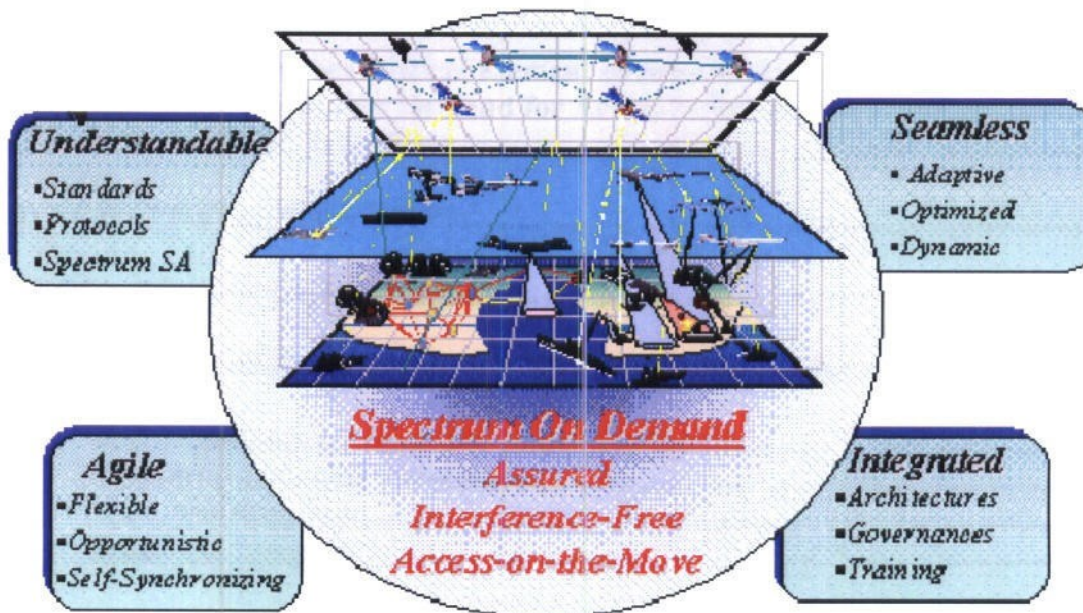


Department of Defense Net-Centric Spectrum Management Strategy



August 3, 2006

Assistant Secretary of Defense (Networks and Information Integration)
Department of Defense Chief Information Officer

DOD Net-Centric Spectrum Management Strategy

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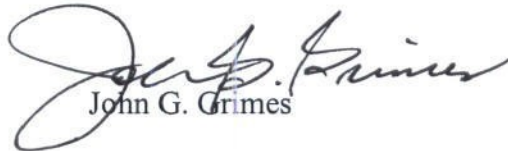
Foreword

The purpose of this document is to better manage the Department's Radio Frequency Spectrum, a finite resource, which is essential in accomplishing the Department's warfighting mission. Pursuant to the President's Management Initiative and the Department of Defense's Transformation, the Spectrum Management (SM) Strategy will improve the management of this vital resource now and in the future.

The Department is taking an integrated approach to developing the transformation to net-centricity. This approach incorporates network and communications enhancements to provide sufficient bandwidth and electromagnetic spectrum for the warfighter and the Department's operations. The net-centric environment is the framework of spectrum users' technical connectivity and interoperability for Department users and mission partners.

Spectrum-dependent systems, such as, radios, radars, satellites, unmanned aerial vehicles (UAVs), the Global Positioning System (GPS), and electronic warfare (EW) are required for all aspects of net-centric warfare.

One of the goals of net-centric spectrum transformation – empowering users through access to trusted information shared in a trusted environment – has driven the development of this SM strategy.



John G. Grimes

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1. Purpose

Net-Centric Spectrum Management (SM) is a new term established to describe an objective capability for the management and use of electromagnetic spectrum within a net-centric environment. This document describes the Department of Defense (DOD) strategy for achieving Net-Centric SM. This strategy directly relates to goals established by the Deputy Secretary of Defense in the DOD Electromagnetic Spectrum Management Strategic Plan¹ and responds to direction given within the Plan – Implementation Plan Guidance². It provides a describes a vision for the management and use of spectrum and establishes goals for achieving that vision. It also defines the methods that DOD will need to apply in order to achieve the Department's goals. This strategy will be followed by a subsequent directive with implementation details to identify specific actions and responsibilities to achieve the net-centric SM vision.

