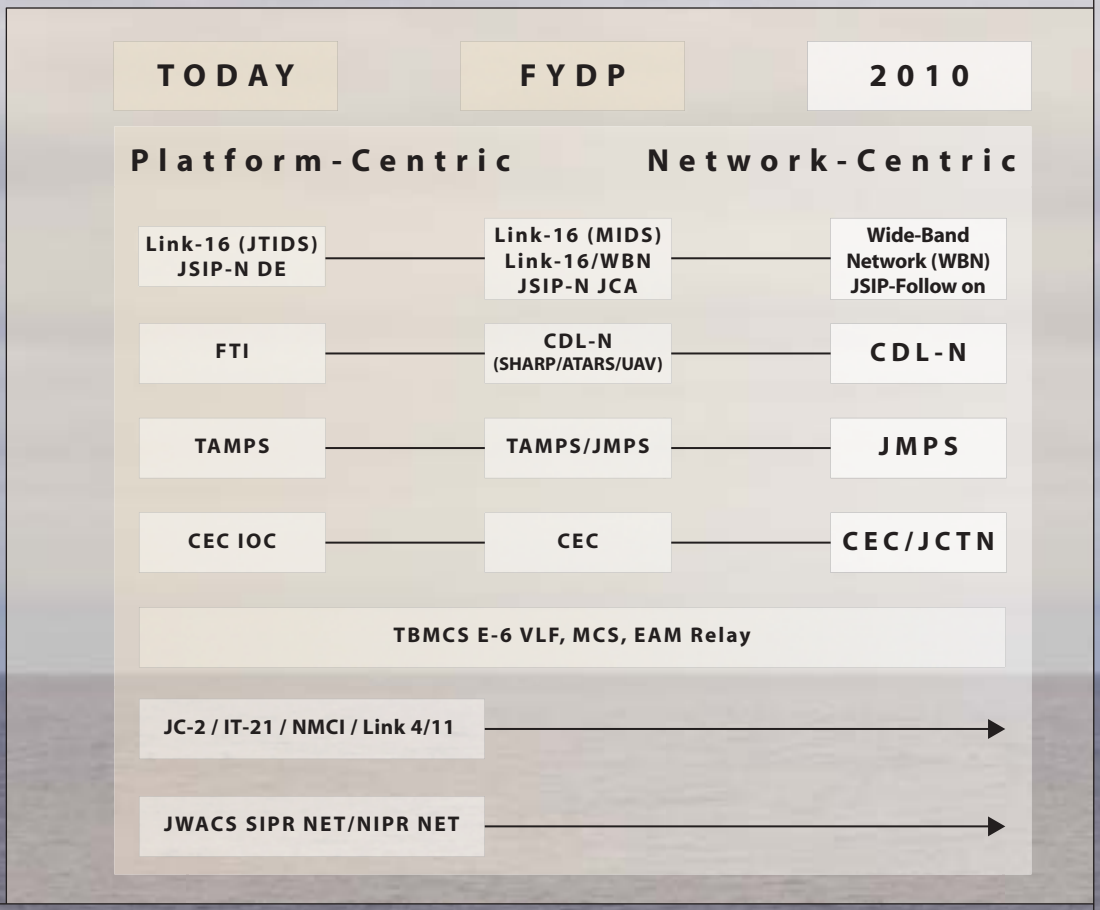
Networks and systems designed to be interoperable with Joint forces will be fundamental to FORCEnet and battlespace dominance. These systems will lead to greater combat power through fusion of critical sensor images, signals, and data; and through timely distribution of processed information to warfighters.

The chart and associated paragraphs below describe how the Navy will transform the numerous planning and data-link systems that will contribute to FORCEnet.

The Joint Service Imagery Processing System (JSIPS) & JSIPS-N (Navy) will be installed on all aircraft carriers, amphibious assault ships, and command ships. The system is a ship- and shore-based processing facility that receives and exploits various types of imagery from national and tactical reconnaissance programs. Data include transmissions from infrared, electro-optical, and synthetic aperture radar (SAR).

The Navy version, JSIPS-N, provides near-real-time imagery in support of Fleet and CVN battle-group intelligence and strike-mission planning. It also supports primary exploitation and dissemination of intelligence from tactical organic and theater imagery.

The Common Data Link-Navy (CDL-N) will be installed in aircraft carriers, amphibious warships and amphibious command ships. The surface-mounted terminal receives signal and imagery intelligence data from remote sensors. It transmits link and sensor control data to airborne ISR platforms.



The CDL-N system also links airborne ISR sensors and the shipboard processors of the JSIPS-N and the Battle Group Passive Horizon Extension System-Surface Terminal. The transmission takes place via an airborne CDL terminal to airborne sensor systems. The F/A-18E/F will use the CDL-N to transmit tactical imagery from its onboard SHAred Reconnaissance Pod (SHARP) system.

Naval Mission Planning Systems (NavMPS) is a suite of applications that will benefit from and contribute to persistent ISR, as it helps personnel to plan and execute tactical air operations. The suite includes the Tactical Automated Mission Planning System (TAMPS), the Navy Portable Flight Planning Software (N–PFPS), and the Joint Mission Planning System (JMPS).

These systems and follow-on integrations offer important new features that extend the Navy's ability to plan and execute TACAIR operations. Aircrew will be able to plan and fly their missions using navigational databases, certified aircraft-fuel performance, and charts from the National Imagery and Mapping Agency (NIMA). The systems also enable the planning and use of precision weapons such as SLAM, JSOW and JDAM. Other features include the ability to plan at force level. Users will be able to parse and deconflict multiple aircraft. JMPS will also clarify to the common operational picture (COP) by means of JC2 interoperability.

The Navy's Cooperative Engagement Capability (CEC) system has significantly improved the CVN battle groups' air defense against the most sophisticated aerial threats. This system integrates the sensor data of each cooperating ship and aircraft into a single composite track picture—one of real-time, fire-control quality.

CEC extends to well beyond the radar horizon the range at which a ship can engage hostile missiles and aircraft. It does this by simultaneously distributing, to each ship within a battle group, the sensor data on airborne threats. Battle groups thereby greatly improve their ability to defend themselves, as well as their ability to provide area and local defense. When used in conjunction with the FORCEnet architecture, CEC will improve targeting against enemy air and land threats, as well as against time critical targets. The Networks and Systems Roadmap shows the Navy's intended transformation for CEC and other airborne systems.

