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**Defense Information Systems Agency**

Department of Defense

# **Net-Centric Spectrum Management: From Concepts to Application**

***DISA Customer Partnership Conference***

**Paige Atkins, Director  
Defense Spectrum Organization  
6 May 2008**

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# Overview

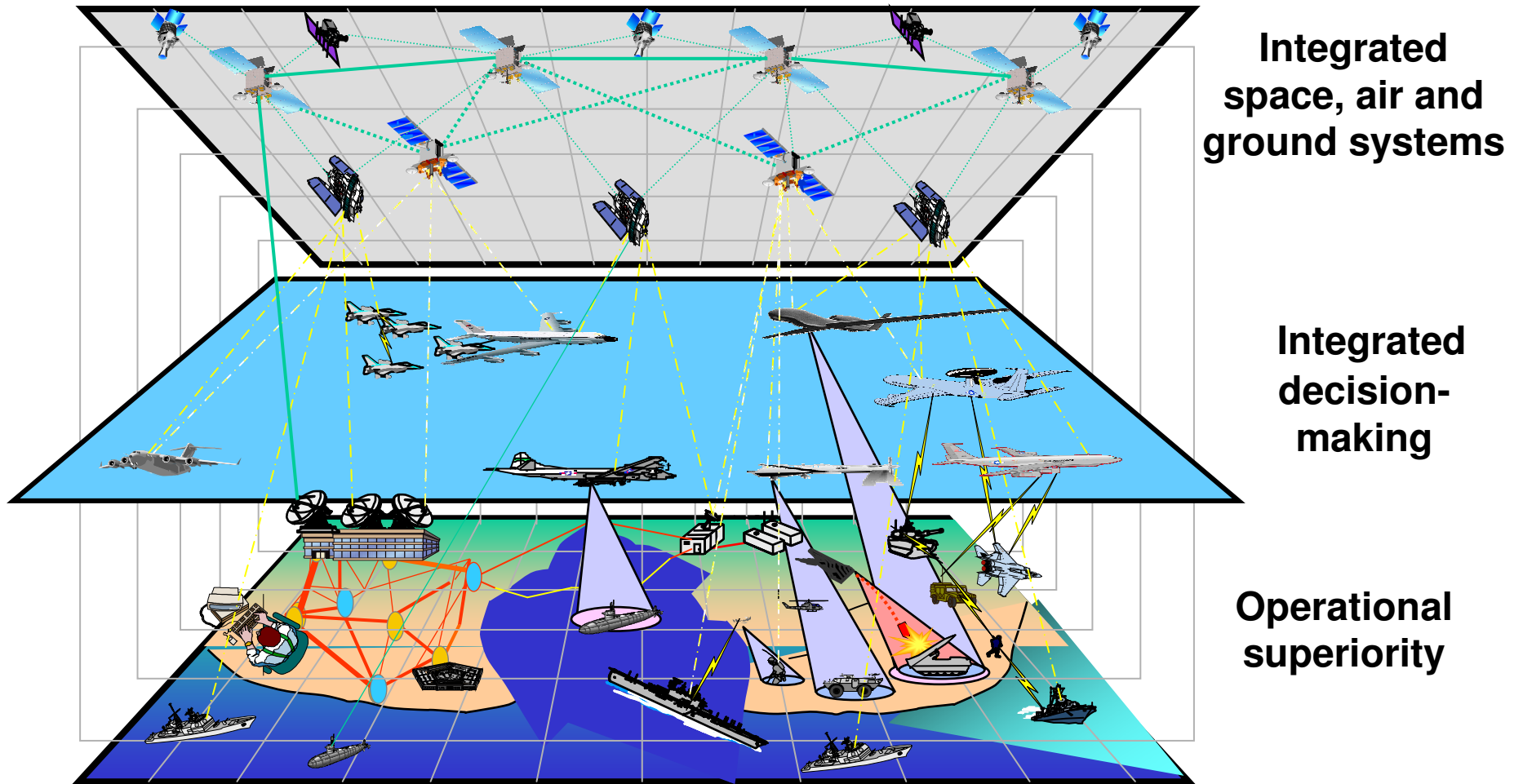
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- **Spectrum environment**
- **DoD Spectrum Challenges**
- **Spectrum management transformation**
- **Defense Spectrum Organization**
- **Key focus areas**
- **Accomplishments**
- **Dynamic Spectrum Access**
- **Take aways**



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# Defense Spectrum Environment



Spectrum enables net-centric operations and warfare



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# Power to the Edge

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- In a net-centric environment, RF spectrum enables the tactical edge
- Optimal spectrum access is vital to bringing power to the edge



**Optimal spectrum access = sharper tactical spear**



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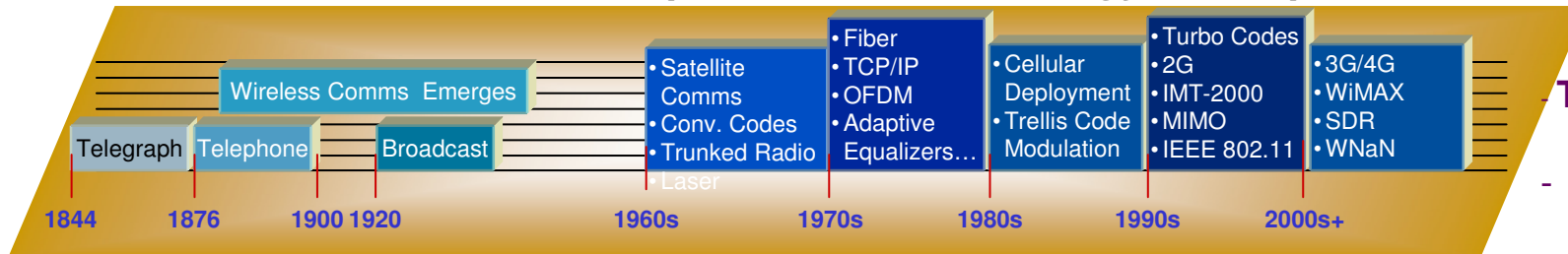
# DoD Spectrum Challenges

## OPERATIONAL: Net-centric joint operations

- Net-Centric Warfare
- Higher bandwidths
- Greater mobility
- Greater agility
- Higher tempo



## TECHNICAL: Five decades of rapid wireless technology development



- The need to access more spectrum
- Encroachment on military bands

## REGULATORY: Increased need for more spectrum, harmonization, etc

- Demands for sharing and harmonization
- Host nation sovereignty
- World Radiocommunication Conference (WRC) impact



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# Spectrum Scarcity

***“We have enough to do the job today,  
but I am not convinced we have  
enough to do the job I see coming  
five years from now.”*** – Claude Bolton,  
outgoing Assistant Secretary of the Army for Acquisitions,  
in *Defense News*, January 7, 2008

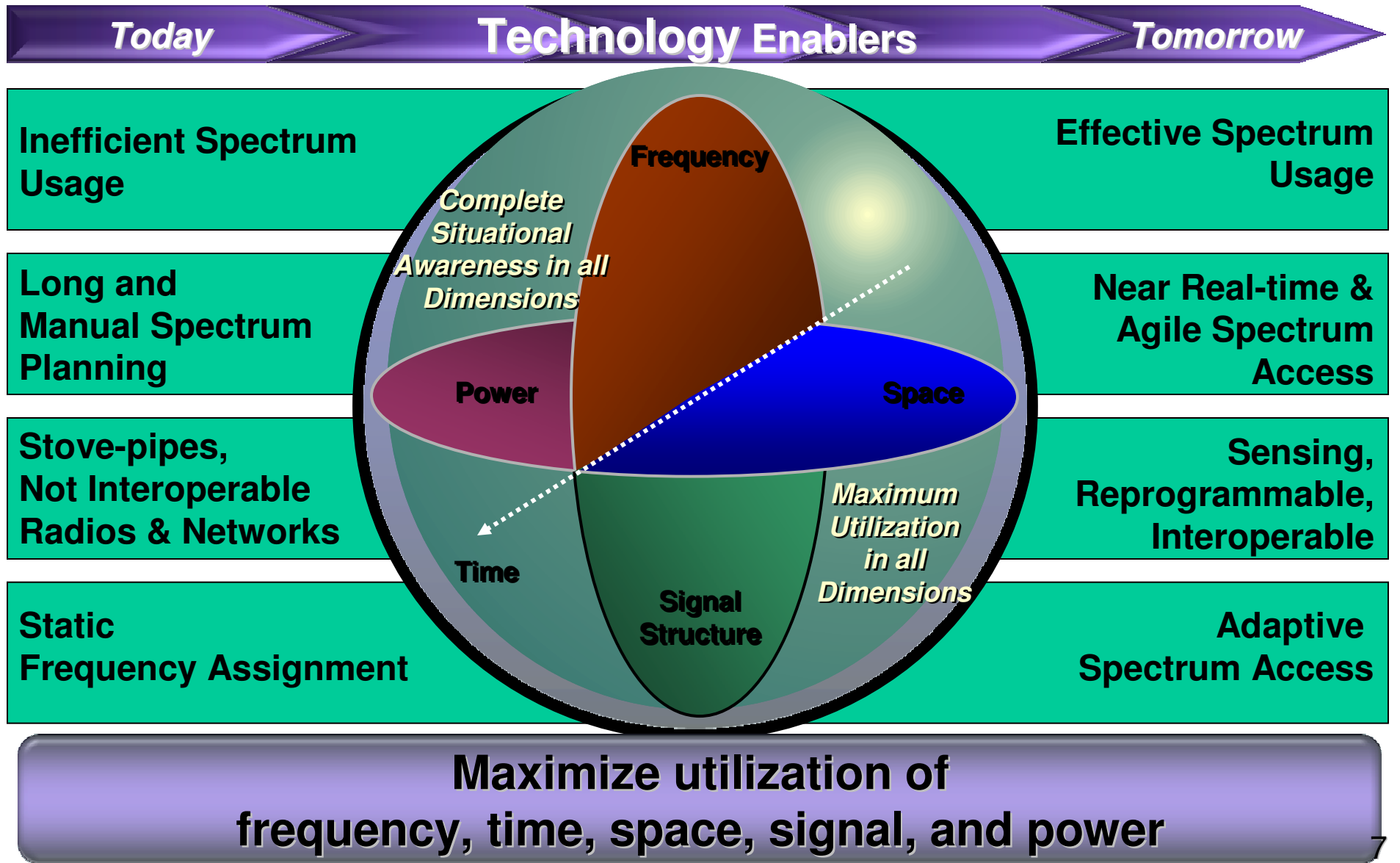


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# Net-Centric Spectrum Management Vision