2. Background

The DOD is in the process of transforming and developing the concepts for the conduct of future joint military operations as framed in the Joint Operations Concepts (JOpsC). The overarching goal of JOpsC is full spectrum dominance³ achieved through a broad array of capabilities enabled by an interconnected network of sensors, shooters, command, control, and intelligence. This network-based interconnectivity will increase operational effectiveness by allowing dispersed forces to communicate, maneuver, share a common operating picture and successfully complete assigned missions more efficiently. The JOpsC requires a net-centric operations environment to provide services and processes to enable a more efficient approach to warfighting and business operations than is possible today.

The key enabler for net-centricity is the Department's Global Information Grid (GIG). The GIG is the globally interconnected end-to-end set of information capabilities that manage and provide information on demand to warfighters, defense policy makers, and support personnel. Secure net-centric links interconnecting people and systems, independent of time or location, will provide improved military situational awareness, better access to DOD business information, and shortened decision cycles.

DOD has developed a comprehensive, integrated approach to providing an enterprise information environment to support net-centricity and has identified the new capabilities needed to effect this objective environment in a series of net-centric strategies. To date, the implementation of this approach includes the publication of the Net-Centric Data Strategy, the Net-Centric Information Assurance Strategy, and the Core Enterprise Services Strategy along with implementation of the Net-Centric Checklist to facilitate transition to the net-centric environment. These strategies inform and guide the Joint Capabilities Integration and

¹ Department of Defense Office of the Assistant Secretary of Defense (Command, Control, Communications and Intelligence), Electromagnetic Spectrum Management Strategic Plan, October 2002, Washington, D.C.

² Department of Defense Office of the Assistant Secretary of Defense (Command, Control, Communications and Intelligence), Implementation Guidance for DOD Electromagnetic Spectrum Management Strategic Plan, June 2004, Washington, D.C.

³ Full Spectrum Dominance is defined by the Department of Defense Joint Operations Concept, November 2003, Washington, D.C. as the defeat of any adversary or control of any situation across the full range of military operations.

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Development System (JCIDS); Planning, Programming, Budgeting, and Execution (PPBE); the Defense Acquisition System (DAS); and operational processes of the Department.

This Net-Centric Spectrum Management Strategy complements these current net-centric strategies and further promotes net-centric transformation. It describes how SM is inextricably coupled to a successful realization of net-centricity and why SM considerations shall be included in the Net-Centric Checklist.

3. Scope

This strategy presents the future view of SM in the net-centric environment. The strategy presents the *what* – the vision of net-centric SM. It does not describe the *how* – the specific approach and implementation required to achieve the vision. It identifies SM practices necessary to support the net-centric environment to assure that SM is infused into future wireless architectures, systems and capabilities. The intent is not to describe the technologies and programs that will implement net-centric SM, but to provide a description of what is needed for SM to accomplish its vital role as an enabler for net-centric operations.

4. Discussion

4.1 Why Spectrum is a Critical Element of Net-Centricity

Net-centricity depends on an environment that provides full connectivity and interoperability to produce and share a common understanding of all dimensions of the battlespace. This will be achieved through the implementation of highly integrated wireless architectures and spectrum-dependent technologies to instrument and network the battlespace. The breadth of spectrum support to the DOD is represented in Figure 1. As shown in the figure, spectrum is a principal component of the GIG's foundation layer. It is the essential resource that enables the operation of wireless networks and vital components on virtually every tactical warfighting system. Spectrum-dependent systems include communications and weapons systems, precision munitions, sensors, geo-location, and other wireless devices. Effective command and control, robust warfighting capabilities, and personnel safety are directly dependent on the assured availability of these systems, which are directly dependent on access to spectrum. Thus, DOD's ongoing transformation to net-centricity has significantly increased Warfighter dependence on spectrum.

