



DoD's IPv6 Transition

Michael Brig
brigm@ncr.disa.mil
DISA/GE44_V



Why IPv6 In The DoD?

- **Future Combat Systems Demand:**

- Ubiquity (IP Centricity)
- Mobility (+ Ad-Hoc)
- Operability (Security, QOS, NetOps)

IPv4 Cannot Support Future Required Capabilities

- **DoD has extensively deployed NATS.**

- For many reasons.
- Even though we have 15% of IPv4 address space.
- These are causing problems.



UNCLASSIFIED

DoD IPv6 Addressing

- **IPv6 (128-bit) Provides:**
 - 340,282,366,920,938,463,463,374,607,431,768,211,456 Addresses
 - .34 duodecillion (1×10^{38})
- **DoD Address Request (In Work):**
 - /32 (Have Now) = 1 Internet Equivalent (4.3 Billion Networks)
 - /16 (2 Years) = .00152% of IPv6 Address Space)
 - /X (10 Years)
 - /Y (Reserved)
 - 1.8×10^{19} (18,000,000,000,000,000,000) Host Addresses per Network
 - Permits Geospatial Addressing
 - The Soldier is a site (network of networks)

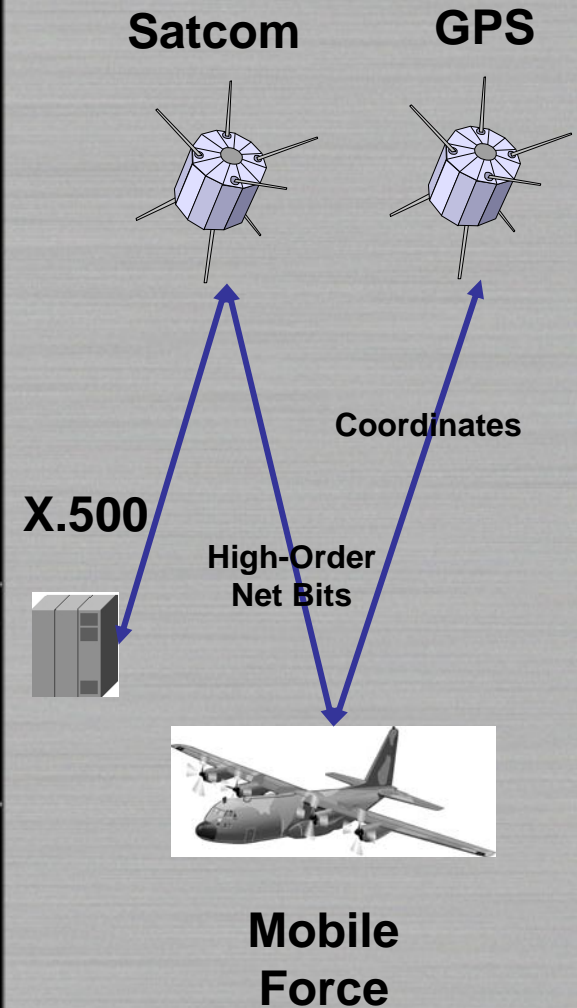
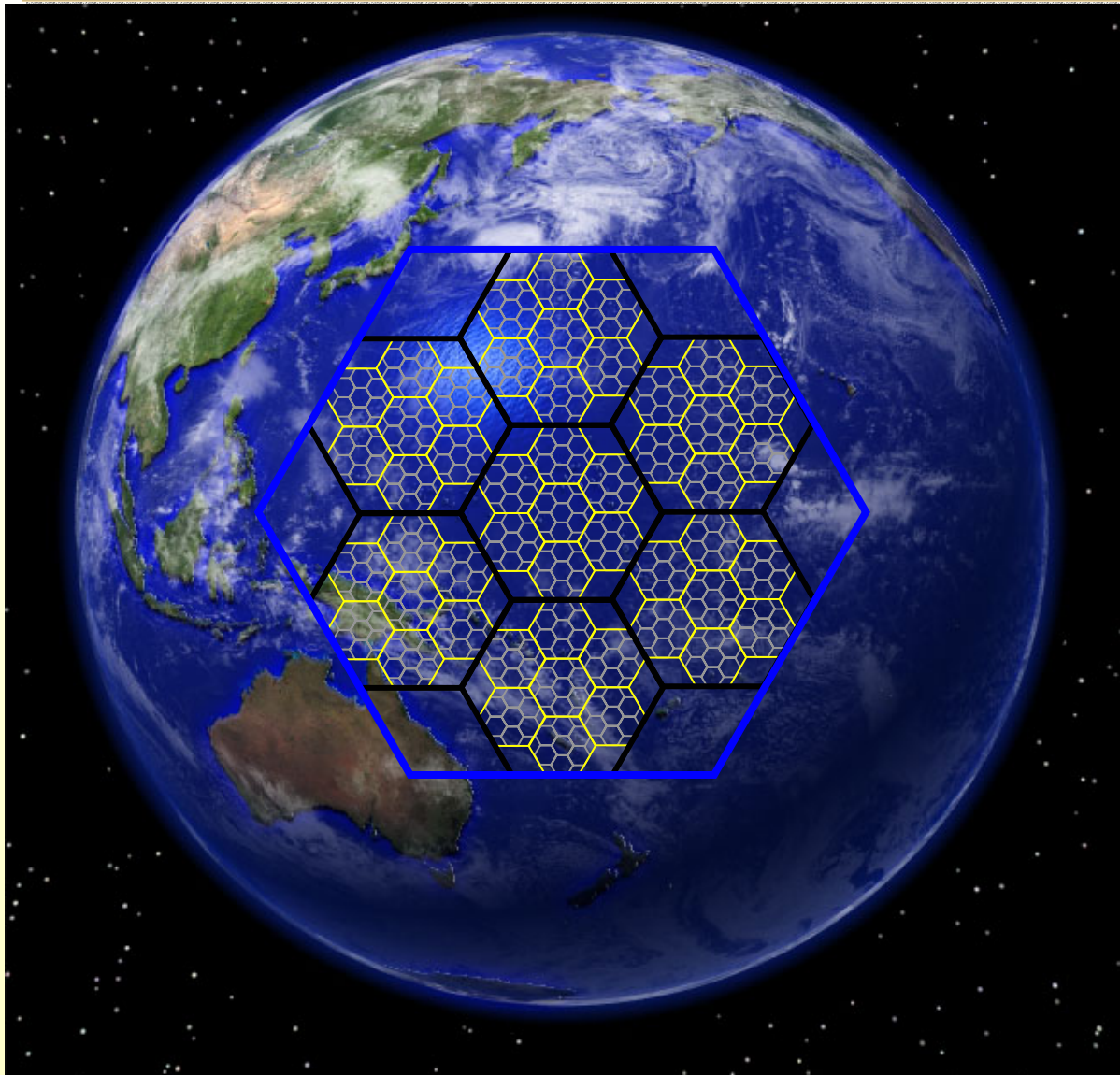