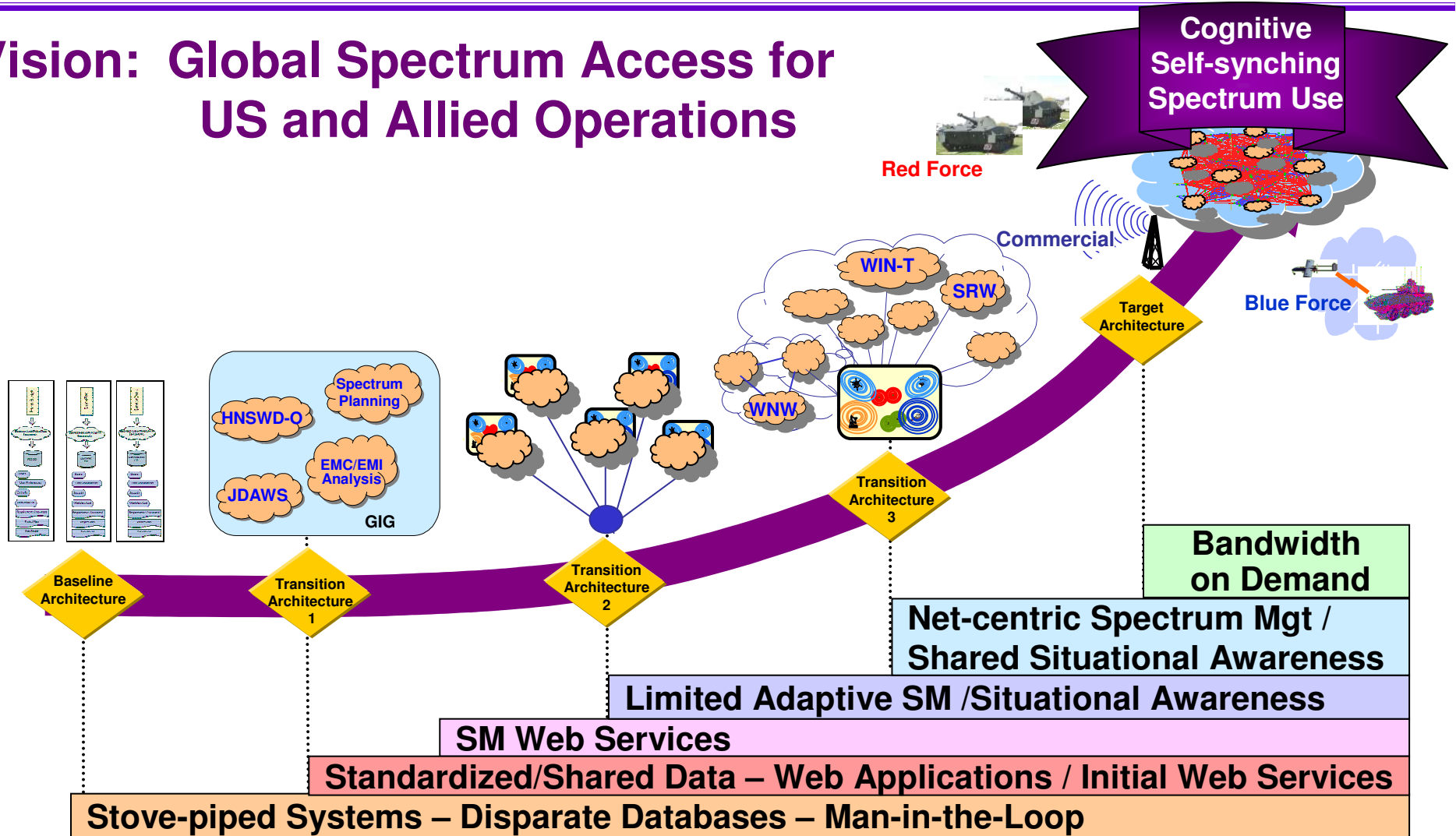




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# Spectrum Management Transformation

## Vision: Global Spectrum Access for US and Allied Operations



EMC/EMI: Electromagnetic Compatibility/Electromagnetic Interference  
 GIG: Global Information Grid  
 HNSWD-O: Host Nation Spectrum Worldwide Database Online  
 JDAWS: JSC Data Access Web Server

SRW: Soldier Radio Waveform  
 WIN-T: Warfighter Information Network - Tactical  
 WNW: Wideband Networking Waveform





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# Defense Spectrum Organization

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## Vision

Global spectrum access for US and allied operations

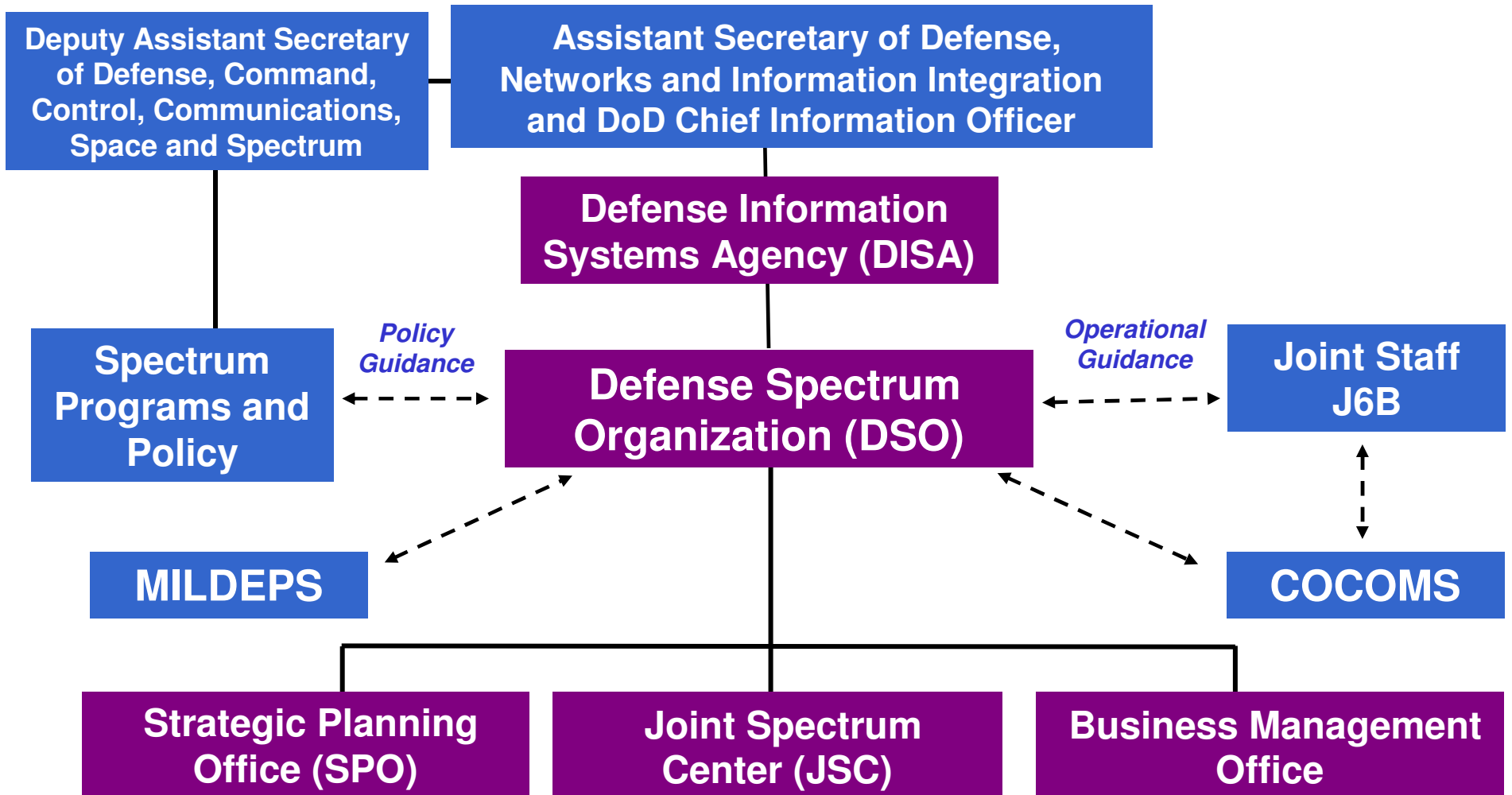
## Mission

DoD Center of Excellence for electromagnetic spectrum, to include integrated planning, policy development, electromagnetic environmental effects engineering, spectrum management, and operations support



