

Executive Summary

Network Centric Warfare (NCW) is no less than the embodiment of an Information Age transformation of the DoD. It involves a new way of thinking about how we accomplish our missions, how we organize and interrelate, and how we acquire and field the systems that support us. NCW moves the Department to the next level of Jointness as envisioned in *Joint Vision 2020*. This monumental task will span a quarter century or more. It will involve ways of operating that have yet to be conceived, and will employ technologies yet to be invented. NCW has the potential to increase warfighting capabilities by orders of magnitude. This view of the future is supported by accumulating evidence from a wide variety of experiments, exercises, simulations, and analyses detailed in the report, prepared for the Congress in response to the provisions of Section 934 of Public Law 106-398.

"We must build forces that draw upon the revolutionary advances in the technology of war...one that relies more heavily on stealth, precision weaponry, and information technologies."

*George W. Bush,
Commander in Chief*

NCW represents a powerful set of warfighting concepts and associated military capabilities that allow warfighters to take full advantage of all available information and bring all available assets to bear in a rapid and flexible manner.

The tenets of NCW are:

- A robustly networked force improves information sharing
- Information sharing enhances the quality of information and shared situational awareness
- Shared situational awareness enables collaboration and self-synchronization, and enhances sustainability and speed of command
- These, in turn, dramatically increase mission effectiveness

NCW should not be misconstrued as a fully developed and deployable warfighting capability. It is not. Far more needs to be done to transform today's platform-centric force into a network-centric one. Far more needs to be done to develop, test, and refine network-centric concepts of operation and co-evolve them with doctrine, organization, command approach, systems, and the other components of a mission capability package. Considerable effort will also be required to develop network-centric capabilities that can effectively be employed in Allied and coalition operations.

The experiences with early efforts to explore network-centric capabilities have been characterized by only a limited capability to network the force and by applications of limited

scope and scale. Despite this limitation, these efforts yielded promising results. Deployment of more fully mature network-centric capability will transform the way in which wars are fought. The resulting impact on the effectiveness of U.S. forces will justify the term "revolutionary."

This report demonstrates that DoD has made a good start. The question is no longer if NCW makes sense, but how best to achieve it. To maintain, indeed, to accelerate, progress toward a network-centric capability requires that we move beyond the limited nature and scope of the applications explored to date. A DoD strategy that is both more systematic and ambitious is required to adequately explore the possibilities.

DoD's NCW Strategy

DoD's strategy for NCW is based upon (1) setting priorities to enable, develop, and implement network-centric concepts and capabilities, (2) establishing specific goals and measuring progress toward these goals, and (3) overcoming impediments to progress. To ensure adequate focus on achieving DoD NCW goals, an Office of Transformation, reporting directly to the Secretary, will be established.

The Internet became "real" when a critical mass of users were networked. Once this tipping point was reached, the value of the Internet grew exponentially.

Setting Priorities

To make NCW happen involves setting priorities. A critical mass of the Joint Force must be robustly networked as the entry fee for NCW and transformation. This requires a strategic focus on interoperability. Interoperability must not be sacrificed for near-term considerations. Battlespace entities (platforms, units, sensors, shooters) must be designed "net-ready." Increased emphasis must be placed upon research in developing awareness, shared situational awareness, and new organizational approaches to achieving synchronization. Research is also needed to improve our ability to accurately represent NCW-related concepts and capability in models and simulations, to help us understand cognitive issues, and to help us understand and manage complex networks. Experimentation, particularly Joint experimentation, must continue to receive increased emphasis.

Establishing Goals and Measuring Progress

DoD recognizes the need to establish measurable NCW goals, to develop an NCW investment and implementation plan to achieve these goals, and to measure progress. An immediate goal must be the availability of a robustly networked Joint force that can experiment with network-centric concepts and capabilities accompanied by a campaign of experimentation focused on discovery. To measure progress, metrics are needed. This report takes the first step by establishing a maturity scale for network-centric capabilities and by outlining an approach to measuring progress toward a network-centric force. Ongoing

efforts to develop measures of key aspects of NCW, including the quality of information, collaboration, awareness, and shared situational awareness need to be given more emphasis, related to measures of command and control and synchronization, and then to measures of mission effectiveness.

