
NETTING
THE NAVY

NAVAL NETWORK WORKING GROUP CO-CHAIRMEN

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FORWARD: WHY NETWORKS MATTER

If there is one lesson all Americans should have learned from the strategic surprises of the last few years, it is that military preparedness never goes out of style. We may not be able to predict precisely what future security challenges will face us, but we can certainly see the consequences of not being ready. That is why I have joined with a bipartisan group of colleagues to form a congressional working group focusing on Navy networks.

What makes robust, resilient networks essential to the future effectiveness of our fighting force is their ability to unify a scattered and diverse defense community in pursuit of shared goals. Although the United States outspends other countries in its military investments, our ambitious agenda for promoting global peace, freedom and prosperity often results in the force being stretched thin. Flexible, high-capacity networks enable America to use all the tools in its military arsenal to maximum effect, conserving both money and lives.

No one knows this better than the U.S. Navy. Throughout its history, the Navy has been the forward edge of U.S. military power, continuously guarding national interests many thousands of miles distant from our homeland. It should not surprise us that the service most frequently deployed to the far corners of the earth should be the first to grasp the force-multiplying potential of networks. Today, the Navy vision of what networks can provide is embodied in a powerful concept called Forcenet (FORCEnet in naval parlance).

Forcenet envisions a web of unbreakable, agile links integrating every element of our joint force in pursuit of common purposes. From the seabed to geosynchronous orbit, this wireless grid will assure that each sailor and marine knows continuously where friends and enemies are, what they are doing, and how best to respond. By fusing together all the sensors and weapons systems at our disposal, Forcenet enables us to cut through the fog of war, and see clearly the steps we must take to prevail.

No military force in history has enjoyed such insight and agility. But making sure that our own force has that power requires us to identify and support the programs most critical to realizing the Navy's networking vision — programs like the Joint Tactical Radio System, the E-2D carrier-based surveillance plane, and the Littoral Combat Ship. In the pages that follow you will see these and other programs described not in isolation, but in terms of the shared contribution they make to our collective security. This is a message that needs to be heard, and I am proud to do my part in telling the story.

Congressman Steve Israel, New York

The sensors and other combat systems of Aegis destroyers have been continuously upgraded to assimilate new technologies and cope with emerging threats. Networking will enable the entire joint force to exploit target tracks generated by the Aegis radar.

GENESIS OF AN IDEA

In the closing years of the last millennium, America's military faced an uncertain future. For the first time in generations, the nation faced no peer competitor overseas. Threats existed, but they seemed minor compared with what had come before. New information technologies were transforming commerce and culture, while Cold War barriers to global economic integration had largely disappeared. The world was changing in ways that made future military needs unclear.

Determined to remain relevant in this emerging world, the leaders of the U.S. Navy decided to remake their service around three goals. First, the Navy would abandon its traditional fixation on the open sea and seek to shape military developments ashore more directly. Second, rather than jealously guarding its autonomy as in the past, the Navy would strive to cooperate more closely with the other components of the joint force. And third, the Navy would try to lead the military in assimilating the benefits of the information revolution.

The latter goal turned out to be an enabler of the other two. When the Navy began exploring the military implications of the information revolution in the early 1990's, senior leaders gradually realized that new technologies had the potential to completely transform warfare. The service launched a program called Copernicus to exploit those technologies, and later invented the concept of "network-centric warfare" at a time when thinking in other services about the future was far less focused.

As the third millennium began, Navy thinking converged with that of policymakers committed to transforming the joint force. Convinced that the nation's military posture was mired in dated, industrial-age concepts, a new crop of senior civilians at the Pentagon urged the services to embrace the potential of emerging technologies. They appropriated the Navy's nascent ideas about networked warfare, and made those ideas a standard for the entire military establishment.

Although few planners foresaw the challenges that the new millennium soon thrust upon America's military, combat in Afghanistan and Iraq did not call into question the basic precepts of network-centric warfare. In fact, it highlighted the promise of the new doctrine, and revealed areas where technological and tactical progress was most needed. Today, the importance of building a netcentric force is acknowledged throughout the defense community, and the Navy continues to lead the nation in defining what that means.

The carrier-based E-2 Hawkeye surveillance plane is being modernized with a more agile, sensitive radar, versatile communications links and other digital enhancements. When the advanced "D" configuration debuts early in the next decade, it will play a pivotal role in networked warfare.