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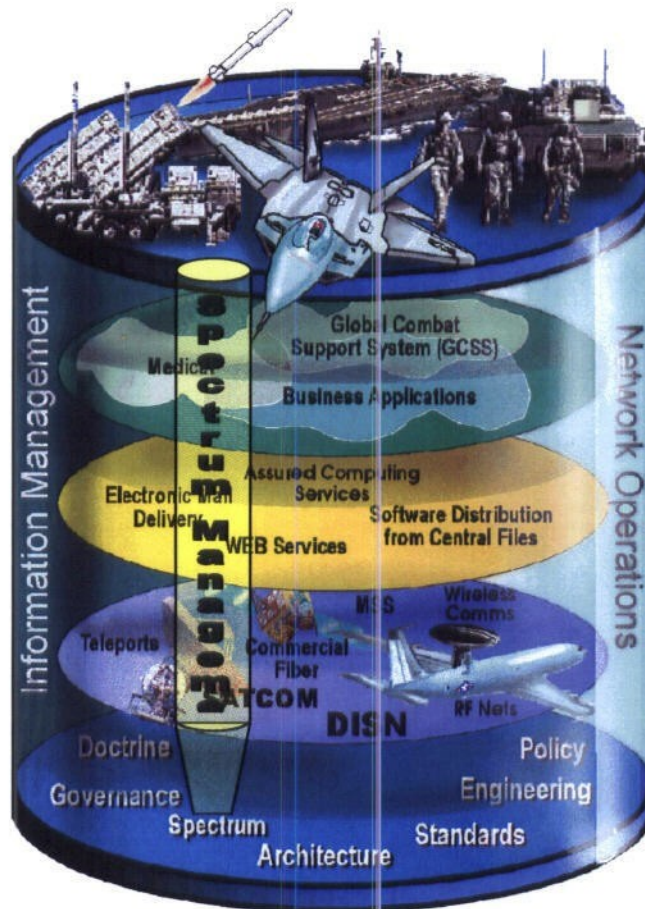


Figure 1: Spectrum's Role in Net-Centricity

4.2 Increased Warfighter Demand for Access to Spectrum

Studies⁴ forecast that DOD's demand for spectrum access will grow significantly with the development and fielding of advanced wireless technologies. This projected increase is a direct result of the need to provide warfighters with increased capabilities⁵ to achieve battlefield dominance. As shown in Figure 2, key DOD wireless systems are heavily concentrated in the frequency bands below 40 GHz. This is due to both the underlying physics of spectrum propagation and by international laws, treaties, and regulations. These same physics and laws similarly apply to commercial users of the spectrum who often compete with DOD for spectrum access to support various wireless services in the same frequency bands. The need to support increased demand for this limited resource in an already congested operating space has made assuring DOD interference-free access to required spectrum progressively more complex. The figure also illustrates how many spectrum-dependent systems share the same frequency bands of the resource and thus their spectrum usage must be continuously assessed, deconflicted, and prioritized to avoid conflicts while supporting demand. Accordingly,

⁴ U.S. Army Report to Congress, Objective Force Bandwidth Requirements, February 2004 and The Defense Information Systems Agency Defense Spectrum Office, Warfighter Spectrum Requirements Analysis, September 2003, Alexandria, VA are two of the most recent studies.

⁵ Net-centric capabilities are described in the Net-Centric Environment Joint Functional Concept, Version 1.0, 7 April 2005.

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5. DOD Net-Centric SM Vision

Net-centric SM vision: *Spectrum access on demand*

The Net-centric SM vision encompasses the DOD CIO goal “to eliminate bandwidth and frequency capability limitations” in order to provide “assured access, bandwidth-on-demand.”⁷ In a net-centric environment, the vision is that spectrum will be accessible to all spectrum-dependent systems on an as needed basis. Warfighters will have spectrum situational awareness allowing them to maximize use of spectrum to exploit battlefield opportunities while avoiding interference to other users. This will be enabled through the use of spectrum planning, standards, SM protocols, and software agents that will provide an understanding of the type and amount of spectrum in use and to support the most effective use of available spectrum. The network will be “alive”, interactive, and instantly aware of spectrum that is available for reuse and reprioritization for use by other wireless systems. As the network moves, the SM structure will adapt as necessary to ensure the systems remain optimized.

To achieve this vision, SM as practiced today must be revised and replaced with a new paradigm, Net-Centric SM, as framed in the goals and methods set forth herein.