An NCW investment and implementation plan is required. In assessing progress one must be careful to distinguish between sustaining and disruptive innovation. Sustaining innovations are our bread and butter. They will come easily. Disruptive innovations, where the real payoff of NCW can be found, require leadership and commitment to overcome existing impediments to progress. This Department is committed to this Information Age transformation and will take the steps necessary to realize it.

Overcoming Impediments to Progress

Major identified impediments to progress that are technical, cultural, organizational, and administrative include:

- Lack of secure, robust connectivity and interoperability
- Intolerance of disruptive innovation
- Lack of understanding of key aspects of human and organizational behaviors
- Lack of NCW-related technology investments

These impediments will slow our progress and limit our ability to achieve the full potential of NCW. An adequate infostructure will promote information sharing, collaboration, and enable new approaches to command and control. The creation of an environment that supports disruptive innovation will allow us to move beyond sustaining innovations to reap the full potential of NCW. Better understanding of individual, team, organizational, and cultural behaviors will significantly accelerate our progress. Investments in NCW-related research and technologies will provide the necessary understanding and tools. Plans to address these impediments and other institutional barriers are being formulated.

About NCW

Warfare takes on the characteristics of its age. NCW continues this trend—it is the military response to both the challenges and the opportunities created by the Information Age. The term Network Centric Operations provides a useful shorthand for describing a broad class of approaches to military operations that are enabled by the networking of the force. When these military operations take place in the context of warfare, the term Network Centric Warfare is applicable.

Network Centric Warfare is to warfare what e-business is to business.

Network Centric Operations provide a force with access to a new, previously unreachable region of the information domain. The ability to operate in this region provides warfighters with a *new type of information advantage*. This advantage is enabled by the dramatic improvements in information sharing made possible by networking. With this information advantage, a warfighting force can achieve dramatically improved *shared situational awareness and knowledge*.

The ability to achieve a heightened state of *shared situational awareness and knowledge* among all elements of a Joint force, in conjunction with Allied and coalition partners, is increasingly viewed as a cornerstone of transformation. Emerging evidence from recent military operations and a broad range of experimentation supports the relationship between shared situational awareness and knowledge enabled by NCW concepts and increased combat power.

The evidence provided in this report demonstrates clearly that warfighters employing NCW concepts can leverage shared situational awareness and knowledge to achieve situational dominance and dramatically increase survivability, lethality, speed, timeliness, and responsiveness. This evidence also points to the fact that the source of the transformational combat power enabled by NCW concepts can only be understood by focusing on the relationships in warfare that take place simultaneously in and among the *physical*, the *information*, and the *cognitive* domains.

Physical Domain: The physical domain is the traditional domain of warfare. It is where strike, protect, and maneuver take place across the ground, sea, air, and space environments. It is the domain where physical platforms and the communications networks that connect them reside. Comparatively, the elements of this domain are the easiest to measure, and consequently, combat power has traditionally been measured primarily in this domain.

Information Domain: The information domain is the domain where information lives. It is the domain where information is created, manipulated, and shared. It is the domain that facilitates the communication of information among warfighters. It is the domain where the command and control of modern military forces is communicated, where commander's intent is conveyed. Consequently, it is increasingly the information domain that must be protected and defended to enable a force to generate combat power in the face of offensive actions taken by an adversary. And, in the all-important battle for information superiority, the information domain is ground zero.

Cognitive Domain: The cognitive domain is the domain of the mind of the warfighter and the warfighter's supporting populace. Many battles and wars are won or lost in the cognitive domain. The intangibles of leadership, morale, unit cohesion, level of training and experience, situational awareness, and public opinion are elements of this domain. This is the domain where commander's intent, doctrine, tactics, techniques, and procedures reside.

The key attributes of the cognitive domain have remained relatively constant since Sun Tzu wrote *The Art of War*.

NCW Force Attributes and Capabilities

A warfighting force that can conduct Network Centric Operations can be defined as having the following attributes and capabilities:

Physical Domain:

- All elements of the force are robustly networked achieving secure and seamless connectivity.

Information Domain:

- The force has the capability to collect, share, access, and protect information.
- The force has the capability to collaborate in the information domain, which enables a force to improve its information position through processes of correlation, fusion, and analysis.
- A force can achieve information advantage over an adversary in the Information Domain.