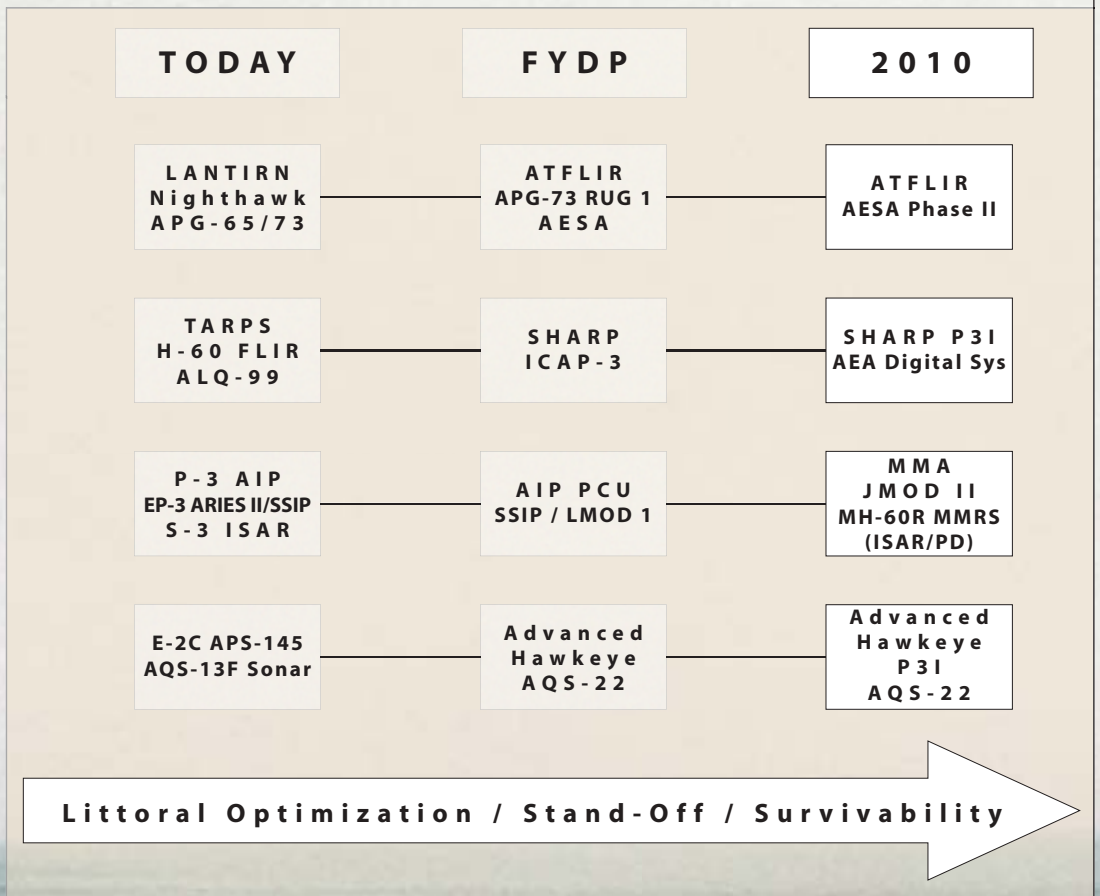
Sensors

Sophisticated sensors, mounted on platforms operating in all dimensions of the battlespace, will be the eyes and ears of the Fleet. The linked sensors aboard highly survivable and flexible platforms will provide the Navy with the knowledge dominance to exploit fully the capabilities addressed in Sea Strike and Sea Shield.

The following chart shows Naval Aviation's roadmap for transforming its sensor systems. The paragraphs immediately below briefly discuss selected systems.

The Advanced Targeting Forward-Looking Infrared Radar (ATFLIR) is an infrared autonomous precision-targeting system to be incorporated into the F/A-18E/F *Super Hornet*. It will permit that aircraft to acquire, recognize, and track targets with coordinates sufficiently accurate for use with the Global Positioning System. ATFLIR replaces the Targeting FLIR, Navigation FLIR, and laser designator tracker pods with a single pod. This new pod, far superior in target recognition and image magnification, frees up an additional weapons station and significantly increases standoff range. The system can detect, classify, and track air-to-air and air-to-surface targets in daylight or nighttime operations. The advanced architecture and solid-state electronics will make ATFLIR far more reliable than its predecessors, as well as easier to maintain and repair.

The F/A-18E/F's Active Electronically Scanned Array (AESA) program increases air-to-air performance in addition to providing other functions in Electronic Warfare. Phase I will enhance air-to-air performance in a hostile electronic countermeasures environment as well as in air-to-ground targeting. Phase II will significantly improve



electronic warfare functions such as target-hostile emitters, as well as aircraft electronic protect and electronic attack functions. Both phases allow air-to-ground autonomous targeting at standoff ranges.

The Navy plans to upgrade AESA to include reconnaissance features, through the use of synthetic aperture radar (SAR) technology as well as improved hardware and software.

The proposed SHAred Reconnaissance Pod (SHARP) will increase the Carrier Strike Group's ability to conduct tactical air reconnaissance. This organic system, installed on the centerline of the F/A-18E/F, operates in day/night and all-weather conditions. It will employ a suite of sensors to collect infrared, visible, and SAR digital imagery at medium and high altitudes. These advances will greatly contribute to the *Super Hornet*'s precision-strike power, to deliver weapons guided by the Global Positioning System (GPS) and digital images.

The Joint Signals Intelligence Avionics Family (JSAF) Block Modernization Program (JMOD) is a state-of-the-art "block-mod" program for the EP-3 *Aries II* aircraft. JMOD, an open-architecture system for intelligence collection and dissemination, builds on the connectivity of the Sensor System Improvement Program (SSIP).

The program is designed to refresh the Fleet's technology rapidly, through incremental upgrades completed during scheduled depot-level maintenance; it will provide the *Aries* with a system able to exploit threat emissions beyond the year 2020.

The Radar Modernization Program (RMP) on the E-2C *Advanced Hawkeye* represents a two-generation technological leap that will extend the battlespace far over the horizon. The advanced digital radar will be able to detect targets well beyond the horizon line, whether over land or over water. Integration with CEC will permit an unprecedented capacity for precision targeting.

The radar modernization also "buys back" battlespace by providing precision air surveillance and increased reaction time; thus making it critical to network centric air operations. This system, when coupled with CEC, will fully integrate the E-2C *Advanced Hawkeye* into the dual role of Theater Ballistic Missile and Cruise Missile Defense (TBMD/CMD).

In conjunction with the *Aegis* and upgraded Standard Missiles (SM-2 Block IVA and SM-3), this will allow the battle group to deploy an organic, theater-wide cruise missile and theater ballistic missile defense. Such a defense will provide an "umbrella" to protect high-priority defended areas as well as U.S. and coalition forces.

The AQS-22 Airborne Low Frequency (dipping) Sonar (ALFS) will be installed in the MH-60R Multi-Mission Helicopter. An active/passive sonar with 2500 feet of cable, ALFS quadruples the area coverage of the existing system.


BEWARE OF JET BLAST
PROPELLERS AND ROTORS

Weapons

The Navy possesses over a dozen types of strike weapons in the categories of precision guidance, defense suppression, free fall, and air-to-air. These weapons will bring the precision, lethality and standoff capability to realize the overwhelming offensive and defensive power of Sea Strike and Sea Shield.

Precision weapons will greatly increase the number of aim points per sorties and minimize collateral damage. Lethal weapons will deny sanctuary to the enemy by destroying a wide category of moving and hardened targets. Standoff weapons, released outside of point air defense zones, will silently glide to impact, thereby minimizing the vulnerability of our launching platforms to enemy air defenses yet delivering a stealthy and lethal attack.

Beyond 2010, new weapons could include technologies in high-power microwaves, directed energy, and hypersonics.

The focus of the following roadmaps is to show current and future air-to-air and air-to-ground weapons and how the Navy plans to consolidate or "neck down" its existing inventory of weapons types. Weapons used for surface and subsurface operations are not mentioned in these roadmaps.

This reduction process will substantially aid Naval Aviation by saving investment funds, reducing training requirements, and improving carrier operations. When combined with advanced technology these changes greatly increase the effectiveness of Naval air strikes and air-to-air combat.

Joint Air-to-Surface Standoff Missile (JASSM)

The Joint Air-to-Surface Standoff Missile (JASSM), the next generation of cruise missiles, ultimately replaces the SLAM-ER (expanded response) series. A powered weapon weighing 2000 pounds, JASSM has a range of over 200 miles. Features include advanced stealth characteristics, state-of-the-art mission planning, precise guidance, and the ability for lethal penetration.