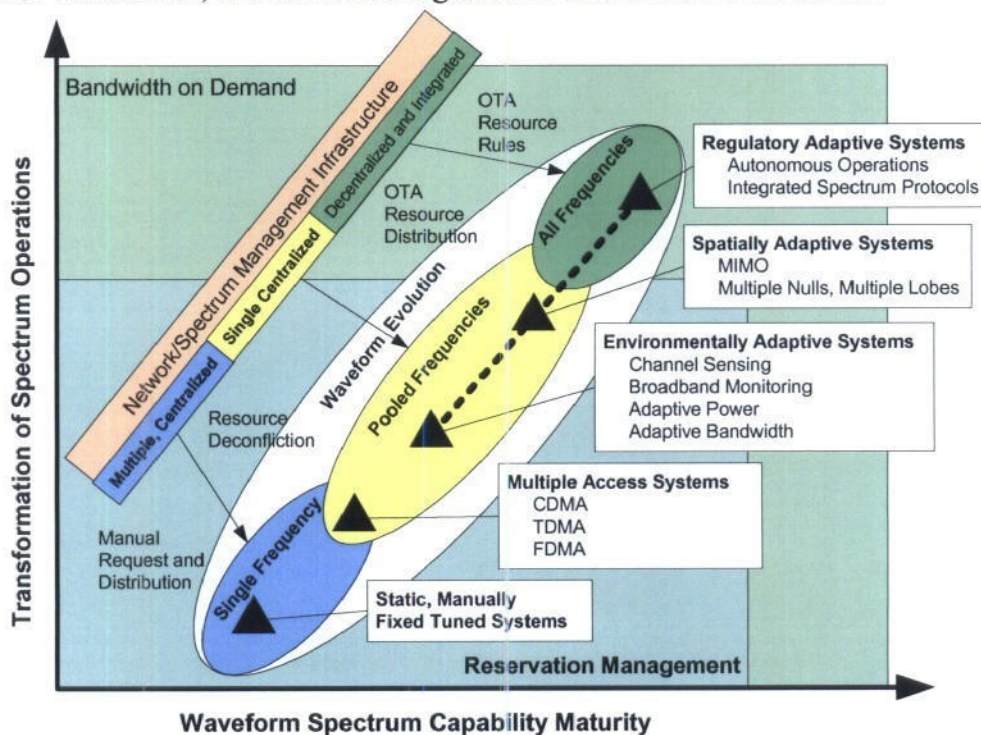


Figure 3: Future DOD Spectrum Management

6. Net-Centric SM Goals

Net-centric SM will provide spectrum support by assuring on-the-move access and processes to minimize or completely negate harmful interference to operations. These assurances are the basic tenets of net-centric SM and support achievement of the “ubiquitous, robust, trusted,

⁷ Attributes identified in Goal #1 of the Department of Defense Chief Information Officer Goals Statement.

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protected network’’⁸ envisioned by the DOD CIO. Because of the complexity and demands associated with supporting network centric operations within the mobile tactical framework, SM must be decentralized and performed autonomously throughout the network to be successful. The SM goals and methods outlined in Table 1 below describe the required transformation needed to achieve net-centric SM.

Table 1: Goals of Net-Centric SM Strategy

Goal	Description
Understandable	<i>Spectrum information is defined via standards and SM protocols so users and spectrum-dependent devices can discern spectrum data available on the GIG. Users post spectrum usage via spectrum data elements that describe the essential attributes of spectrum utilization. Spectrum situational awareness is maintained through a Spectrum User-Defined Operational Picture (S-UDOP).</i>
Agile	<i>SM policies and practices will provide flexibility to allow systems to dynamically adjust and scale to support change in size and scope of demand to be responsive to mission requirements.</i>
Seamless	<i>Enabled by agile SM policies and practices, future spectrum-dependent devices will be able to reconfigure their spectrum use and spectrum control attributes independently.</i>
Integrated	<i>Net-Centric SM considerations are infused into DOD processes, practices, planning, doctrine, training and operations. SM is recognized throughout DOD as a necessary and complementary function that is essential to maintaining the network.</i>

7. Methods for Achieving Net-Centric SM Goals

7.1 **Make Spectrum Information Understandable:**

7.1.1 Establish Common Integrated Spectrum Standards and SM Protocols:

To facilitate rapid exchange of spectrum information and promote immediate detection of spectrum use, DOD will develop a standard spectrum lexicon in the form of spectrum standards and SM protocols for use by all spectrum users. These will be robust enough to support the various standards, SM protocols and policies in use today, yet be flexible enough to support incorporation of new concepts and evolving spectrum management policies and rules. The standards and SM protocols will be constructed to ensure that the network will recognize the current state of any spectrum-dependent system and the bandwidth required at any instant to promote rapid spectrum reconfiguration of specific devices. This approach will provide the context for net-centric spectrum utilization and promote agile, dynamic spectrum access by facilitating a knowledgeable spectrum environment.