Cognitive Domain:

- The force has the capability to develop and share high-quality situational awareness.
- The force has the capability to develop a shared knowledge of commanders' intent.
- The force has the capability to self-synchronize its operations.

Shared situational awareness enabled digitized forces to fight successfully over a much larger area, with fewer forces, than non-digitized forces ([Section 8](#)).

The central hypothesis of NCW is that a force with these capabilities can increase combat power by:

- Better synchronizing effects in the battlespace
- Achieving greater speed of command
- Increasing lethality, survivability, and responsiveness

Network Centric Operations to date has focused on the tactical and operational levels of warfare, but they impact all levels of military activity from the tactical to the strategic. At the operational level, Network Centric Operations provide commanders with the capability to generate precise warfighting effects at an unprecedented operational tempo, creating conditions for the rapid lockout of adversary courses of action.

Road to NCW

It is one thing to talk about network-centric concepts and quite another to see them implemented. A lot of things need to come together to make a network-centric capability a reality. This is because, by its very nature, network-centric capabilities:

- Involve new ways of thinking about how task and missions can be accomplished
- Change organizational roles and responsibilities
- Require that information be shared outside of existing communities
- Depend, in part, upon the development of new technologies
- Require a better understanding of how to create, share, and exploit awareness
- Create value in new ways

NCW concepts “unlocked the potential combat power that was latent in the JTF, but had been wasted due to segmentation of the battlespace.”

*ADM Blair, USCINCPAC
(Section 8)*

Innovation...is not a process that usually proceeds in a linear way. But hindsight tends to make us think that it does. Because we try to compose coherent histories of innovation, we may actually overlook the uncertainty and chance that inevitably exist.

American & British Aircraft Carrier Development: 1914-1941

Therefore, to make Network Centric Warfare a reality, a number of conditions must exist. These include:

- An infostructure that is robustly networked to support information sharing and collaboration
- A climate that fosters disruptive innovation
- An appropriate technology base and an improved understanding of related issues
- A way of analyzing and assessing network-centric capabilities

Overcoming impediments and encouraging desirable emergent behaviors appears to be a more promising approach to achieving a network-centric force than relying upon a centralized planning process to orchestrate every step of the journey. This journey begins with the recognition that a critical mass of connectivity and interoperability is necessary to both encourage and support new ways of doing business. Therefore, networking the force

will be the top priority. The means for accomplishing this is the Global Information Grid (GIG). The ability of the GIG to establish global connectivity with sufficient bandwidth to reach this critical mass is dependent upon having adequate access to radio frequency spectrum.

DoD recognizes the importance of fostering and protecting disruptive innovation and looks to a vigorous and rigorous program of Joint and Service experimentation to nurture new and better ways to accomplish our assigned missions.

In Network Centric Warfare, no single platform or sensor is the heart of the system.

In parallel, DoD plans to invest more in NCW-related areas of science and technology, including an increased emphasis on cognitive behaviors associated with social sciences and complex adaptive systems.

Finally, DoD plans to systematically assess the results of experiments, improve its ability to analyze NCW concepts and capabilities, and to measure progress. A major component of DoD's implementation strategy will be the development and employment of an appropriate set of metrics and a maturity model for network-centric applications across DoD.

Summary of Findings and Conclusions

Findings

- There is compelling evidence that supports the theory of NCW.
- Progress has been made in developing an understanding of the basics of network-centric concepts and their ability to contribute to mission success.
- Applications to date of NCW theory have barely scratched the surface of what is possible. However, early experimentation by JFCOM and Services have provided significant justification for Congress to continue investing in the development of NCW as the cornerstone enabler of future combat forces.
- There are significant impediments to progress.

Conclusions

- In the future, the network will be the single most important contributor to combat power.
- There is considerable and growing urgency associated with removing the impediments to progress.
- Timely removal (or mitigation) of impediments will be facilitated by an OSD-level Office of Transformation.

- A goal to achieve specific network-centric capability by a specific date is needed.
- NCW offers unprecedented promise to achieve long sought-after capabilities without corresponding increases in resources *in the long run*.
- NCW and Network Centric Operations should be the cornerstone of DoD's strategic plan for the transformation of the forces.

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