UNCLASSIFIED



UNCLASSIFIED

Global "Geospatial" Grid



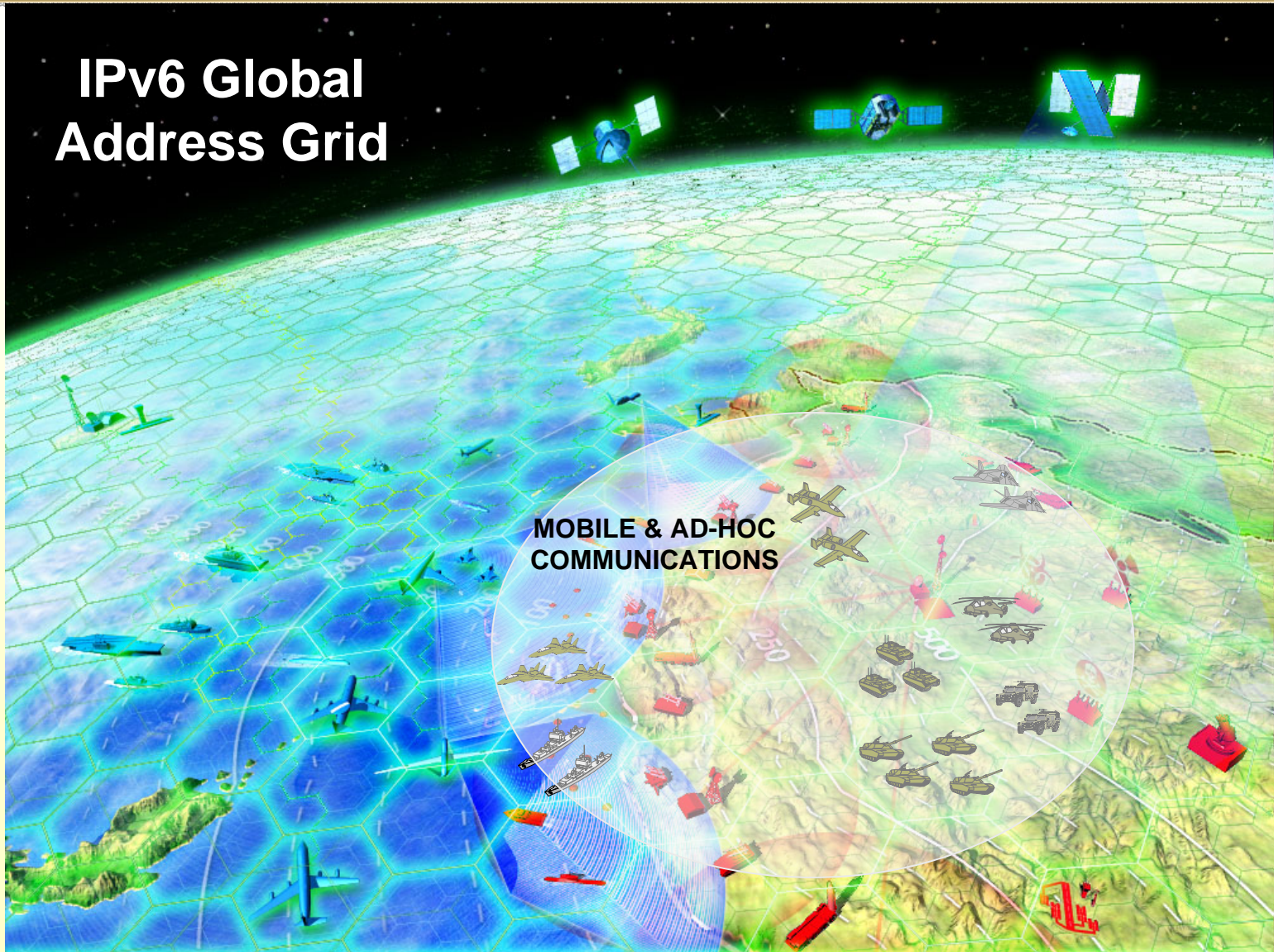


UNCLASSIFIED

IPv6 Address Grid

Mobile & Ad-Hoc Communications