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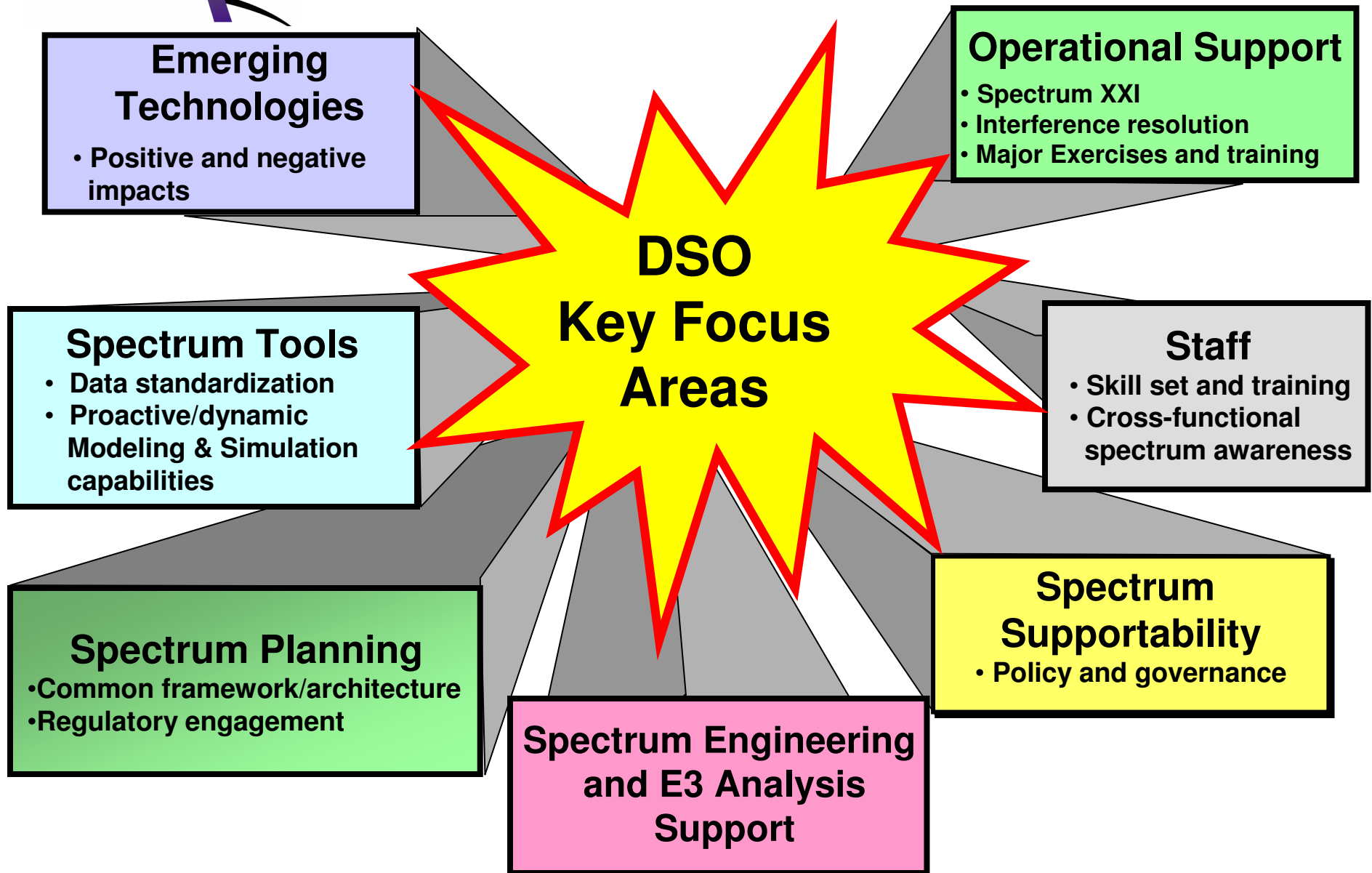
# Defense Spectrum Organization



*Policy – Strategy – Planning – Technology – Analysis – Acquisition – Operations*



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# Joint Spectrum Center Missions

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## Warfighter Support

- Spectrum management (SM) operations teams
- Interference resolution
- Info Ops/Special Technical Ops and Electronic Warfare support
- Hazards of Electromagnetic Radiation on Ordnance (HERO) assessments
- Electromagnetic Environment (EME) data to support deployments
- Joint Service Ordnance Electromagnetic Environmental Effects (E3) Program
- Battlefield SM Training

## Spectrum Information Management

- Collection and maintenance of SM, E3, and HERO data
- Development of DoD E3 technical standards (Lead Standardization Activity)
- Operate and Maintain the DoD Frequency Resource Record System (FRRS)
- Provide SM and E3 training
- Configuration management and maintenance of SPECTRUM XXI Joint frequency assignment tool

## Acquisition Support

- Provide Electromagnetic Compatibility (EMC) analyses, on a reimbursable basis, to DoD Agencies, Federal Agencies and Industry
- Provide E3 Assessments for DoD **acquisition** & **test** communities
- Review requirements and acquisition documents for SM and E3 adequacy
- Measurement and testing support

## Research and Development

- Spectrum Management and E3 information systems development
- Modeling and Simulation development
- EMC analytical tools development
- Research spectrum efficient technologies
- Develop analytical algorithms



# Strategic Planning Office Missions

## National Team

- Development of DoD EM Spectrum Management Strategic Plan and associated Implementation Plan
- Develop the Defense Spectrum Management Enterprise Architecture (DSMA)
- Support the Presidential Spectrum Policy Initiative
- Establish DoD spectrum requirements forecasting
- Conduct strategic outreach
- Represent DISA at the Military Communications-Electronics Board Frequency Panel

## International Team

- Coordinate DoD participation in international spectrum forums (ITU, CITELE, etc)
- Organize and lead DoD preparation at World Radiocommunication Conferences
- Maintain mil-to-mil links through NATO and CCEB, as well as bilateral meetings
- Satellite coordination
- International outreach

## Emerging Spectrum Technologies (EST) Team

- Track, monitor & analysis EST developments and assess impacts on DoD systems.
- Development of spectrum management framework to enable Dynamic Spectrum Access
- EST-related education and outreach activities, including workshops & other events

## Strategic Priorities

- Pursuing net-centric spectrum management transformation goals
- Developing DSO's working relationships with other Federal agencies and with industry
- Accelerating and broadening outreach through mil-to-mil contacts globally



# Unclassified Strategy, Policy, and Guidance

## Electromagnetic Spectrum Management Strategic Plan

**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

**Draft**

**Department of Defense Electromagnetic Spectrum Management Strategic Plan**

- Adapting to the New Strategic Environment -

February 2007  
Office of Assistant Secretary of Defense Networks and Information Integration  
Washington, DC 20301

## E3 and Spectrum Policy

Department of Defense  
**DIRECTIVE**

NUMBER 3222.3  
September 2004

(A) (S)

SUBJECT: DoD Electromagnetic Environmental Effects (E3) Program

References: (a) DoD Directive 3222.3, "Department of Defense Electromagnetic Compatibility Program," August 20, 1999 (deletions canceled); (b) AFS System Publication 1-02, "Department of Defense Dictionary of Military and Anatomical Terms," September 23, 2002; (c) 48 CFR 101-11.600, "Procedures for Data Quality and Supportability of Information Technology (IT) and National Security Systems (NSS)," June 26, 2004; (d) DoD 4500.2-AM, "Defense Standardization Program Policies and Procedures," March 9, 2000.

**1. RESONANT AND PURPOSE**

The Directive:

1.1. Revises reference (a) to update policy and responsibilities for the management and implementation of the DoD Electromagnetic Environmental Effects (E3) Program to ensure mutual electromagnetic compatibility (EMC) and effective E3 control among ground, air, sea, and space-based electronic and electrical systems, subsystems, and equipment, and with the existing national and non-military electromagnetic environment (EME).

1.2. Assigns responsibilities for the execution of the DDEE Program.

1.3. Promotes the following DDEE Program objectives:

1.3.1. Achieving operational EMC for all electronic and electrical systems, subsystems, and equipment developed, acquired, and operated by the DoD Components (Operational EMC and effective E3 control is a sub-set of this system, subsystem, and

Department of Defense  
**DIRECTIVE**

NUMBER 4650.1  
March 2004

(A) (S)

SUBJECT: Policy for Management and Use of the Electromagnetic Spectrum

References: (a) DoD Directive 4650.1, "Management and Use of the Radio Frequency Spectrum," June 24, 1987 (deletions canceled); (b) Section 305 and Chapter 6 of title 47, United States Code; (c) Office of Management and Budget (OMB), Circular A-11, Part 2 (as amended); (d) Title 47, Code of Federal Regulations, Chapter III, Part 300, U.S. Department of Commerce, National Telecommunications and Information Administration (NTIA), "Manual of Regulations and Procedures for Federal Radio Frequency Management," as amended, current edition; (e) through (h), see enclosure 1.

**RESONANT AND PURPOSE**

The Directive:

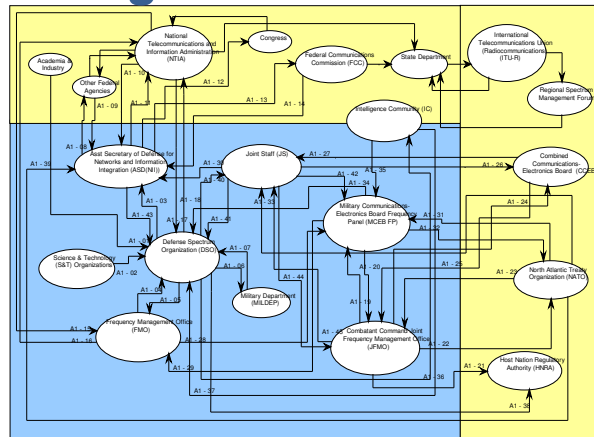
1.1. Revises reference (a) to update the policy and responsibilities for electromagnetic spectrum management and use by the Department of Defense.