The Joint Standoff Weapon (JSOW)

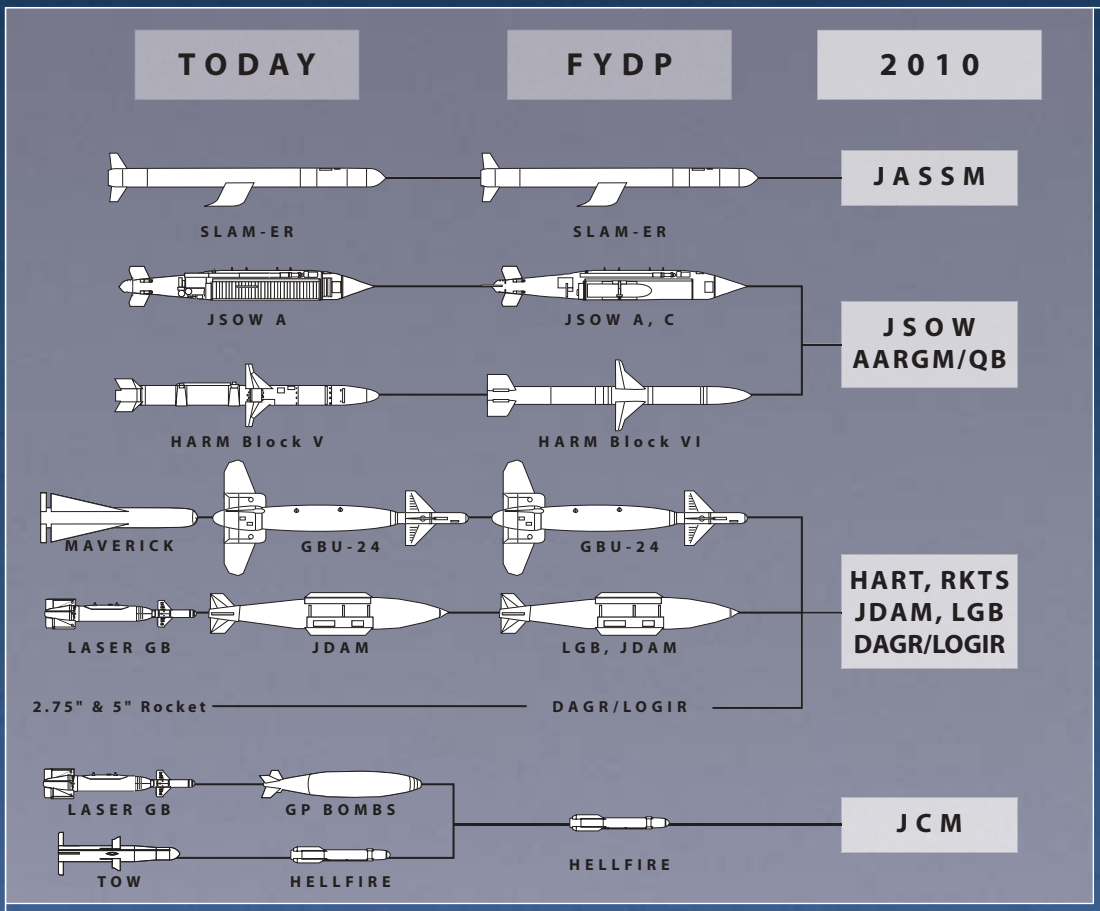
The Joint Standoff Weapon (JSOW) is a family of armaments that permit Naval aircraft to attack targets at increased standoff distances. The weapons employ both the Global Positioning System and the Inertial Navigation System (INS) to provide precision guidance. All JSOW variants share a common body but can be configured for use against area targets or for bunker penetration. Future improvements may include seekerless unitary warheads. These will be able to hit moving targets by fusing data from airborne targeting platforms. Other improvements will provide real-time intelligence prior to launch, as well as transmission of weapons impact assessment (WIA) prior to detonation.

Advanced Anti-Radiation Guided Missile/Quick Bolt (AARGM/QB)

AARGM/QB is a follow-on program to HARM. This weapon uses offboard targeting information, an advanced Anti-Radiation Homing Receiver, and a secondary GPS/INS/Active Millimeter Wave seeker to increase lethality against SAM radars that shut down. It also improves the capability for battle damage assessment (BDA). Phase II of the program provides a replacement motor which, though smaller in size, increases the missile's range and speed. This enhancement permits stealth aircraft to carry HARM internally.

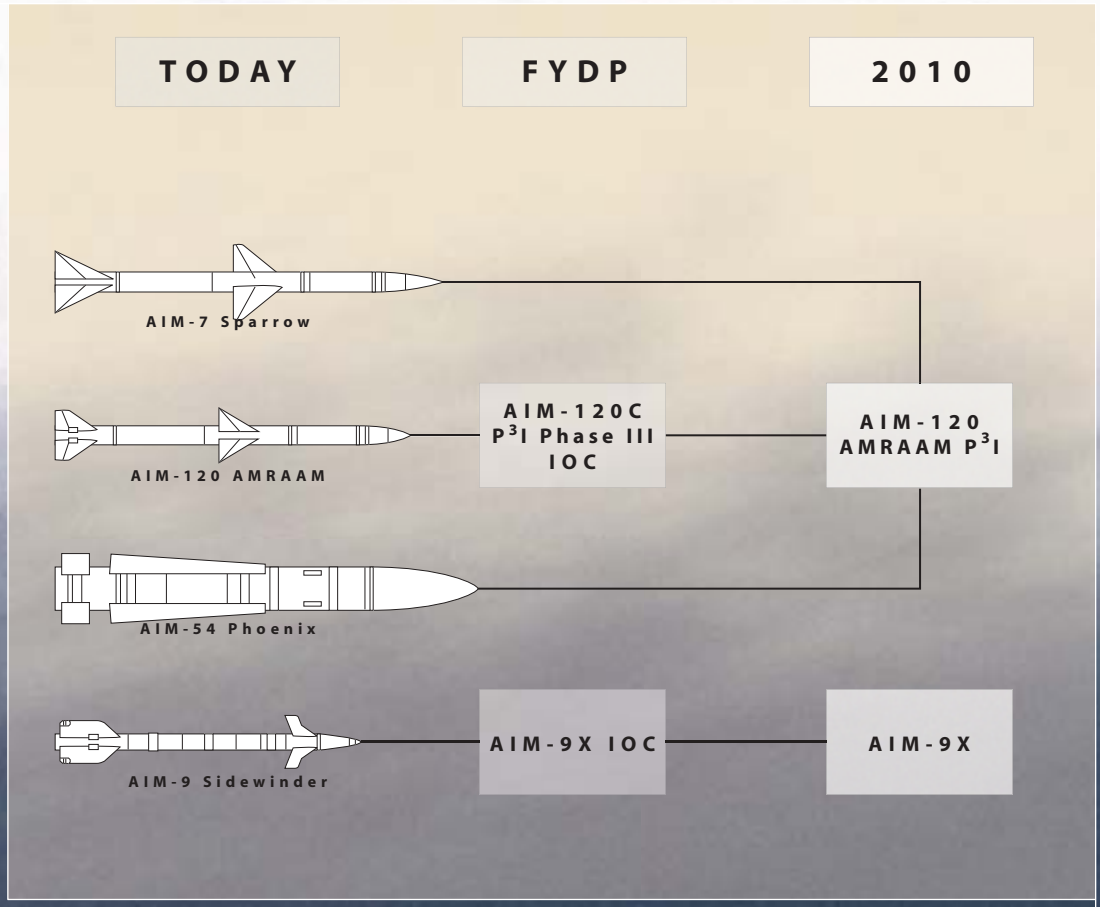
Hornet Autonomous Real-Time Targeting/Precision Guidance Kit (Joint Direct Attack Munition) - HART/PGK (JDAM)

The Joint Direct Attack Munition (JDAM) with a Precision Guidance Kit (PGK) and ATFLIR is being used as the first spiral development to the Hornet Autonomous Real-Time Targeting (HART). This system can be attached to 500-, 1000-, and 2000-pound general-purpose bombs. The Navy plans upgrades including an autonomous seeker with improved terminal guidance for reduced circular error probable (CEP).