**IPv6 Global
Address Grid**

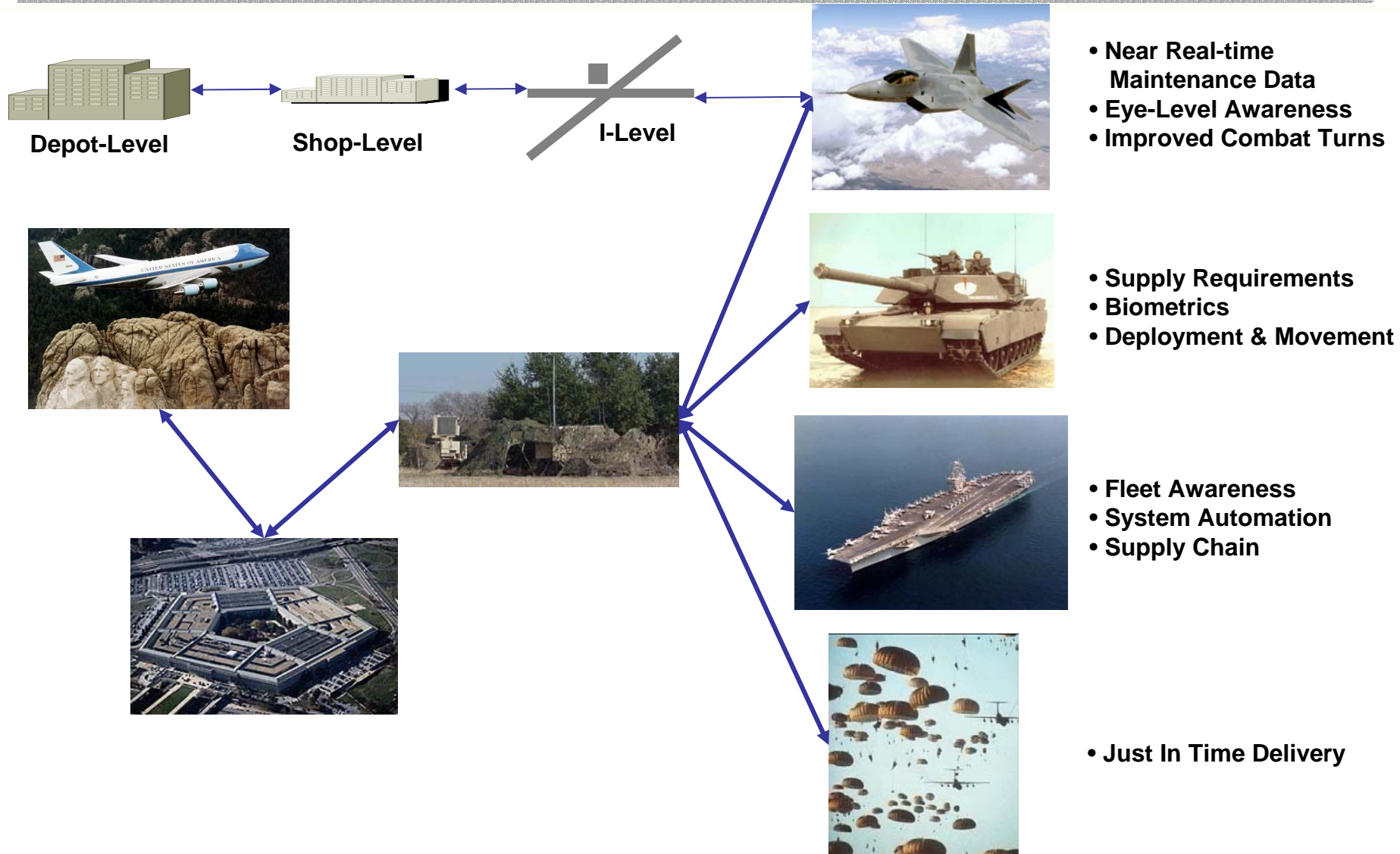




UNCLASSIFIED

Operations & Support

Micro-Electronic Addressing