⁸ Department of Defense Chief Information Officer Vision Statement

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7.1.2 Adopt a Common Spectrum Data Format:

Spectrum data and metadata will be provided to the network in accordance with the DOD Discovery Metadata Standard (DDMS). The DDMS provides a common set of structured attributes that support the rapid exchange of desired data. This standardized common data format will permit the discovery of spectrum information for posting to the S-UDOP and will support the retrieval of spectrum data from among the other data on the network.

7.1.3 Develop Spectrum User-Defined Operational Picture (S-UDOP):

The S-UDOP will provide the means for fusing posted spectrum data and offer multiple viewing options to support planning, deployment, rehearsal, and actual operations. The first step in the process involves a standardized approach to identifying spectrum requirements. Users will be able to tailor the S-UDOP to identify areas of spectrum confliction and use the information for post-operation analysis. For example, the S-UDOP may always indicate ongoing spectrum use, but it will be flexible enough to allow the user to filter specific spectrum bands or look at the spectrum demand of a specific category of wireless devices. This information may also be used to understand SM implications associated with the development of future wireless systems and support bilateral or multilateral negotiations affecting DOD net-centric SM implementation.

7.2 Make SM Agile and Responsive:

7.2.1 Incorporate Flexible Spectrum Use:

As technologies evolve, many spectrum-dependent systems will be multi-nodal, capable of operating across the dimensions of the spectrum space including multiple frequency ranges, time, and signal parameters, some of which are not commonly supported by today's implementations. The DOD will influence the evolution and development of national and international SM policies to keep pace with these advances in wireless technologies to fully exploit the spectrum flexibility they present. Developing and incorporating flexible SM policies and practices into spectrum-dependent systems will eliminate the need for the static frequency configuration utilized by most current wireless systems and facilitate greater utilization of available spectrum.

7.2.2 Incorporate Context-Aware Spectrum Use:

A potential for enabling the exploitation of unused spectrum is to allow spectrum-dependent systems to control spectrum access, determine the amount of spectrum needed for the specific instance, and then select the appropriate spectrum parameters for the system based on considerations of the current environment. Technologies are in development that will allow systems to sense the electromagnetic spectrum environment and reconfigure to use the optimum spectrum that is available on an instant-by-instant basis. In addition to the RF environment, systems will take into account mission and operational goals, policy constraints, and other external context information to guide access to the spectrum space. This context-aware use of spectrum will be key to supporting mobile systems that must move, reconfigure, and integrate with other wireless systems in the same physical environment. SM practices will adjust dynamically as wireless systems reconfigure forming a management and implementation team to ensure uninterrupted connectivity.

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7.2.3 Develop Framework for Flexible Policy Adaptation:

The true potential of net-centricity for wireless devices can only be achieved if the policies and rules for SM can be dynamically changed while executing operations. The current rule-based approach requires the linkage of spectrum accreditation to a specific wireless device, which inhibits spectrum flexibility and context-aware spectrum use. The current national and international SM framework will evolve to support multiple spectrum solutions for wireless devices rather than single-solution practiced today. This framework will allow adaptation of policy based on time, topography, and location that will permit wireless technologies to evolve without being restricted to a predefined implementation.

7.3 Make SM Seamless:

7.3.1 Incorporate Spectrum Standards/SM Protocols Into Spectrum-Dependent Systems:

Through the extensive interaction between acquisition and spectrum policy activities, future spectrum-dependent systems will contain the necessary hardware and software to facilitate dynamic spectrum implementation. While performing its intended function, spectrum-dependent devices will be able to simultaneously sense and dynamically adapt to the spectrum environment of the operational battlespace.

7.3.2 Integrate S-UDOP into Operational Planning and Battle Management Systems:

To facilitate evaluation of spectrum options during the planning process, the user-defined operational picture will include the capability to import spectrum data into planning systems. This will allow operational planners to analyze and assess spectrum requirements in relation to force structure options and integrate with other planning considerations. Spectrum planning information will be exchanged with coalition partners as well as other federal and local government agencies to optimize DOD support to other operations. This information will also be used to support simulation, risk analysis, conflict resolution, and asset management.