Joint Common Missile (JCM)

JCM is the follow-on to the TOW/Maverick/Hellfire weapons, which are currently in inventory. Initial operational capability is planned for FY08. JCM will enhance Naval Aviation's effectiveness in littorals, military operations in urban terrain (MOUT), and close-air-support environments. It will be one of the prime weapons for the AH-1Z helicopter and the F/A-18E/F *Super Hornet*. JCM will provide reactive targeting to enhance prosecution of assigned threat sets.



AIM-9X Sidewinder

The AIM-9X Sidewinder is a major modification to the AIM-9M Sidewinder short-range air-to-air missile. This will provide U.S. fighters with air superiority against tomorrow's advanced threats. The program upgrades the missile with a focal-plane-array guidance-control section, a highly maneuverable airframe, and signal processors that enhance capabilities for kinematics and infrared countermeasures. The Joint Helmet Mounted Queuing System (JHMQS) provides "first look, first shoot" capability to Naval Aviators.

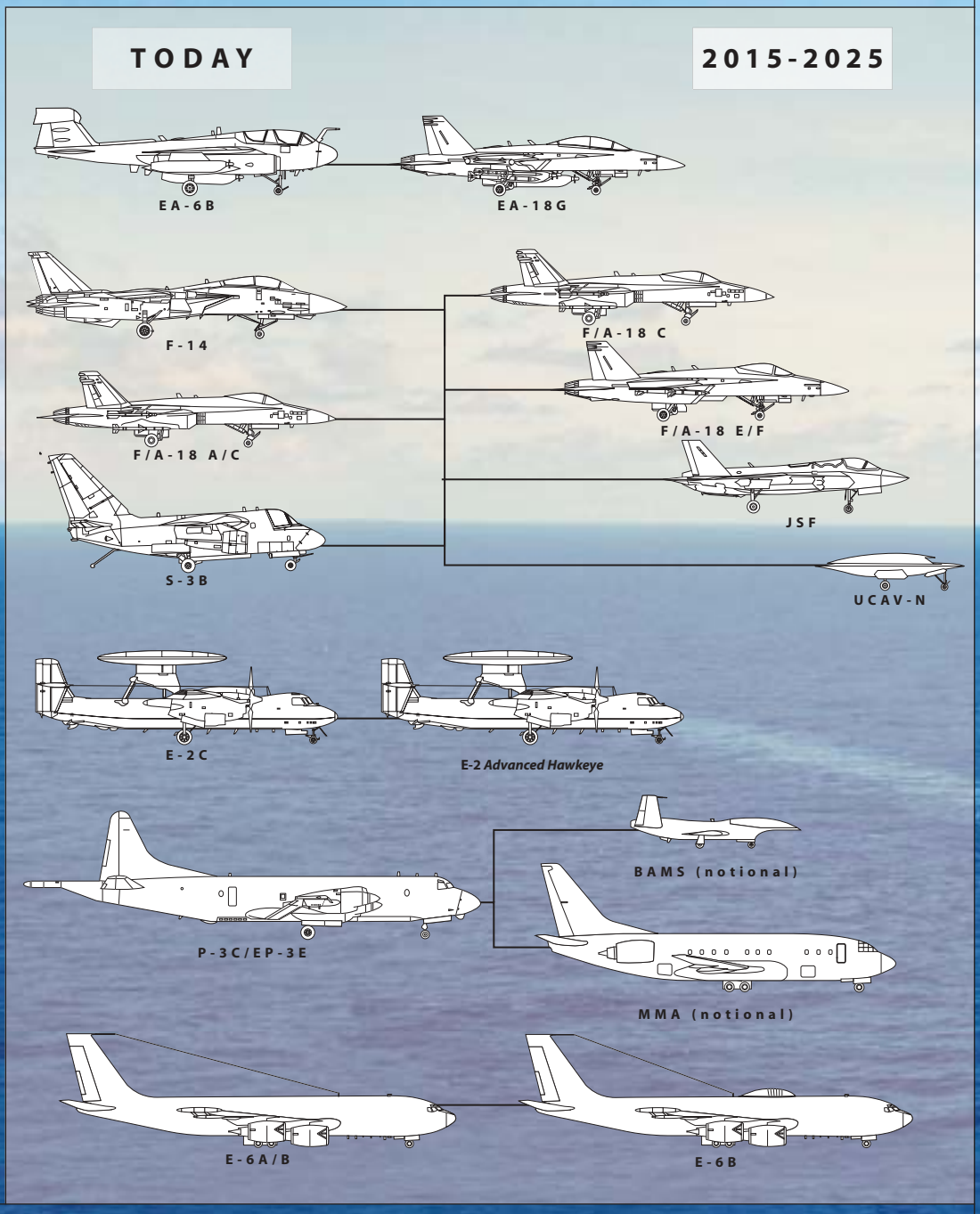
AIM-120C Advanced Medium-Range Air-to-Air Missile (AMRAAM)

The AIM-120C modernizes the AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM) program. This Pre-Planned Product Improvement Program (P3I) includes clipped wings for internal carriage, propulsion enhancements, increased warhead lethality, and enhanced electronic counter-countermeasures (ECCM).

Navy Aircraft

Multimission-capable, manned aircraft will dominate Naval Aviation's order of battle for the foreseeable future. The strike/fighter, electronic attack, command and control, maritime support, and rotary wing aircraft on our roadmap will assure the capabilities of Sea Strike, Sea Shield, and Sea Basing. This arsenal of sea-based, sophisticated aircraft will represent the leading edge of warfighting capability.

From Time Sensitive Strike to Homeland Defense, these aircraft will take the fight to the enemy anywhere on the globe. These multiroled platforms—designed with technological growth in mind—are highly flexible, survivable, affordable, effective, and interoperable.



The following roadmap and paragraphs describe Naval Aviation's transformational aircraft and also illustrates the reduction in the type/model/series to realize our Naval Aviation vision.

The roadmaps below represent an overview of key areas of significant transformational capability under Sea Power 21. They should not be considered an exhaustive list of upgrade or modernization programs.


X-35C

Strike/Fighters

Future Naval air wings will contain F/A-18s, Joint Strike Fighters (JSF), and Unmanned Combat Air Vehicles (UCAVs).

F/A-18E/F *Super Hornet*

The F/A-18E/F *Super Hornet* provides a number of critical enhancements to keep the Navy's strike fighters a lethal force well into the 21st Century. These upgrades include critical growth capability, enhanced survivability, and weapon bring-back improvement. Avionics upgrades include the Advanced Electronic Scanned Array (AESA) radar, the Advanced Targeting FLIR (ATFLIR) and the SHAred Reconnaissance Pod (SHARP) system. The *Super Hornet* will also assume the organic tanking mission of the S-3B.

Joint Strike Fighter (JSF)

The Joint Strike Fighter (JSF) Program will develop and field a tri-service family of next-generation strike fighter aircraft, emphasizing affordability and survivability. The aircraft will complement the *Super Hornet* thanks to the JSF's all-aspect stealth strike design and 700nm radius of action without refueling. The JSF will enhance the air wing's capacity and flexibility for power projection; when employed from a carrier, it will enhance the striking capability of the Joint Task Force (JTF).

Electronic Aircraft

The EA-6B has served long and well as the Joint electronic attack and suppression aircraft, but the *Prowler* is reaching the end of its service life. An analysis of alternatives for Airborne Electronic Attack was completed in December 2001. Based on this analysis, the Navy will initiate spiral development of the EA-6B Improved Capability III (ICAP III) Airborne Electronic Attack (AEA) system as part of a Joint solution to electronic attack. This technology will transfer to next-generation AEA platforms including the Navy EA-18G.