1.2. Implements the provisions of references (b), (c), and (d) within the Department of Defense.

Available as paper copy from the Office of Management and Budget, 725 Third Street, NE, Washington, DC 20503 or in format as an electronic product.

DoDI 3222.3 • DoDI 4650.1

## Defense Spectrum Management Architecture





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# Spectrum Supportability

*Addresses the availability of sufficient electromagnetic spectrum for the development, training, and compatible operations of spectrum dependent systems in their intended operational environment.*



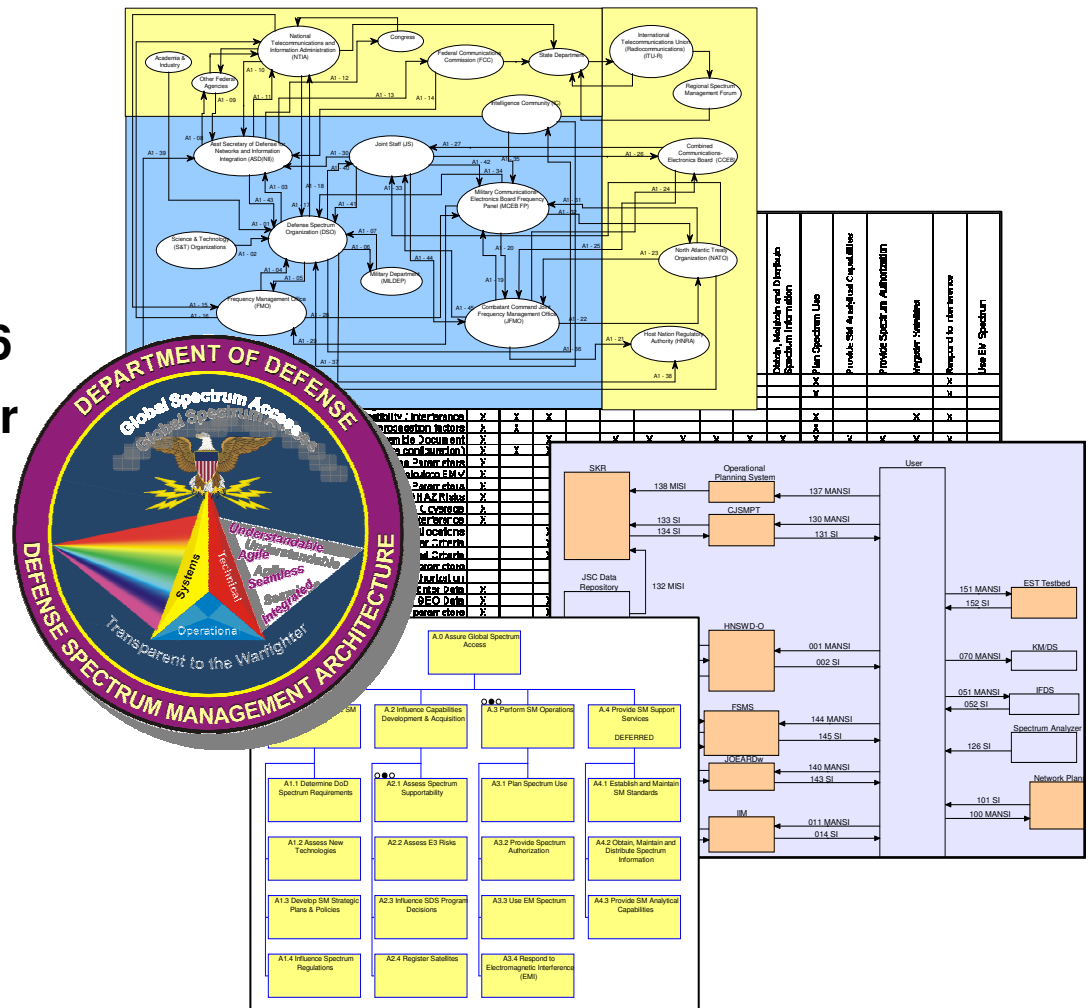
**Vision: All systems fielded can obtain spectrum assignments and operate in such a way as to provide the capability (the warfighter) needed when the requirement was generated**

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# Unclassified Defense Spectrum Management Architecture (DSMA)

- Enterprise Architecture for DoD Spectrum Management (SM)
  - SM component of the GIG
  - Department of Defense Architectural Framework
- “As-Is” products: base-line 2006
- Representative products for four “To-Be” epochs and associated Transition Architectures (TAs)
  - TA1: 2007-2012
  - TA2: 2012-2016
  - TA3: 2016-2020
  - TARGET: 2020+
- Includes Transition Strategy & Roadmap



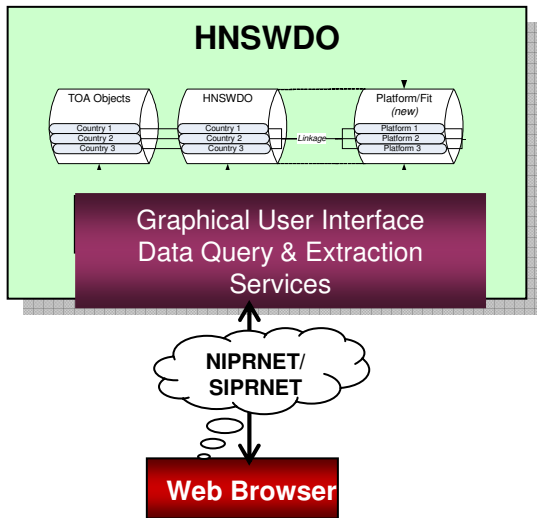




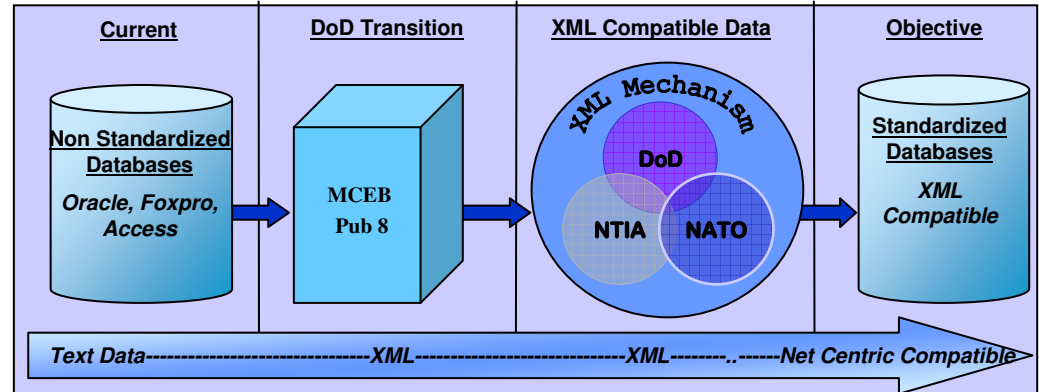
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# Information Sharing and Tools

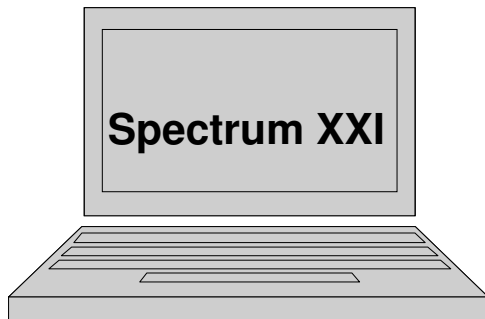
## Host Nation Spectrum Worldwide Database Online (HNSWDO)



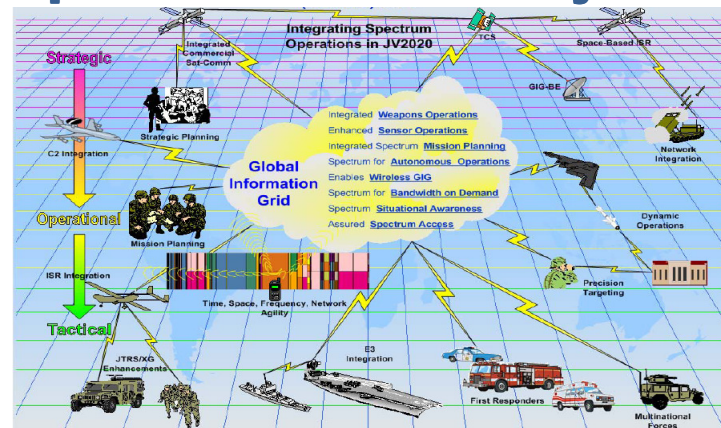
## Data Standardization and Transformation