This common picture will depict dynamic spectrum usage for all DOD Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance systems and capture coalition, commercial, and adversary spectrum use to the maximum extent possible as well. Spectrum use information will be posted and available to the S-UDOP in near real-time to provide a complete picture of the battlespace and facilitate reprioritization and allocation as necessary to support on-going operations. This will allow commanders to assess battlefield requirements, evaluate spectrum options, identify priorities, and evaluate wireless operations in relation to spectrum resources.

7.3.3 Incorporate Dynamic Implementation of Spectrum Policy:

Using spectrum information provided through the network, net-centric wireless systems would automatically assess their operating environment, evaluate spectrum options available through automated policy and rule distribution, and establish themselves within the optimum spectrum band, thus achieving efficient and effective use of the spectrum. As the net evolves, the system applies its “understanding” of spectrum and “agile” spectrum attributes to dynamically reconfigure and synchronize with its new environment - thereby maintaining uninterrupted operations. Spectrum resources will be dynamically allocated among spectrum-dependent devices based on mission needs such as time, location, topology, and commander’s intent. Net-

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centric SM thus supports the ability of networks to form, move, and reconfigure based on the dynamic situation by assuring spectrum for connectivity.

7.4 Make SM Integrated:

7.4.1 Develop SM Architecture Framework for DOD:

Architectures facilitate understanding of the relationships and dependencies among systems, data, information, materiel, and services that enable them to operate effectively together. SM will be detailed in an architecture that depicts the transformation of SM within DOD from its currently planned state (2005) to an objective net-centric functionality. The SM architecture will include a transition strategy and roadmap with detailed descriptions of the operational capabilities, environment characteristics, and architecture imperatives for each transition point. A specific SM architecture is required to develop and maintain the necessary products for assessing SM implications within the PPBE and JCIDS processes; for portfolio management and acquisition support (decision support, risk management, etc.); for considering business process re-engineering, functional process improvements or organizational changes; and to assist in providing the necessary strategies for achieving full transformation.

7.4.2 Integrate SM into DOD Net-Centric Governance (Establish a Process):

The DOD CIO through the ASD/NII SM Directorate, in coordination with SM community leadership, will establish a DOD-wide SM net-centric governance process to promote, guide, and ensure implementation of net-centric SM practices. SM guiding documents, policies, and procedures will be updated to reflect changes from the current SM structure, and new documents will be developed to facilitate new approaches and implementations. This governance process will provide oversight of net-centric SM development to ensure the SM framework supports and complements net-centricity.

7.4.3 Train, Test, Advocate, and Educate about SM:

Best practices show that new procedures and practices are assimilated more quickly when fully understood and consistently promoted. The SM community leadership will coordinate SM training, testing, and awareness throughout the DOD components to ensure that all acquisition personnel, developers, suppliers, and users of the spectrum are fully aware of new procedures and processes. As new tools and implementation approaches are developed, training will be conducted and codified in appropriate directives.

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Figure 3 shows how the goal and methods interrelate to support the tenants of Net-Centric SM.