Command and Control Aircraft

The E-2C will remain the foundation of the Carrier Strike Group's airborne command and control capabilities, but will continue to harness new technologies in order to increase Naval Air's lethal striking power. We have described the E-2 *Advanced Hawkeye* (formerly the Radar Modernization Program or RMP) under the Sensors Roadmap. The E-2C is critical to network centric air operations. To achieve a seamless transition to a full Joint architecture, the Navy has designed its weapon systems to be fully interoperable with the Airborne Warning and Control System (AWACS) and ground-based systems.

Maritime Support Aircraft

The Multimission Maritime Aircraft (MMA) is projected to replace the P-3C *Orion* and EP-3E *Aries* aircraft, both of which are approaching the end of their service lives. The transformational bottom-up design of the MMA will integrate its onboard mission suite with UAV- and satellite-based systems and sensors. The platform will advance its predecessors' ASW and ISR superiority by incorporating evolving advances in networks, sensors, and communications. MMA will assure access to the battleforce across the broad littoral, thus critically advancing the Navy's ability to project power ashore.

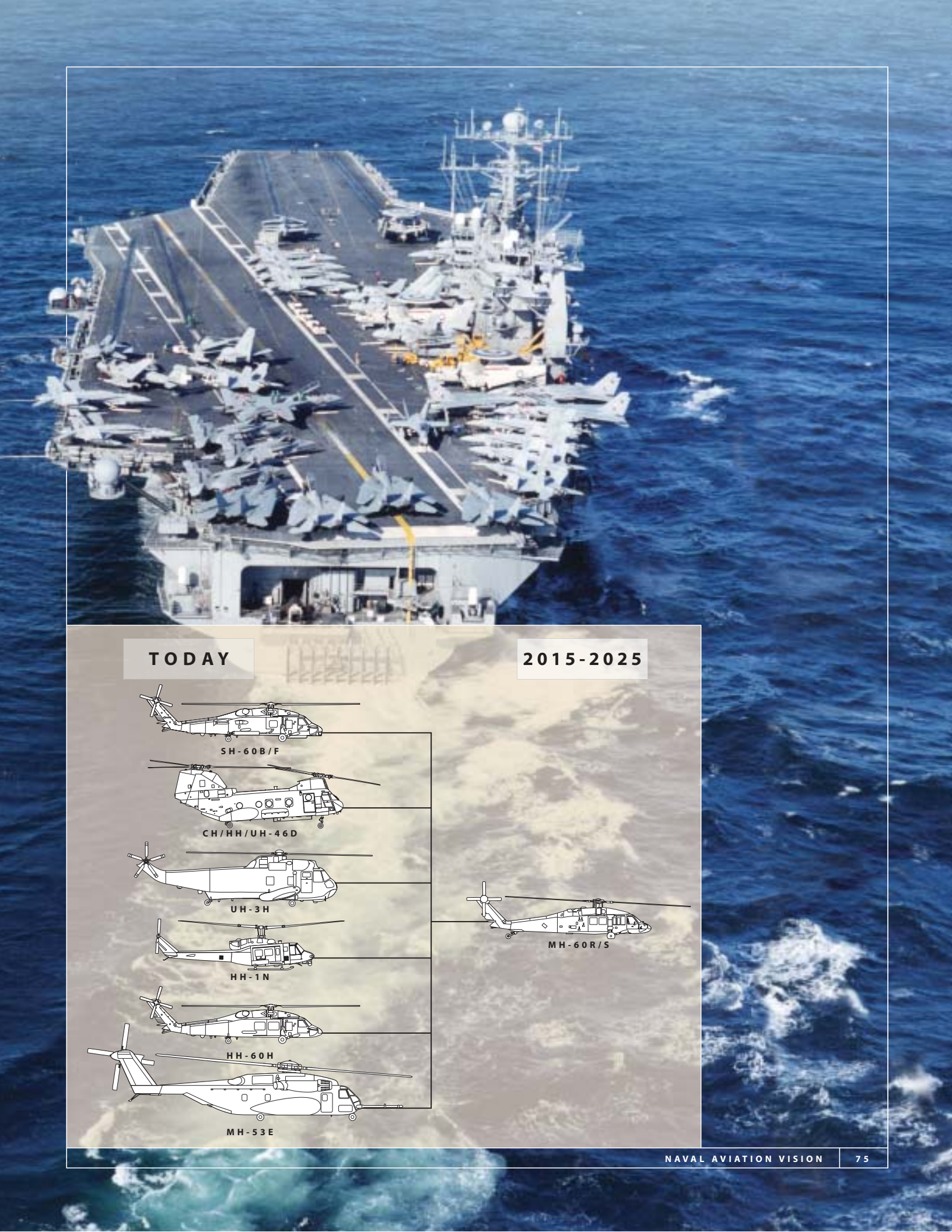
Rotary-Wing Aircraft

MH-60R (*Seahawk*) and MH-60S (*Knighthawk*) Multi-Mission Combat Helicopters

The MH-60R Multi-mission and the MH-60S Multi-mission Combat helicopters are the two pillars of the CNO's Naval Helicopter Concept of Operations for the 21st Century. Under the "Helo CONOPS," the *Seahawk* and *Knighthawk* will deploy aboard aircraft carriers as companion squadrons under the leadership of the Air Wing Commander.

The MH-60R will provide surface and subsurface warfare support to Sea Shield by means of its sensors and weapons suite—this includes Airborne Low Frequency (dipping) Sonar, Electronic Support Measures, Advanced Forward Looking Infrared, precision air-to-ground missiles, fixed forward-firing machine guns, and lightweight torpedoes. The MH-60S will partner with the MH-60R for surface warfare missions carrying the same Forward Looking Infrared and air-to-ground weaponry.

The MH-60S will have flexibility for reconfiguration, serving in Combat Search and Rescue as well as providing Naval Special Warfare support to Joint Theater operations. The platform will perform Anti-Mine Countermeasures using any one of five advanced sensor/weapons packages to provide detection, localization and neutralization to these anti-access threats. The MH-60S will anchor the Fleet logistics role in Carrier Strike Group and Amphibious Ready Group operations.
The MH-60R/S platforms possess 85% commonality to provide ease of maintenance and maximum flexibility for training.


TODAY
2015-2025
SH-60B/F
CH/HH/UH-46D
UH-3H
HH-1N
HH-60H
MH-53E
MH-60R/S

Unmanned Aerial Vehicles (UAVs)

A key transformational initiative in support of Sea Power 21, UAVs possess broad capabilities and are powerful force multipliers. They provide Battle Group Commanders with enhanced situational awareness, improved tactical and persistent ISR, and a shorter "kill chain." Strike UAVs of the future will achieve even greater penetration, stealth, and lethality. No single system can meet this challenge, so our strategy focuses on multiple solutions within a "family" concept and exploits off-the-shelf equipment. This approach will integrate UAVs into Navy, Marine, and Joint warfighting concepts of operations (CONOPS). The Tactical Control System (TCS), a Navy-led Joint program for air-vehicle control and data dissemination, will integrate UAVs into the Joint combat architecture. Naval Aviation is simultaneously executing short- and long-term plans in the following mission areas:

Tactical Surveillance and Targeting

Small UAVs will aid small-unit operations and Force Protection. Larger and more powerful systems will support missions at sea, on the littorals, and on land.