## Operational Enhancements



## Global Electromagnetic Spectrum Information System

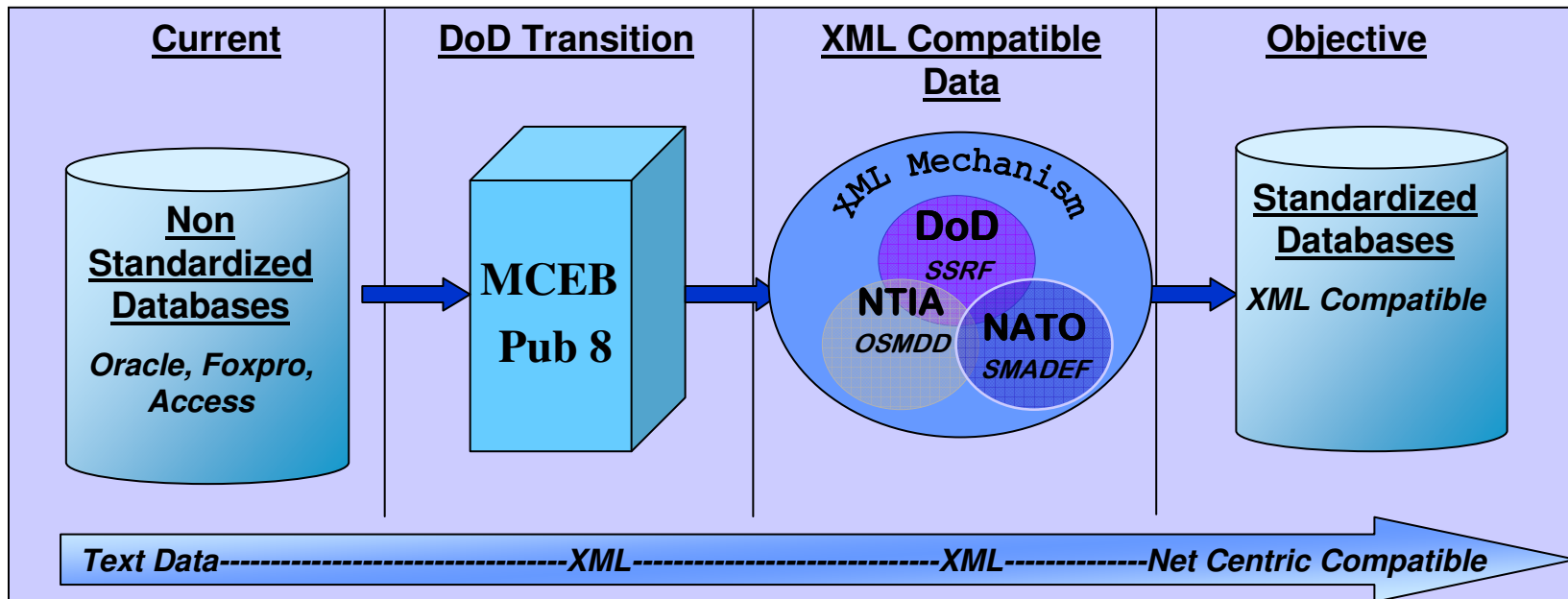


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# Spectrum Data Transformation

- Common data exchange standard using eXtensible Markup Language
  - Leveraging Net-Centric Enterprise Services
  - Data that is discoverable, accessible and understandable
- Improved data access
  - Improved user interface/query capability
  - Machine-to-machine data exchange interface
  - Single sign-on
- Enhanced compliance checking to improve data accuracy



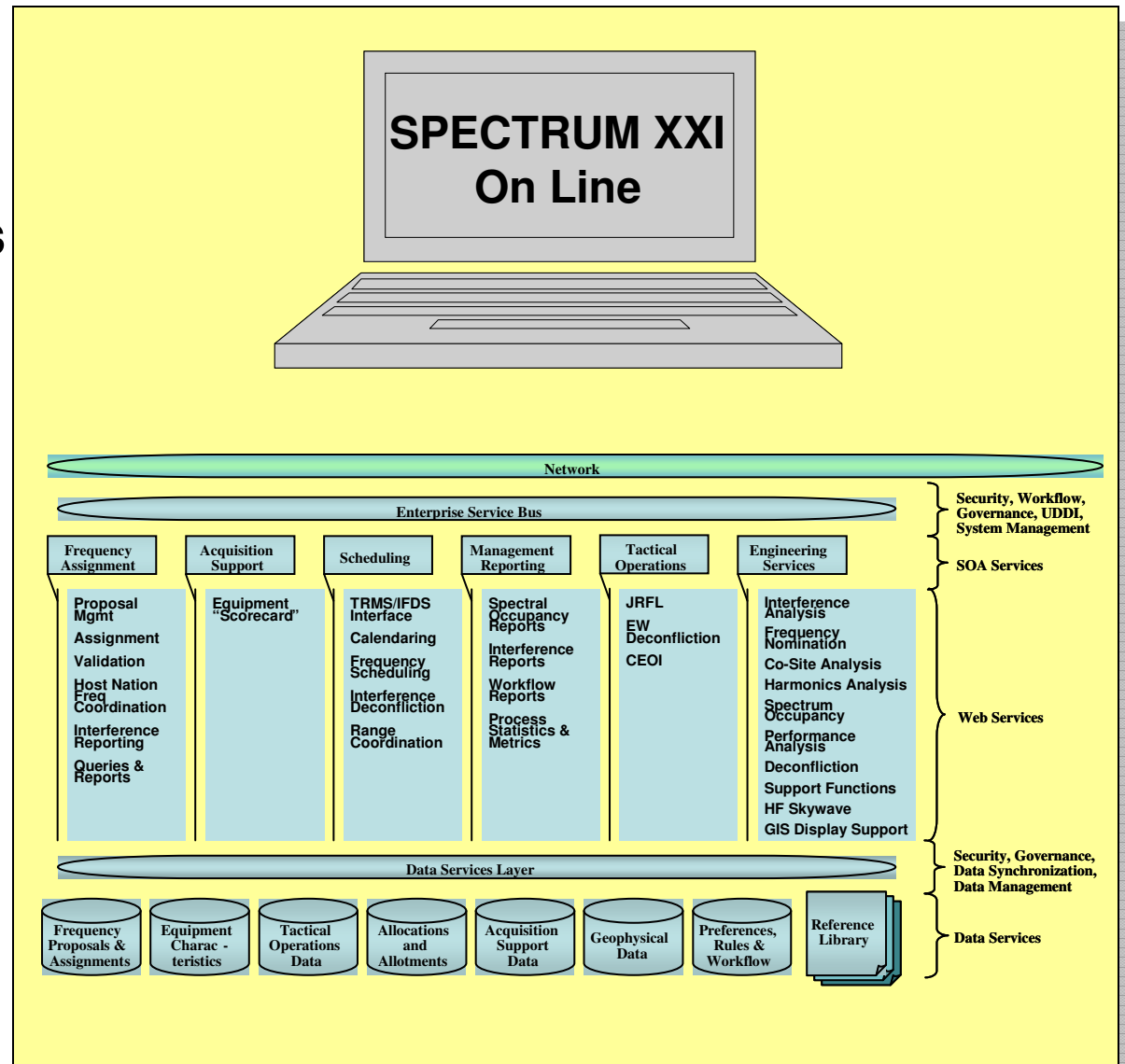
NTIA: National Telecommunications & Information Administration  
OSMDD: Office of Spectrum Management Data Dictionary

SSRF: Standard Spectrum Resource Format  
SMADEF: Spectrum Management Allied Data Exchange Format