THE NAVY'S VISION

The Navy's vision of what networks can deliver is captured in a concept called Forcenet ("FORCEnet" in service parlance) that first received public exposition in 2002. In a speech at the Naval War College, former Chief of Naval Operations Adm. Vern Clark set forth a concise explanation of the Navy's role in the post 9-11 world organized around three overarching missions: Sea Strike, Sea Shield and Sea Basing. Sea Strike was defined as the ability to project "dominant and decisive offensive power." Sea Shield was defined as the ability to project defensive power. Sea Basing was defined as the ability to project sovereignty — in other words, to provide logistics to the joint force in the absence of land bases.

Underpinning all three of these missions was a resilient web of sensors and communications links that Adm. Clark called Forcenet. He described Forcenet as "an initiative to tie together naval, joint and national information grids to achieve unprecedented situational awareness and knowledge management." In effect, Forcenet would be the glue that held the Navy's future posture together, transforming a scattered and diverse fighting force into an agile, integrated organization.

Clark's vision was embraced by his successor, Adm. Mike Mullen, in 2006 guidance to the fleet. On the first page of the guidance, Adm. Mullen stated that harnessing sea power to the needs of a new era "will demand the ability to aggregate and disaggregate forces quickly; it will demand highly sophisticated networks, connectivity and stealth; it will demand better joint, allied and coalition interoperability; and it will demand that we build for the future a new fleet of ships, aircraft and submarines to wield that power across the spectrum of conflict."

In the Navy's vision, its fleet and other warfighting assets are a distributed system analogous to the internet, with nodes dispersed around the globe in pursuit of various national purposes. In order to operate in a unified and efficient manner, this scattered force must share a common web of sensors and communications links that provides a comprehensive, continuously updated picture of global conditions. The information moving over this web must be timely, accurate and relevant, and the links conveying the information must be sufficiently secure so that enemies cannot intercept or corrupt it.

A further feature of this web is that it must be seamlessly connected to the rest of the joint force, and to the other security-related agencies of the federal government, so that there are no barriers to interservice or interagency cooperation. In peacetime, barriers to cooperation result in missed opportunities and wasted resources. In wartime, the same barriers result in military defeats and wasted lives. But what gives Forcenet richness and reach is the fact that, like the internet, it is a system of systems — a myriad of interconnected networks operating according to the same standards — that offers immediate information access to a shared community of users.

The carrier-based F/A-18 E/F Super Hornet will be a mainstay of strike warfare for many years to come. By introducing new communications links and access to a robust joint network, each Super Hornet can be made far more effective and efficient than in the past.

THE POWER OF NETWORKS

Networks are communities of shared activity defined by the interaction among their participants. The two essential components in any network are the participants and the links between them. The character of the network is determined by who participates and what kinds of information they share.

Networks are not new. Human beings have created them since the dawn of civilization, and these human creations often seem to mimic structures found in nature. For example, today's cellular communications networks are schematically similar to the cell structures found in living organisms, with both exhibiting a capacity to store and process information, transfer information between cells, obtain energy from the external environment, and adapt to stresses originating in that environment.

Such similarities aren't surprising, since all of existence ultimately traces its features to the same physical principles. But what special properties of networks make them so commonplace in nature and in human society? First, they enable activities or outcomes that cannot be accomplished individually by their participants. Second, these activities typically enhance the performance or survival prospects of each participant. Third, the network creates a community of shared purpose that can weather the loss of individual pieces by adapting.

In other words, natural and manmade networks alike facilitate the complexity that allows more capable, resilient structures to evolve. That is particularly true in the case of today's electronic networks, which are evolving at a much faster pace than other types of networks have in the past. As a result, changes that once might have taken centuries to unfold — from transformation of the warfighting environment to modifications of the genome — today can occur within the span of a single lifetime.

Electronic networks are well-suited to the complex, fast-paced character of modern military operations. All electromagnetic energy travels at the constant speed of 300,000 kilometers per second, so information can be instantly sent anywhere in the world. At higher frequencies (vibrations per second), vast amounts of data can be compressed into brief transmissions; each frequency in the visible-light portion of the spectrum can carry ten billion bits of data per second, and many frequencies can be transmitted at the same time through one hair-thin fiber line. In addition, digitization of content — translating it into binary computer code — enables diverse forces to share information easily, thereby achieving the interoperability essential to effective collaboration.