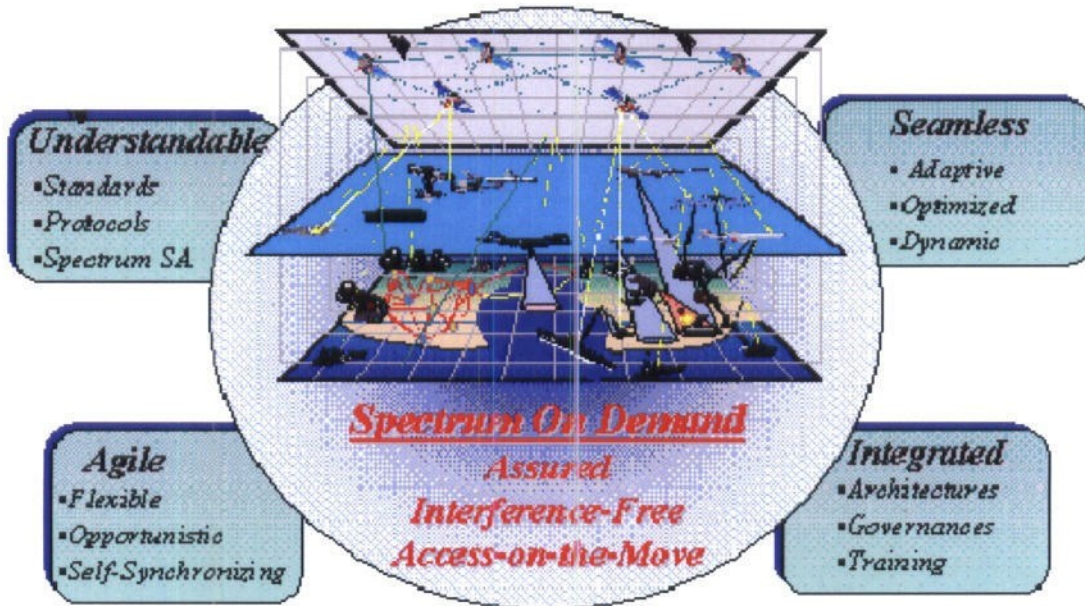


Figure 3: Net-Centric SM

8. Implementing Net-Centric SM

8.1 Implementation

Implementation of this strategy will be subject to a number of technical, programmatic, and cultural changes that will be addressed through a series of planning documents and governance. This strategy will progress through additional detailed guidance provided by the DOD CIO to include:

- A Net-Centric SM directive to codify execution of the strategy
- A Net-Centric SM Transition Plan that describes the actions, management approach, and sequencing of activities required to implement the strategy
- Implementation guidelines that identify key aspects of the strategy for specific action by DOD activities, identification of transition points, and expected enhancements to SM
- Establishment of an ongoing awareness campaign to promote the strategy and identify the key interfaces for SM to synchronize with other Net-Centric approaches and strategies

8.2 Responsibility

The Assistant Secretary of Defense for Networks and Information Integration/Department of Defense Chief Information Officer (ASD(NII)/DOD CIO), as the Principal Staff Assistant on spectrum matters, both within the Department and for Departmental spectrum matters presented before international, regional, and national spectrum management forums, shall provide direction and guidance for implementing and achieving the goals of net-centric SM. The ASD(NII) will direct the establishment of Net-Centric SM governance and directives in coordination with the Military Departments, the Joint Staff, and the acquisition community.

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9. Net-Centric SM Challenges

There are a number of challenges that must be addressed and mitigated to enable DOD to achieve the SM goals described in this document. These challenges and mitigation approaches will be addressed in implementation guidance and appropriately incorporated into the transition plan. Table 2 identifies the challenges and mitigation approaches.

Table 2: Net-Centric SM Challenges and Mitigation Approaches

Challenge	Mitigation Approach
Promote RF system development solutions to facilitate achieving Net-Centric SM goals	<ul style="list-style-type: none"> • Coordinate with GIG End-to End Systems Engineering Group • Incorporate appropriate guidance in Net-Centric Implementation Directives (NCID) and Net-Centric Checklist • Coordinate with acquisition community and defense research agencies • Participate in spectrum-related IPTs and WGs • Develop and implement automated planning processes and tools
Promote national and international acceptance and adoption of technologies that facilitate Net-Centric SM concepts	<ul style="list-style-type: none"> • Coordinate with National Telecommunications and Information Administration (NTIA), Federal Communications Commission (FCC), and International Telecommunication Union (ITU) spectrum policy forums • Present advantages of the Net-Centric SM concept through software radio demonstrations and technical papers • Coordinate with coalition partners
Financially support implementation of Net-Centric SM methods	<ul style="list-style-type: none"> • Identify and document resource requirements • Prioritize requirements and incorporate into PPBE and JCIDS • Develop methodology to quantify the "value of spectrum" in order to justify investments

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Challenge	Mitigation Approach
Implement a spectrum governance structure that streamlines DOD SM processes and synchronizes SM with related net-centric efforts	<ul style="list-style-type: none"> • Review and revise SM governance to conform and promote net-centric SM • Incorporate SM into related GIG governance structures • Socialize the net-centric SM concept through national and international Community of Interest (COI) and among users of wireless systems
Transition legacy systems to implement Net-Centric SM methods	<ul style="list-style-type: none"> • Implement guidance that accommodates legacy transition on an incremental basis • Identify and support necessary resources to facilitate transition
Establish accepted spectrum standards and SM protocols	<ul style="list-style-type: none"> • Coordinate with SM COI to develop standards and SM protocols • Formalize standards and SM protocols in technical manuals and architectures • Plan and implement life-cycle testing activities commensurate with risk levels and effects on mission
Implement security services to support delivery and authentication of SM information	<ul style="list-style-type: none"> • Coordinate with information assurance (IA) and data activities • Ensure electronic warfare and intelligence community considerations are addressed in security methods