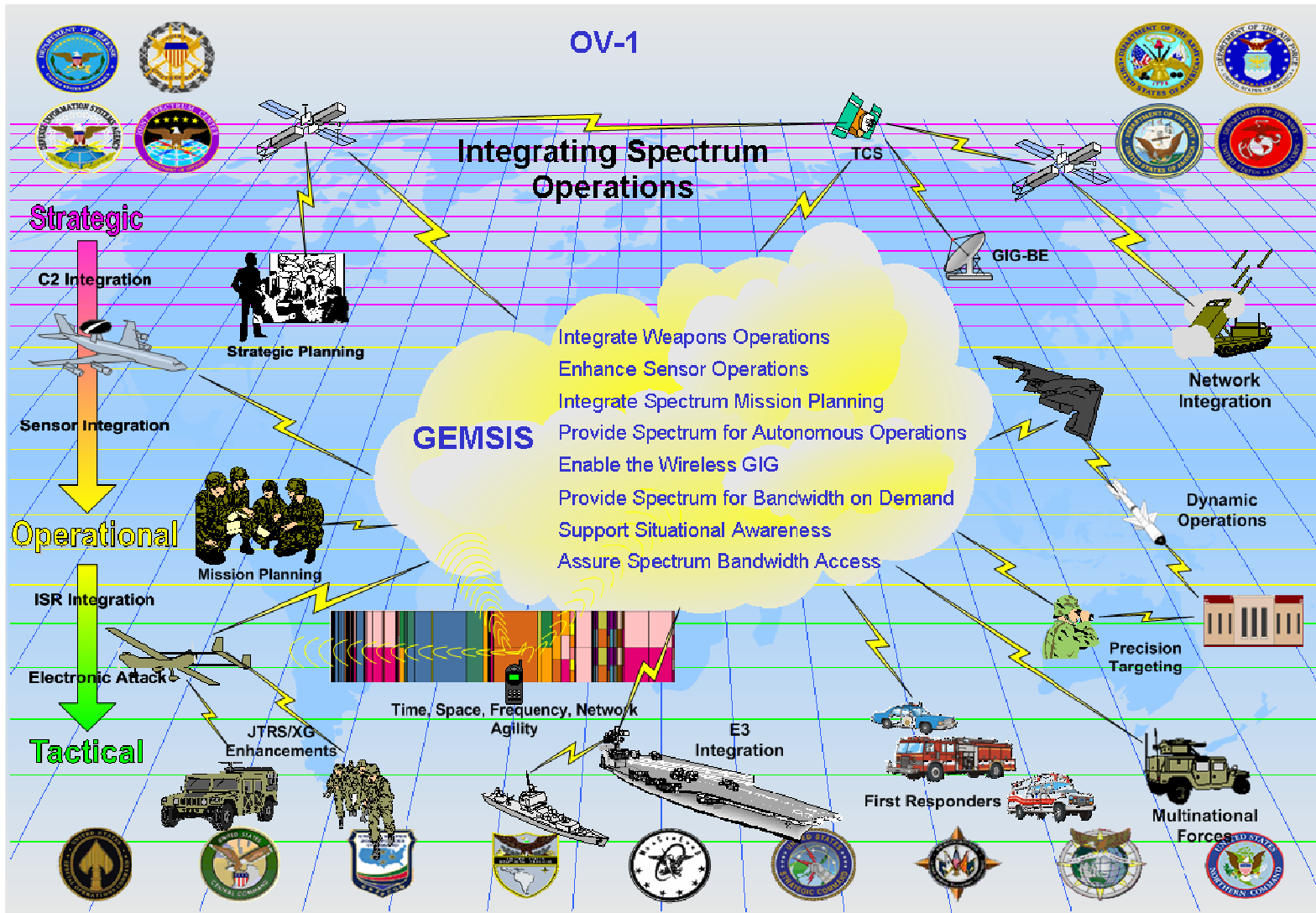


# Near-Term Operational Enhancements

- Improved frequency assignment algorithms
- Improved user interface
- Service-Oriented Architecture
- New spectrum data exchange standard



# Unclassified GEMISIS Overview





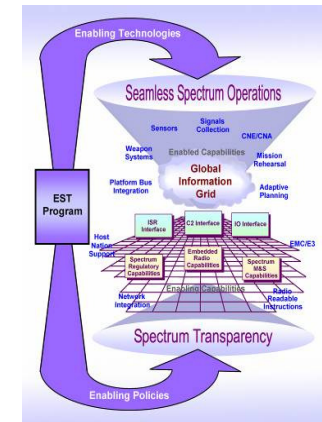
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# Additional Accomplishments

## Operational Support



## Emerging Spectrum Technology



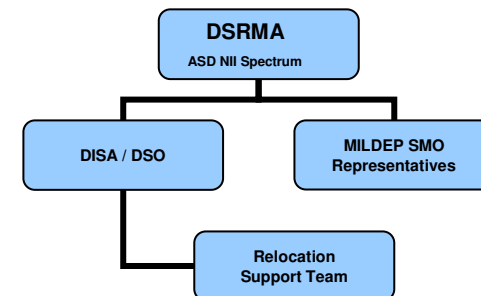
## Outreach and Allied Engagement



## Advanced Wireless Services-Radar Working Group



## Spectrum Relocation

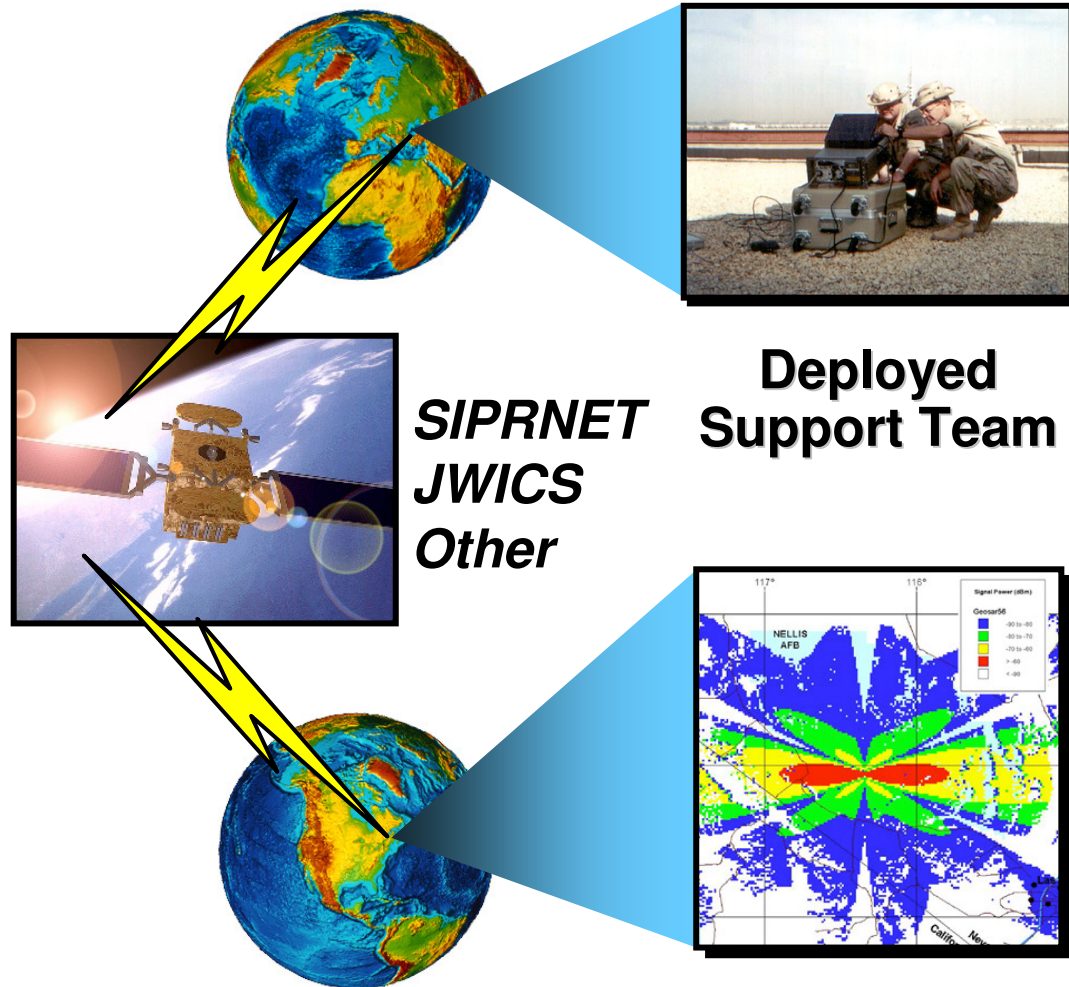


DSRMA: Defense Spectrum Relocation Management Activity

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# Warfighter Support



**Define** - Build spectrum SIGINT database, JCEOI and JRFL, HERO, review OPLANS; Spectrum Mgmt Training, Site Survey

**Manage/Control/Defend** - Deconflict frequencies, Resolve interference (JSIR), EW deconfliction

Databases  
 Area Studies  
 Coverage Plots  
 EMC Outputs  
 IO/STO Support  
 JSIR  
 Review Doctrine & Pubs

SIGINT- Signal Intelligence  
 JCEOI- Joint Communications Electronics Operating Instruction  
 JRFL- Joint Restricted Frequency List  
 HERO- Hazards of Electromagnetic Radiation to Ordnance  
 OPLANS- Operations Plans  
 JSIR- Joint Spectrum Interference Resolution  
 EW- Electronic Warfare

**JSC**



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# Spectrum Relocation

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- **U.S. auction for Advanced Wireless Services (Sep 06)**
  - 104 bidders won 1087 licenses in 1710-1755 MHz for \$13.7B
- **U.S. Federal agencies modifying affected systems**
  - DoD systems impacted
  - Cost of relocation paid for by auction proceeds
  - Up to 4 years to transition systems
  - Working with commercial licensees for early entry and co-existence *if operationally possible*
- **Established single focal point and interactive web site (portal) for coordination and analysis**

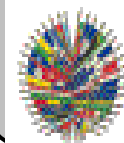
**Enabling new wireless broadband consumer services while protecting critical military operations**



# International Outreach - WRCs

- World Radiocommunication Conferences (WRCs) are international forums for world agreement within the International Telecommunication Union (ITU)
- Held every four years to update/modify the international Radio Regulations
- Operate by consensus, voting only rarely
- The international Radio Regulations form the basis on which individual countries and regions develop their own radio regulations
- Set the world stage for future technological development
- Greater emphasis on consolidated regional positions and proposals
- Directly impact DoD's spectrum access globally

## Regional Preparation



# CITEL



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# **DISA** World Radiocommunication Conference (WRC)