The Littoral Combat Ship embodies the Navy's commitment to networked warfare in an environment of diverse, unpredictable dangers. The warship's versatility is maximized by relying on flexible design features such as modularity and open architectures.

New warfighting systems such as this Global Hawk unmanned aircraft will enable the Navy to conduct core missions in novel ways. The success of these new systems depends heavily on creating a networking environment that assures high-capacity communication around the globe and across the joint force.

CRITICAL DESIGN FEATURES

The Navy needs to become an agile, fully integrated fighting force that is continuously aware of global conditions from the seabed to geosynchronous orbit. Moreover, it needs to mesh seamlessly with other parts of the joint force and national-security establishment, applying tactics and technology in the most effective manner whether the locus of operations is at sea, on land, or in the air. As naval planners have analyzed what kind of network is required to support such goals, six design features have come to dominate their thinking:

- Forcenet must provide the carrying capacity to handle any foreseeable volume of communications, dynamically allocating bandwidth to meet warfighter needs in the most timely and efficient fashion.
- Forcenet must facilitate comprehensive interoperability among the diverse elements of the joint force, using common standards and interfaces to assure there are no barriers to the sharing of information across the force.
- Forcenet must enable multisource fusion of all relevant warfighting information, assimilating outputs from national, joint and organic naval sensors in a composite, continuously updated picture of the operational environment.
- Forcenet must afford information assurance despite its many users, meaning that it is sufficiently resilient even when under attack to maintain its core functions while countering enemy efforts to exploit or impede it.
- Forcenet must support agile command capabilities, especially the capacity to make precise, perceptive choices in the heat of battle that are instantly conveyed to all relevant forces in the theater of operations.
- Forcenet must incorporate human-centric processes that optimize the ability of individual users to get the information they need in the form that is most useful, a feature often associated with internet-style operating principles.

A warfighting network embodying all of these principles would have the strength and flexibility to sustain the versatile fighting force envisioned by Navy planners. It would enable warfighters to adapt quickly to changing circumstances, utilizing superior knowledge to stay ahead of enemy moves while applying all joint assets in the most precise and appropriate manner.

The P-8A Multimission Maritime Aircraft was conceived as a versatile surveillance aircraft that could support naval operations both at sea and ashore. In a networked environment, the P-8A will be able to operate in tandem with unmanned aircraft to provide seamless surveillance and intelligence-gathering.

A MODEL: COOPERATIVE ENGAGEMENT

Among the various networking initiatives that the Navy is pursuing, the one that is most frequently held up as a model of what new technologies can achieve for warfighters is the Cooperative Engagement Capability (CEC). CEC is a system for combining air defense information from multiple participants into a shared picture of the threat environment that is more complete and more timely than any single participant could generate on its own.

Conceived at the Applied Physics Laboratory of Johns Hopkins University in the early 1990's, the Cooperative Engagement Capability consists of two primary components: powerful processors on participating ships and planes that quickly merge targeting information from on-board and off-board sensors, and wireless data links that convey sensor readings among the members of a combat force. The processors contain algorithms that instantly reconcile the best radar measurements from each source, yielding composite target tracks that can be fed directly to defensive weapons. The high-capacity data links are designed to resist jamming and interception while minimizing the time required to distribute information to all participating nodes.

This elegant architecture enables all the ships and planes in an area of operation to become participants in a single, integrated air defense network with a shared understanding of the surrounding air space. Because all of the relevant sensor readings from each participant are being fully utilized, that common air picture provides information that is more detailed and more timely than would be feasible defending from a single location. For example, an Aegis destroyer can fire its defensive missiles at an attacking aircraft long before the aircraft is detected by its own radars, using highly reliable target tracks filtered and fused from the measurements of radars on other ships, nearby aircraft, and (potentially) surveillance assets ashore. The ship's capacity to engage is constrained only by the range of its weapons, not by any limitations in its on-board sensors.

CEC was created to cope with the complex air defense environment that naval forces confront when operating in littoral regions. There is much more radar clutter in such areas than in the open seas, especially when air engagements must be accomplished over land. In addition, coastal regions typically contain a diverse mix of aircraft whose identities and intentions are not entirely clear. CEC uses digital data links, advanced processors and software solutions not available a generation ago to meet defensive needs in this emerging area of operations, so that naval assets can function effectively despite the presence of nearby threats.

The Cooperative Engagement Capability exhibits many of the key features of netcentric warfighting — netted sensors, information fusion, automated processes, collaborative tactics and a common operating picture. It provides a powerful solution to air defense challenges, one that is potentially extensible to the entire joint force and to the full range of airborne and ballistic threats.