10. Conclusion

This document offers a DOD Net-Centric Spectrum Management Strategy through presentation of the vision for Net-Centric SM along with the identification of goals, and methods to achieve these goals. This strategy requires fundamental change in the processes and procedures currently utilized by DOD for SM and changes how SM is addressed during the development, deployment, and operation of spectrum-dependent systems. Achieving net-centric SM will require active participation throughout DOD and also require direct and continuous liaison with both national and international spectrum entities. Net-centric SM will not be achieved in the near future, but will evolve as systems, processes, and practices assimilate the attributes of net-centricity; and will be dependent on the establishment of a national and international policy framework that supports the new spectrum management approach. This strategy will also require continued refinement as net-centricity matures and will be amended and revised as necessary to assist in assuring the attainment of an operational net-centric environment.

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Appendix A – Acronyms

CIO	Chief Information Officer
COI	Communities of Interest
DAS	Defense Acquisition System
DDMS	DOD Discovery Metadata Standard
DOD	Department of Defense
FCC	Federal Communications Commission
GIG	Global Information Grid
IA	Information Assurance
ITU	International Telecommunication Union
JCIDS	Joint Capabilities Integration and Development System
JOpsC	Joint Operations Concepts
NCID	Network Centric Implementation Directives
NTIA	National Telecommunications and Information Administration
PPBE	Planning, Programming, Budgeting, and Execution
SM	Spectrum Management
S-UDOP	Spectrum User-Defined Operational Picture

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Appendix B – Terminology

Terms used in the Net-Centric SM Strategy are defined for reference.

- Battlespace: The environment, factors, and conditions that must be understood to successfully apply combat power, protect the force, or complete the mission. This includes the air, land, sea, space, and the included enemy and friendly forces; facilities; weather; terrain; the electromagnetic spectrum; and the information environment within the operational areas and areas of interest. (Joint Pub 1-02)
- Context-Aware: A system is context-aware if it can extract, interpret and use context information and adapt its functionality to the current context of use. The challenge for such systems lies in the complexity of capturing, representing and processing contextual data.
- De-confliction: A systematic management procedure to coordinate the use of the electromagnetic spectrum for operations, communications, and intelligence functions. This procedure minimizes possible interference issues that might arise after frequency assignment. (CJCSM 3320.02)
- Electromagnetic Interference (EMI): Any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics and electrical equipment. It can be induced intentionally, as in some forms of electronic warfare, or unintentionally, as a result of spurious emissions and responses, inter-modulation products, and the like. (JP 1-02)
- Electromagnetic Spectrum: The range of frequencies of electromagnetic radiation from zero to infinity. For the purposes of DOD policy, "electromagnetic spectrum" shall be defined to be the range of frequencies of electromagnetic radiation that has been allocated for specified services under the U.S. and international tables of frequency allocation (reference (d)), together with the spectrum outside the allocated frequency range where use of unallocated frequencies could cause harmful interference with the operation of any services within the allocated frequency range. The terms "electromagnetic spectrum," "radio frequency spectrum," and "spectrum" shall be synonymous. (DODD 4650.1)
- Global Information Grid (GIG): The globally connected, end-to-end set of information capabilities, associated processes, and personnel for collecting, processing, storing, disseminating, and managing information on demand to warfighters, policy makers, and support personnel. (DODD 8320.2)
- Information Assurance (IA): Information operations that protect and defend information and information systems by ensuring their availability, integrity, authentication, confidentiality, and nonrepudiation. This includes providing for restoration of information systems by incorporating protection, detection, and reaction capabilities. (Joint Pub 3-13)

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- Spectrum-Dependent Systems: Those electronic systems, subsystems, devices and/or equipment that depend on the use of the electromagnetic spectrum for the acquisition or acceptance, processing, storage, display, analysis, protection, disposition, and transfer of information. (DODD 4650.1)
- Spectrum Management (SM): The planning, coordinating, and managing of the joint use of the electromagnetic spectrum through operational, engineering, and administrative procedures. The objective of spectrum management is to enable electronic systems to perform their functions in the intended environment without causing or suffering unacceptable interference. (JP 1-02)