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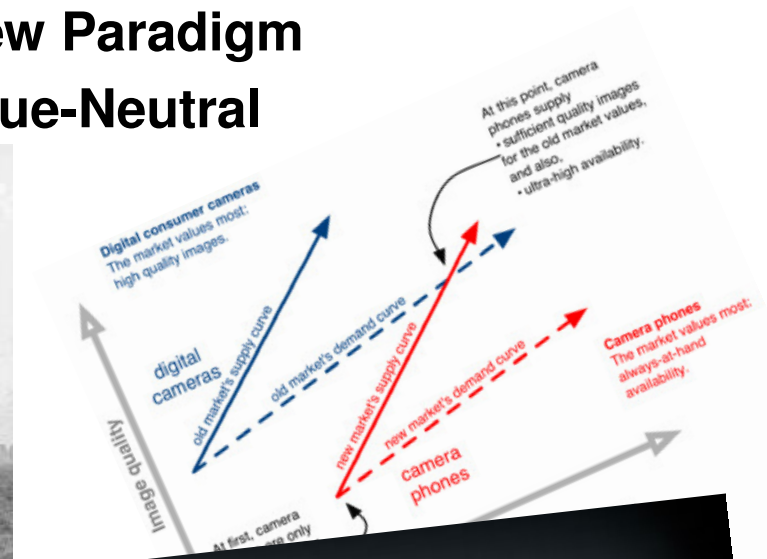
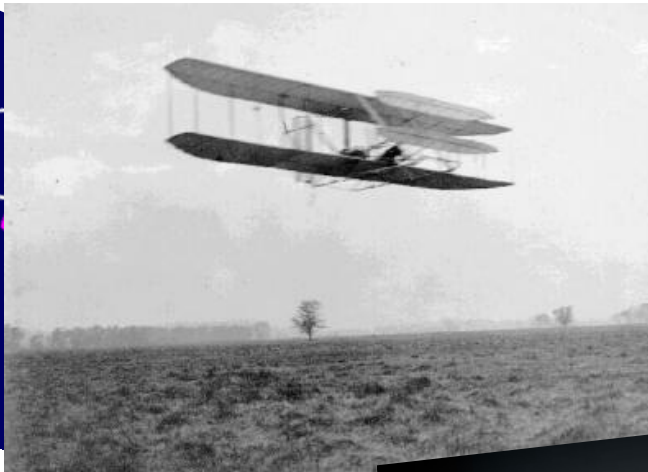
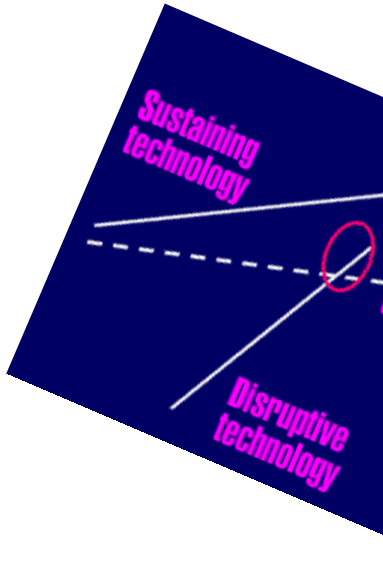
- **Several WRC-07 agenda items were of DoD concern**
- **Significant success protecting DoD interests**
  - Mitigated impacts of additional International Mobile Telecommunications (IMT) spectrum
  - Supported civil aviation requirement while protecting JTIDS/MIDS
  - Preserved HF spectrum critical to military operations
  - Obtained additional aeronautical telemetry spectrum to support flight testing
- **Preparations for WRC-11 have already started**
  - Prevented most harmful proposals from getting on agenda
  - Preparing for several agenda items of significant DoD interest
  - Several items are “wildcards”

**Collaboration = success!**



# Unclassified Dynamic Spectrum Access (DSA) A Disruptive Technology

“Disruptive” = New Paradigm  
The Term is Value-Neutral

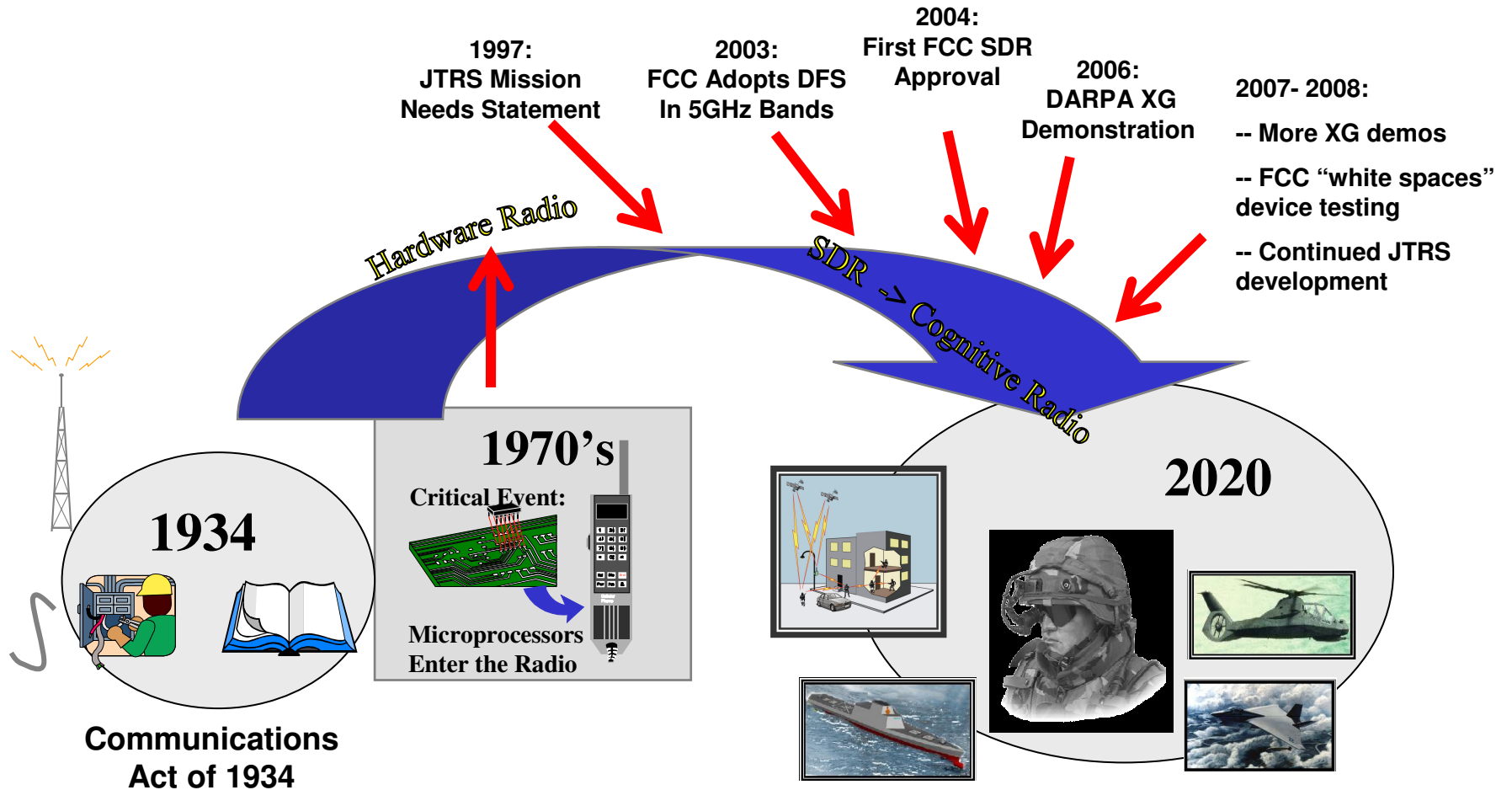


- DSA will shake up business plans and alter interactions among people and groups
- DSA will change the way spectrum is used and managed



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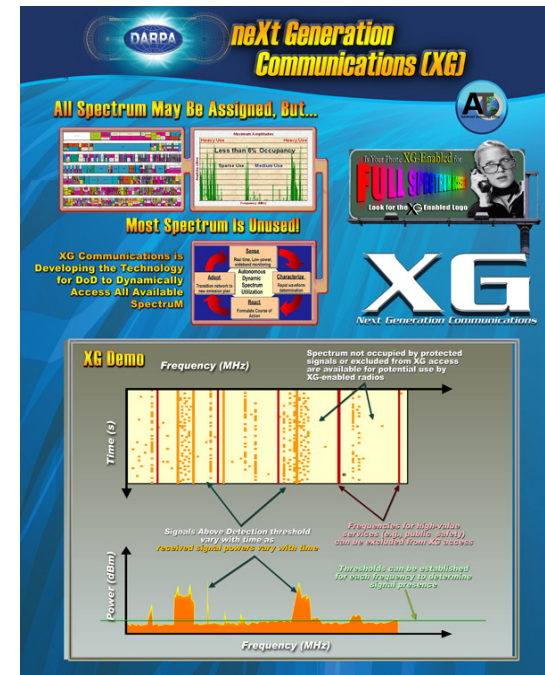
# SDR & Cognitive Radio Evolution



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# DoD's Leadership

- SDR capability pioneered through Joint Tactical Radio System (JTRS)
- DARPA continuing DSA development through its NeXt Generation (XG) program
  - April 2008 demo will employ Army & Marine Corps SDR tactical radios
  - Demo to show XG performance in a jamming environment
- DARPA initiated the Wireless Network after Next (WNaN) program
  - Leverages and extends XG



*The result of the XG program will be to develop and demonstrate a set of standard dynamic spectrum adaptation technologies for legacy and future emitter systems for joint service utility.*

*<http://www.darpa.mil/sto/smallunitops/xg.html>*



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# DSA – The Big Picture

## Regulation and Policy

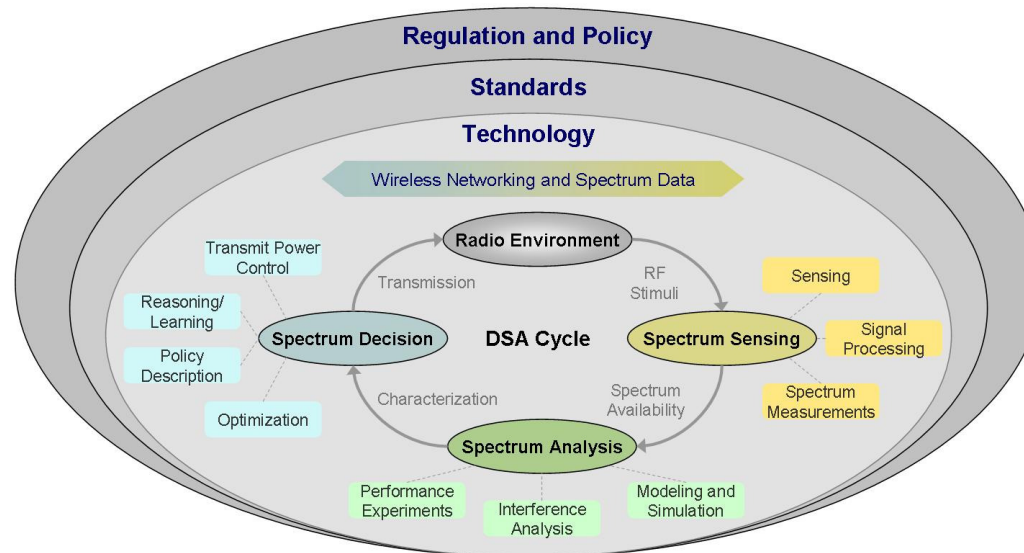
- Policies must keep up with the pace of technology development
- Regulatory challenges
  - Spectrum sharing
  - Waveform and device certification
  - Policy verification and enforcement
  - Security