Space-based communication, navigation and reconnaissance systems will play a central role in realizing the goals of Forcenet. The unique reach provided by spacecraft makes effective networking of the joint force more feasible and efficient.

PRIORITY PROGRAMS

Forcenet is more a realignment of existing programs than a new program in its own right. It provides a framework for initiating and integrating more focused efforts that collectively lead to the goal of networked warfighting. The Cooperative Engagement Capability is one such effort. A handful of other programs also contribute disproportionately to progress toward netcentric operations, either because they provide the necessary web of data links or because they provide warfighting platforms optimized to employ those links.

In terms of data links, the Multifunctional Information Distribution System (MIDS) and the earlier Joint Tactical Information Distribution System (JTIDS) are critically important parts of the Navy's battlespace networking environment. These systems, also known as Link-16, provide encrypted, anti-jam data-exchange using a radio waveform and message format that enables ships, aircraft and ground vehicles to communicate tactical information quickly in wartime. Without such a system, warfighters would be unable to share a common operating picture of how conflicts are unfolding, and thus could not use their assets to maximum effect. Link-16 is a U.S. joint standard messaging system that is also used by most major allies. The new MIDS terminals will be installed on Navy warships and aircraft such as the F/A-18 E/F fighter. The Navy is the executive agent for this joint program.

In the future warfighting environment, most tactical communications will be transmitted via the Joint Tactical Radio System (JTRS, or "Jitters"). JTRS is a multichannel, software-defined radio that can simultaneously and securely communicate among diverse users. Because it is software-defined, the radio can be instantly reconfigured for a wide range of applications without requiring additional hardware, and it will be able to handle a number of different radio waveforms including Link-16. The synergy of MIDS and JTRS is so powerful that they are likely to be the dominant programs for joint tactical communications over the next two decades, hosting essential networking initiatives such as the Tactical Targeting Network Technology for striking time-sensitive targets.

MIDS and JTRS will eventually be installed on most of the Navy's warfighting platforms, and across the rest of the joint force. However, all platforms are not equal in netcentric operations, because only the newest systems have open architectures and other features necessary to exploit the full potential of emerging technology. Within the Navy, four such systems stand out: the E-2D Advanced Hawkeye carrier-based radar plane, the P-8A land-based multimission patrol plane, the Broad Area Maritime Surveillance (BAMS) unmanned aerial vehicle, and the Littoral Combat Ship.

Advanced Hawkeye is the latest evolution of the E-2 turboprop aircraft that has provided long-range surveillance, battle management and communications relay to the fleet for decades. All of these functions are being greatly

enhanced by the introduction of MIDS, JTRS and the Cooperative Engagement Capability onto the next-generation E-2D. Advanced Hawkeye will play a central role in maximizing the value of cooperative engagement capabilities, because it will offer cutting-edge sensor and communications capabilities from a vantage point far above the service's surface assets. When it becomes operational early in the next decade, E-2D will be the Navy's premier networked platform and an indispensable contributor to the integrated air picture.

The P-8A was conceived as a highly capable antisubmarine plane, but it is being equipped with a range of reconnaissance systems and communications links that will make it a key player in surface warfare on land and at sea. By using a modified 737 commercial transport to host an open architecture, the Navy has assured that the P-8A will be an affordable, adaptable solution to many future warfighting needs. It will probably operate in tandem with the high-altitude, long-endurance BAMS surveillance vehicle, an unmanned system that offers unprecedented persistence combined with many of the networking features being incorporated into manned platforms. The Littoral Combat Ship is a modular, multimission warship designed to accomplish anti-submarine, anti-surface, special operations and maritime interdiction missions in a fully networked, joint warfighting environment.

NAVAL NETWORK WORKING GROUP

The Naval Network Working Group is a bipartisan study group formed to identify and assess the technology requirements associated with creating a net-centric Navy. It was founded in 2006 by Representatives Ander Crenshaw, Steve Israel, Mark Steven Kirk and Rick Larsen.

Through focused research, sponsored forums and other efforts, the Naval Network Working Group will strive to educate Congress and the public on the value of a networked force and explain the logic of the key features comprising the emerging Forcenet. It thus will facilitate the birth of a revolutionary new naval force posture, unprecedented in human history, that can assure the success of U.S. military operations in a second American Century.

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