- The Dragon Eye UAV is a key part of the Marines' Interim Small Remote Scouting System, providing "over-the-hill" reconnaissance day and night. A production decision is expected in summer 2003.
- The Pioneer Improvement Program (PIP) upgrades the Marines' Pioneer UAV to ensure long-term viability out to FY10.
- The Fire Scout Vertical Take-off and Landing Tactical UAV (VTUAV) will complete engineering, manufacturing, and development (EM&D) shipboard testing in FY04. The experimental vessel HSV-X2 will serve as a surrogate for the Littoral Combat Ship (LCS). The Navy is reviewing ways to field a Tactical UAV by FY07.

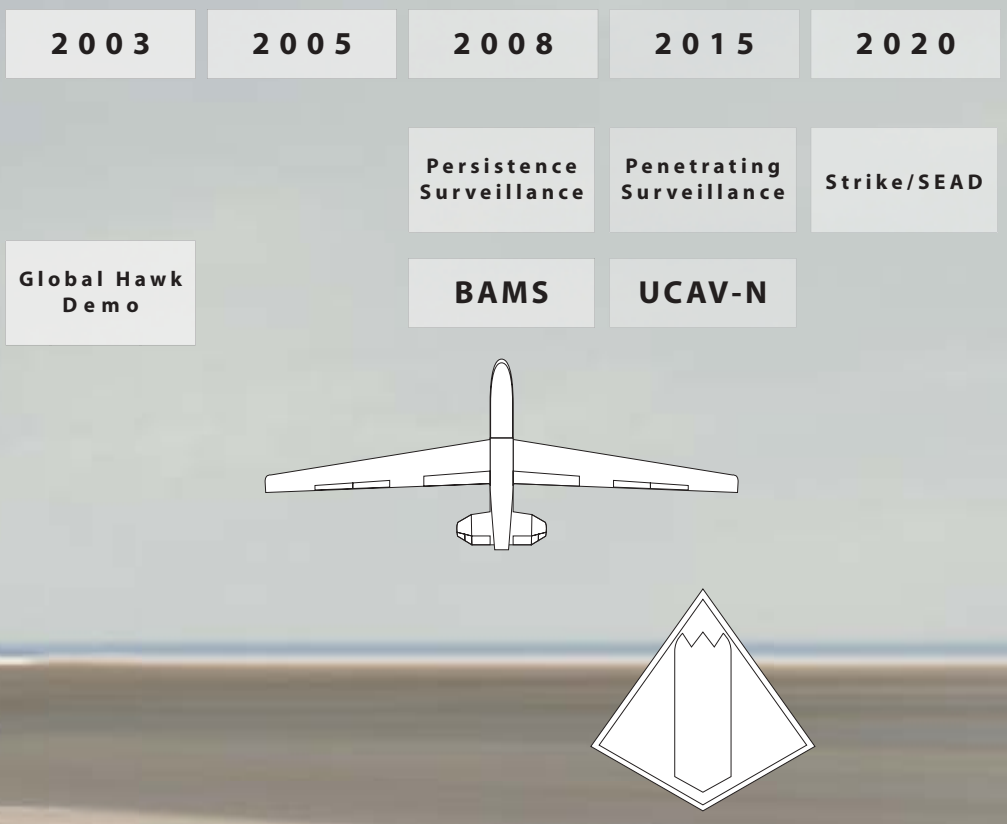
Long Dwell/Standoff ISR

The Broad Area Maritime Surveillance (BAMS) UAV will play a key role in Network Centric Operations and Sea Power 21. As a node in FORCEnet, the BAMS UAV will provide high altitude, persistent, multi-INT ISR. This capability will serve as an enabling force for the Fleet Commander.

BAMS UAV will support a spectrum of Fleet missions, serving as a distributed ISR node in the overall Naval environment. Missions might include ISR queuing, strike support, Signals Intelligence (SIGINT), and communications relay. The platform will be the Fleet Commander's "low hanging satellite," a hub for information collection. The UAV will operate independently or collaborate directly with other manned, unmanned, and space-based platforms.

Penetrating Surveillance/SEAD/Strike

Naval Aviation has begun work on the Unmanned Combat Air Vehicle-Navy (UCAV-N). This will be a carrier-based, multi-mission aircraft able to perform surveillance/reconnaissance, strike, and Suppression of Enemy Air Defenses (SEAD) missions against the most heavily defended targets. UCAV-N will provide the targeting and Battle Damage Assessment (BDA) to complement the Navy's long-range standoff weapons. The Navy and the Air Force are currently planning to establish a Joint UCAV program.



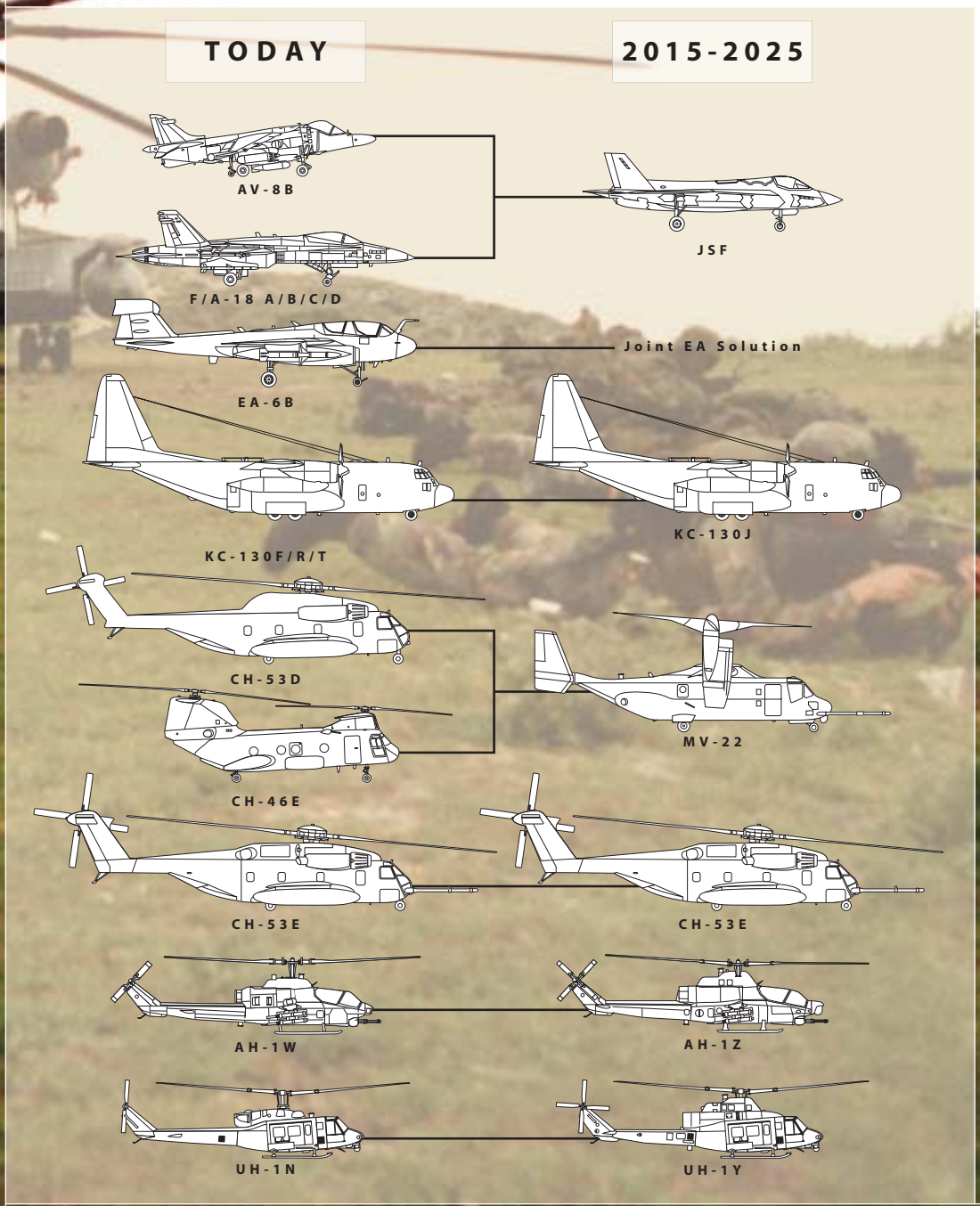
Marine Corps Aircraft

The following roadmap and descriptions illustrate how the Marine Corps is changing and downsizing its aviation fleet in order to transform its force. They should not be considered an exhaustive list of upgrade or modernization programs.