## Technology

- Multiple devices operating in heterogeneous networks without causing harmful interference
- Technology Components
  - Spectrum sensing
  - Spectrum Analysis
  - Spectrum Decision
  - Wireless Networking
  - Spectrum Data

## Standards

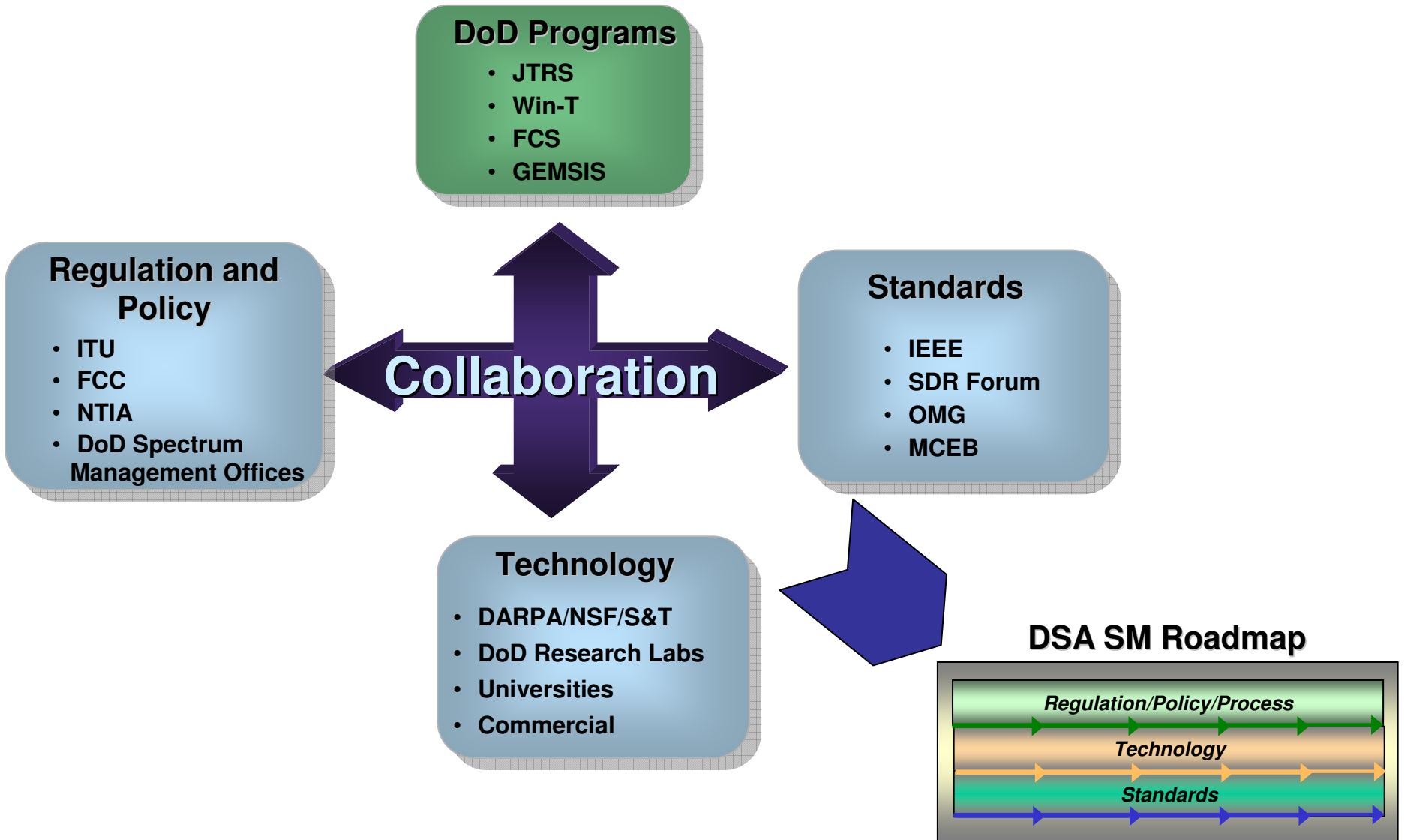
- Technology standardization to broaden vendor base and improve interoperability
- National and International regulatory and standards organizations
  - ITU
  - IEEE WGs (P1900, 802)
  - NTIA SDR WG
  - SDR Forum





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# Collaboration is Key



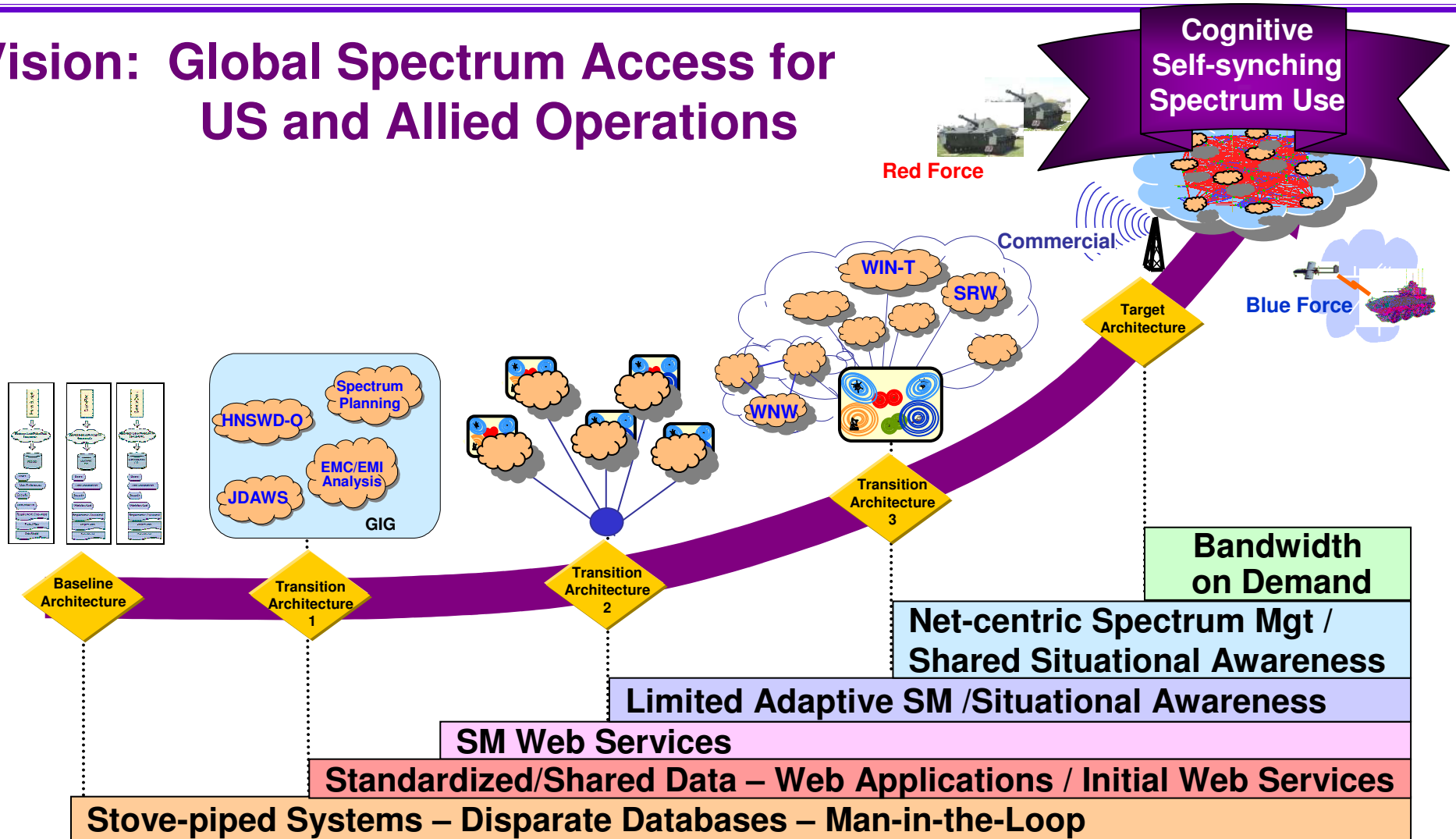
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# Spectrum Management Transformation

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## Key Take Aways

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- **Diversity and complexity of the electromagnetic environment drive the imperative to change**
- **Global mission intensifies spectrum challenge**
- **Must address people, process and technology to enable Defense spectrum management transformation**
- **Partnerships within the DoD, and across the Federal government, academia and industry are critical**
- **We are moving from concept to reality**

**Spectrum is the ultimate team sport!**



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