Tactical Aircraft (TACAIR)

Navy/Marine TACAIR Integration will provide increased efficiency and warfighting effectiveness in future operations through better use of resources.

The Marine Corps plans to replace its tactical AV-8B and F/A-18A/C/D aircraft with the Joint Strike Fighter's Short Takeoff/Vertical Landing (STOVL) variant. This move is fundamental to transforming TACAIR in the Corps. STOVL JSF truly represents "leap-ahead technology." By combining the F/A-18's multi-role attributes with the AV-8B's basing flexibility, the USMC will gain a low-signature, state-of-the-art aircraft. STOVL JSF will play a role in all six functions of Marine aviation, while having the ability to operate from twice as many Naval platforms and five times as many runways as conventional aircraft. The JSF will reduce the logistical "footprint" by over 50% relative to the F/A-18 and the AV-8, while dramatically reducing deployment time and lift requirements. The Marines' Airborne Electronic Attack aircraft has not yet been determined, but may be an electronic version of JSF.


TODAY
2015-2025
AV-8B
F/A-18 A/B/C/D
JSF
Joint EA Solution
EA-6B
KC-130F/R/T
KC-130J
CH-53D
CH-46E
MV-22
CH-53E
CH-53E
AH-1W
AH-1Z
UH-1N
UH-1Y

Assault Support Aircraft

The MV-22 *Osprey* is a tilt-rotor Vertical/Short Take-Off or Landing (V/STOL) aircraft designed as the medium-lift replacement for the Vietnam-era CH-46 and CH-53D helicopters. The *Osprey* can operate either as a helicopter or a turboprop aircraft, and incorporates advances in composite materials, airfoil design, fly-by-wire controls, and digital avionics. The MV-22 is overwhelmingly superior to the CH-46 it replaces—possessing twice the speed, five times the range, and three times the payload.

The KC-130J *Hercules* is a multirole, multimission tactical tanker and transport aircraft, well suited to the mission needs of the forward-deployed Marine Air-Ground Task Force. As the replacement for the KC-130F/R, the J-model will provide increased speed and range, an improved refueling system, night systems, and increased survivability.

The H-1 upgrade program involves conversion of both the AH-1W and the UH-1N from a two-bladed rotor system to a four-bladed system. The aircraft have also received new designations: AH-1Z and UH-1Y, respectively. The Navy intends the upgrade program to resolve existing safety issues, significantly enhance combat capability, zero airframe time, and achieve 85% commonality between aircraft. Major modifications include a new rotor system, new composite main and tail rotors, an upgraded drive system, and structural modifications to pylons.

Summary

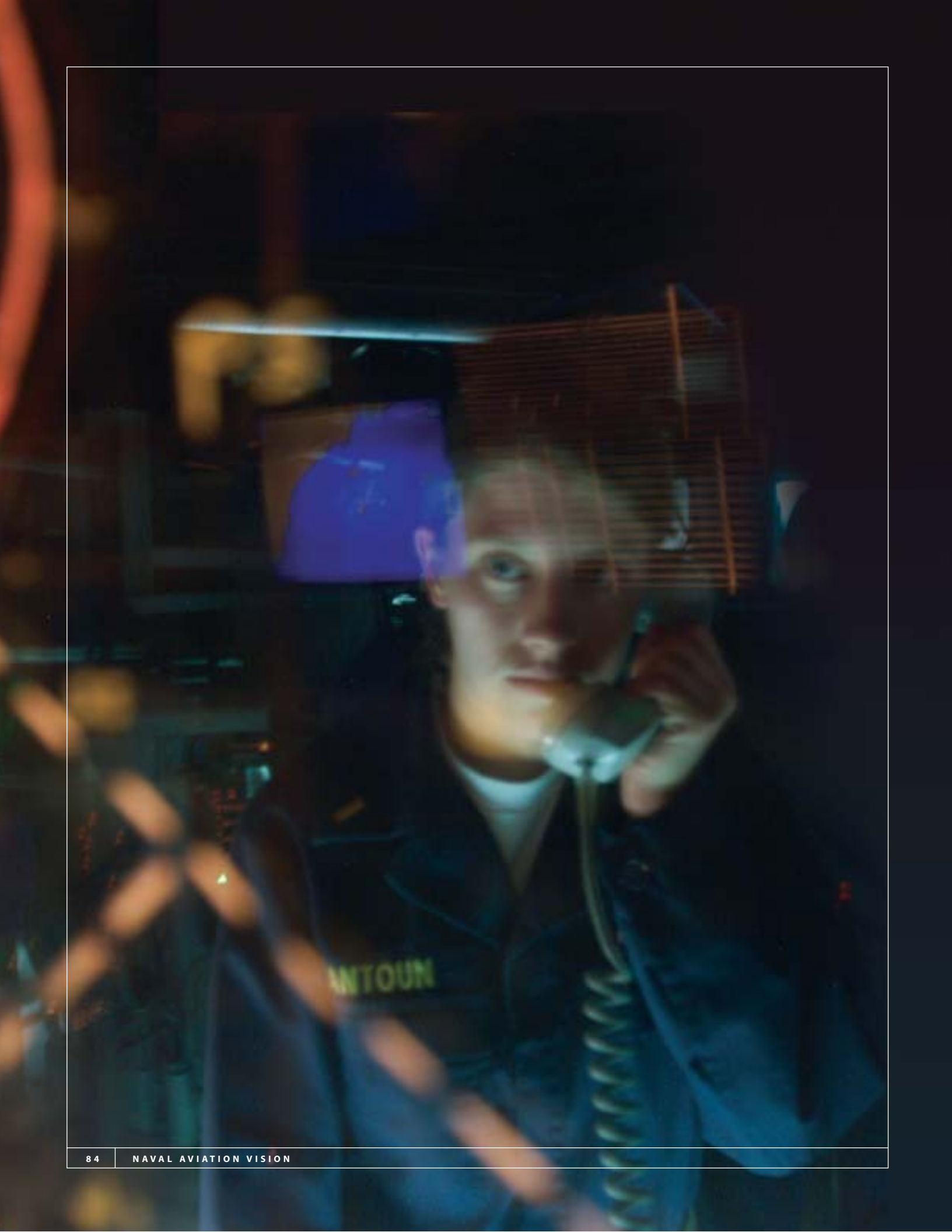
Naval Aviation is and will remain a potent and ready force. Over the last century, it has offered our leaders additional options for immediate response to international crises. We are confident that it will continue to fill this role well into the future. Should deterrence fail, the Navy and its aviation arm assure access for the Joint Force as they enter the conflict.

The Naval Aviation roadmaps noted within this document will support the Navy's overall transformation. These changes will better enable the Navy to project its own power onto the littoral battlefield, as well as ensure other Joint Forces' sustained access.

This transformation will also further similar initiatives within our sister services: the Navy's ability to project offensive and defensive power ashore will aid the Army and the Air Force's efforts to become lighter and more expeditionary, less dependent upon overseas bases.

Whatever crises may face our nation in the 21st Century, we are confident that the President of the United States—as well as nervous enemy leaders—will continue to ask the age-old question, "Where are the carriers?!" Naval Aviation's vision is that the answer will always be: "On station and ready for action!"

The Navy will soon follow this Vision statement with a comprehensive Naval Aviation Investment Plan. This plan will address the force level investment to meet its military requirements today and well into the future. The development team includes the Naval Aviation Strategic Partnership; the Commander of Naval Air Forces (CNAF); the Director, Air Warfare Division (N78); and the Commander, Naval Air Systems Command (NAVAIR).



Appendix A:

Acronyms and Abbreviations

AARGM	Advanced Anti-Radiation Guided Missile
ACTD	Advanced Concept Technology Demonstration
AEA	Airborne Electronic Attack aircraft
AESA	Active Electronically Scanned Array
AIP	Anti-Surface Warfare Improvement Program
ALFS	Advanced Low Frequency (dipping) Sonar
ARG	Amphibious Ready Group
ASW	Anti-submarine warfare
ASUW	Anti-surface warfare
AMRAAM	Advanced Medium-Range Air-to-Air Missile
ATARS	Advanced Tactical Airborne Reconnaissance System
ATDLS	Advanced Tactical Data Links Systems
ATFLIR	Advanced Targeting Forward Looking Infrared Radar
ATRB	Advanced Technology Review Board
AWACS	Airborne Warning and Control System
BAMS	Broad Area Maritime Surveillance aircraft
BDA	Battle Damage Assessment
BIC	Business Initiatives Council (part of Dept. of Defense)
BMD	Ballistic Missile Defense
C4I	Command, control, communications, computers, and intelligence
CDL-N	Common Data Link-Navy
CEC	Cooperative Engagement Capability
CFFC	Commander, United States Fleet Forces Command
COMLANTFLT	Commander, United States Atlantic Fleet
CMD	Cruise Missile Defense
CNAF	Commander, Naval Air Forces
CND/CNA	Computer network defense and attack
CNO	Chief of Naval Operations
COE	Common operating environment
COP	Common operating picture
CSG	Carrier Strike Group
CVN	Designation for nuclear-powered aircraft carrier
CVN 21	Designation for Next-Generation Aircraft Carrier
DARPA	Defense Advanced Research Projects Agency
DCGS-N	Distributive Common Ground Station-Navy
DOD	Department of Defense
EM&D	Engineering, Manufacturing & Development
EMALS	Electro-Magnetic Aircraft Launch System
ESG	Expeditionary Sensor Grid; Expeditionary Strike Group
EW	Electronic warfare
FBE	Fleet Battle Experiment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FLIR	Forward Looking Infrared Radar
FNC	Future Naval Capabilities
GCCS-M	Global Command and Control System-Maritime
GPS	Global Positioning System
HART/PGK (JDAM)	Hornet Autonomous Real-Time Targeting/Precision Guidance Kit, HART/PGK (JDAM) (formerly the Precision Joint Direct Attack Munition)
ICAP III	Improved Capability III (for the EA-6B's AEA system)
IO	Information operations
IOC	Initial operational capability
INS	Inertial Navigation System
IPB	Intelligence preparation of the battlespace
ISAR	Inverse Synthetic Aperture Radar
ISR	Intelligence, Surveillance, and Reconnaissance
IT21	Information Technology for the 21st Century concept
IW	Information warfare
JAASSM	Joint Advanced Air-to-Surface Standoff Missile
JASSM	Joint Air-to-Surface Standoff Missile
JC2	Joint Command and Control (formerly Global Command and Control System-Maritime, GCCS-M)
JCM	Joint Common Missile
JDAM	Joint Direct Attack Munition
JF	Joint Force
JMOD	Joint Airborne SIGNINT Architecture Modernization
JMPS	Joint Mission Planning System
JSF	Joint Strike Fighter
JSIPS-N	Joint Service Imagery Processing System-Navy
JSOW	Joint Standoff Weapons System
LANTIRN	Low-Altitude Navigation and Targeting Infrared at Night
LCS	Littoral Combat Ship
LGB	Laser-guided bomb
MAGIS	Marine Air-Ground Intelligence System
MAGTF	Marine Air Ground Task Force
MCM	Mine countermeasures
MCP	Mission Capability Package
MIDS-LVT	Multifunctional Information Distribution System-Low Volume Terminal
MMA	Multimission Maritime Aircraft
NAVAIR	Naval Air Systems Command
N-PFPS	Navy Portable Flight Software
NavMPS	Naval Mission Planning Systems
N78	Air Warfare Division, Office of the Chief of Naval Operations
NAWC	Naval Air Warfare Center
NAWCTSD	Naval Air Warfare Center Training Systems Division (part of the Naval Air Systems Command)
NCO	Network Centric Operations; Net Centric Operations
JFN	Joint Fires Network
NIMA	National Imagery and Mapping Agency
NMPC	Naval Military Personnel Command
NMCI	Navy-Marine Corps Intranet
NWDC	Navy Warfare Development Command
O&S	Operations and support

ONR	Office of Naval Research
OPTEMPO	Operational tempo
PJDAM	Precision Joint Direct Attack Munition (now the Hornet Autonomous Real-Time Targeting/Precision Guidance Kit, HART/PGK (JDAM))
Project SAIL	Sailor Advocacy Through Interactive Leadership
PSYOP	Psychological operations
QDR	Quadrennial Defense Review
R&D	Research and development
RMP	Radar Modernization Plan
S&T	Science and technology
SAM	Surface-to-air (missiles)
SAR	Synthetic Aperture Radar
SEAD	Suppression of enemy air defenses
SHARP	SHAred Reconnaissance Pod
SIAP	Single Integrated Air Picture
SIGINT	Signals Intelligence
SLOC	Sea Lanes of Communication
SSIP	Sensor System Improvement Program

STOM	Ship to Objective Maneuver
STOVL	Short Takeoff / Vertical Landing
TACAIR	Tactical aircraft
TAMD	Theater Air and Missile Defense
TAMPS	Tactical Automated Mission Planning System
Task Force EXCEL	Excellence Through Our Commitment to Education and Learning
TBMD	Theater Ballistic Missile Defense
TCS	Tactical Control System
TCT	Time Critical Targeting
TDLJMS	Tactical Data Link Joint Message Standard
TES-N	Tactical Exploitation System-Navy
UAV	Unmanned aerial vehicle
UCAV	Unmanned combat air vehicle
UCAV-N	Unmanned Combat Air Vehicle-Navy
USAF	United States Air Force
USMC	United States Marine Corps
USN	United States Navy
V/STOL	Vertical/Short Takeoff or Landing

Appendix B:

Image Credits

Cover Design by Ken Collins, Cover Painting by Chris Jantsch: "Naval Aviation's Future" is an atmosphere of clear skies with some high clouds to add dimension and calm seas. The right (front cover) shows a conceptual CVN-21 with E-2 *Advanced Hawkeye*, EA-18G, and JSF on the flight deck, one JSF taking off, and one F/A-18F on approach; three F/A-18E fly overhead and one MH-60S stands off to port. The left (back cover) shows an LHA with UH-1Y and AH-1Z on deck and three CH-53E approaching a coast, while three MV-22, two JSF, a P-3C, and a BAMS UAV fly overhead.

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iii	000414-N-7750C-004	At sea aboard *USS DWIGHT D. EISENHOWER* (CVN 69), April 14, 2000–U.S. Navy Photo by Photographer's Mate 3rd Class David E. Carter II
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	Superimposed photo	NAVAIR Atlantic Ranges, unrecorded date–U.S. Navy Photo by Randy Hepp. Image retouched by Chris Jantsch
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