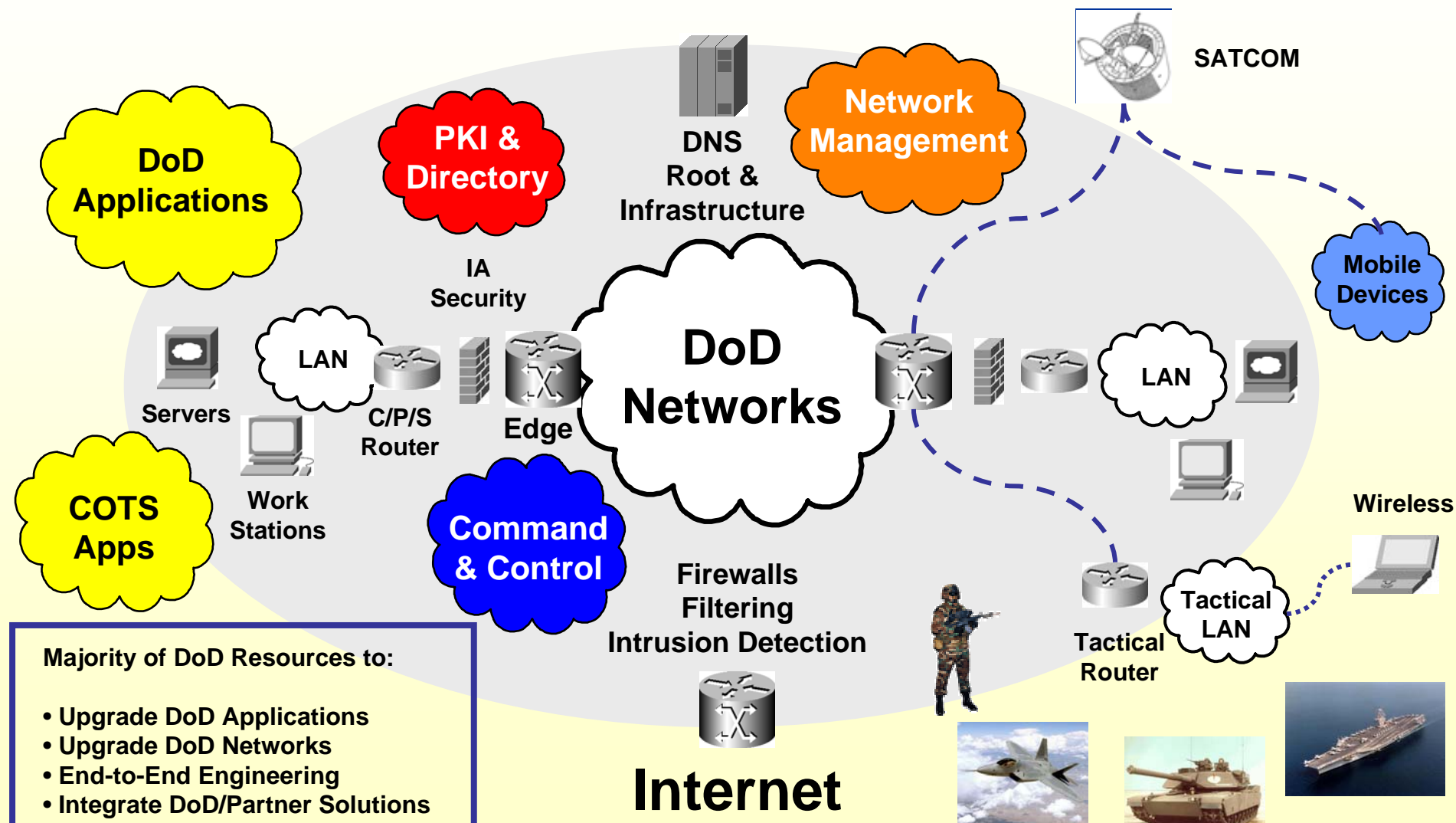




UNCLASSIFIED

Transition Implications

IPv6 Will Touch EVERYTHING



Majority of DoD Resources to:

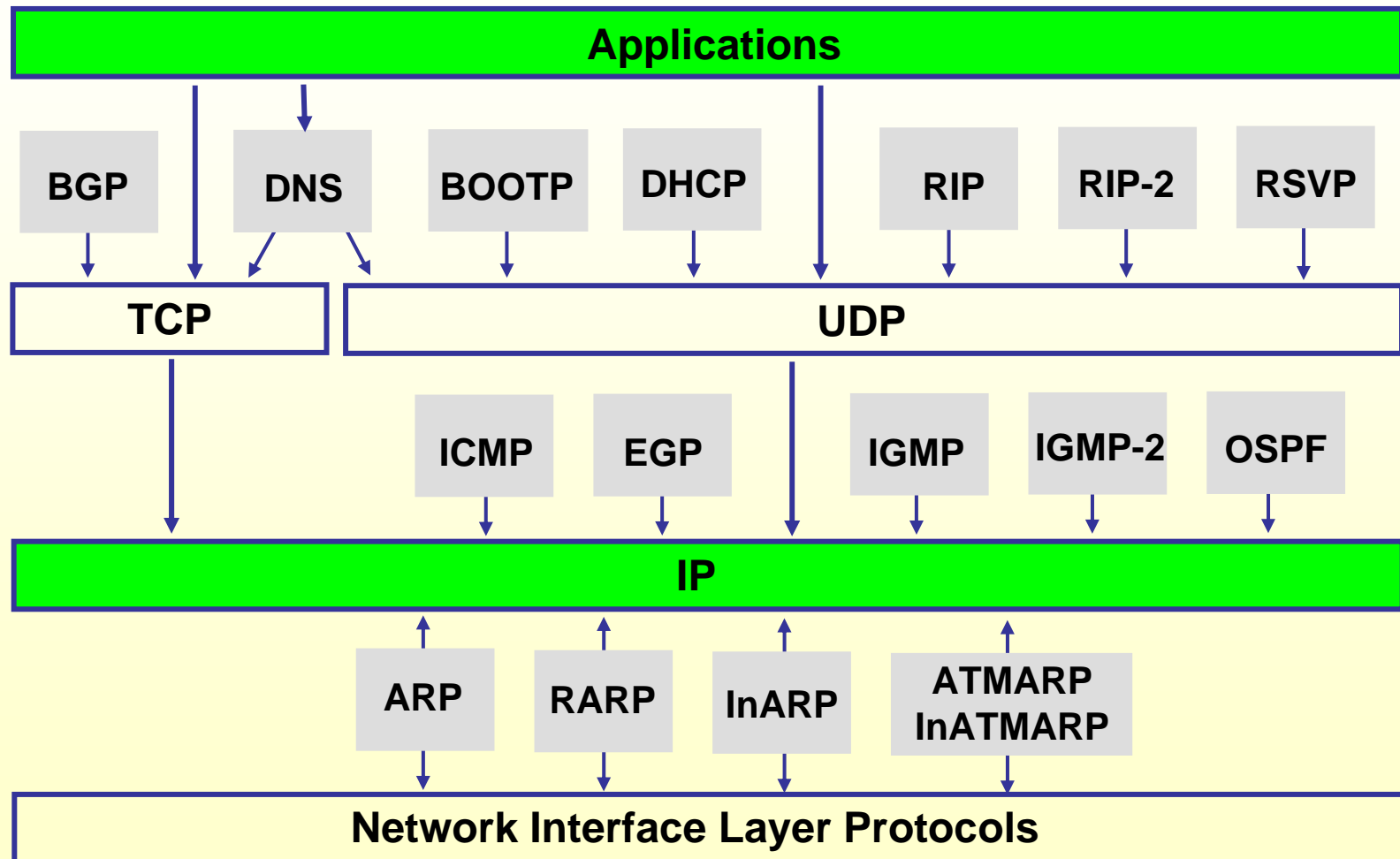
- Upgrade DoD Applications
- Upgrade DoD Networks
- End-to-End Engineering
- Integrate DoD/Partner Solutions
- Develop Mobile/Ad Hoc Capability

UNCLASSIFIED



UNCLASSIFIED

IPv6 Protocol Impacts



UNCLASSIFIED



UNCLASSIFIED

DOD IPv6 Transition Direction*

9 June 2003 DoD(CIO) Memorandum, SUBJECT: IPv6

- 1. Minimize later transition costs by buying IPv6 capabilities now.**
- 2. Address Enterprise issues early via large scale pilot implementations.**
- 3. Execute an aggressive but thoughtful end-to-end transition.**
- 4. Protect interoperability and security during transition.**

Result:

Utilize already programmed technology refresh dollars to fund most of the transition.

Goal:

Complete transition by FY 2008.

UNCLASSIFIED



UNCLASSIFIED

Reducing Transition Risks via Pilots

What Constitutes “Proof” that DoD is ready to Complete Transition to IPv6? For Example:

- Demonstrate security of unclass networks ops, classified network ops,
- Demonstrate end-to-end interoperability in a mixed IPv4-IPv6 environment
- Verify equivalent or better performance than IPv4 based networks
- Demonstrate voice, video, data integration
- Demonstrate effective operation in low-bandwidth environments
- Demonstrate scalability of IPv6 networks
- Support mobile users (voice, data and video)
- Demonstrate transition techniques
- Demonstrate ability to provide netops of networks
- Demonstrates tactical deployability and ad hoc networking

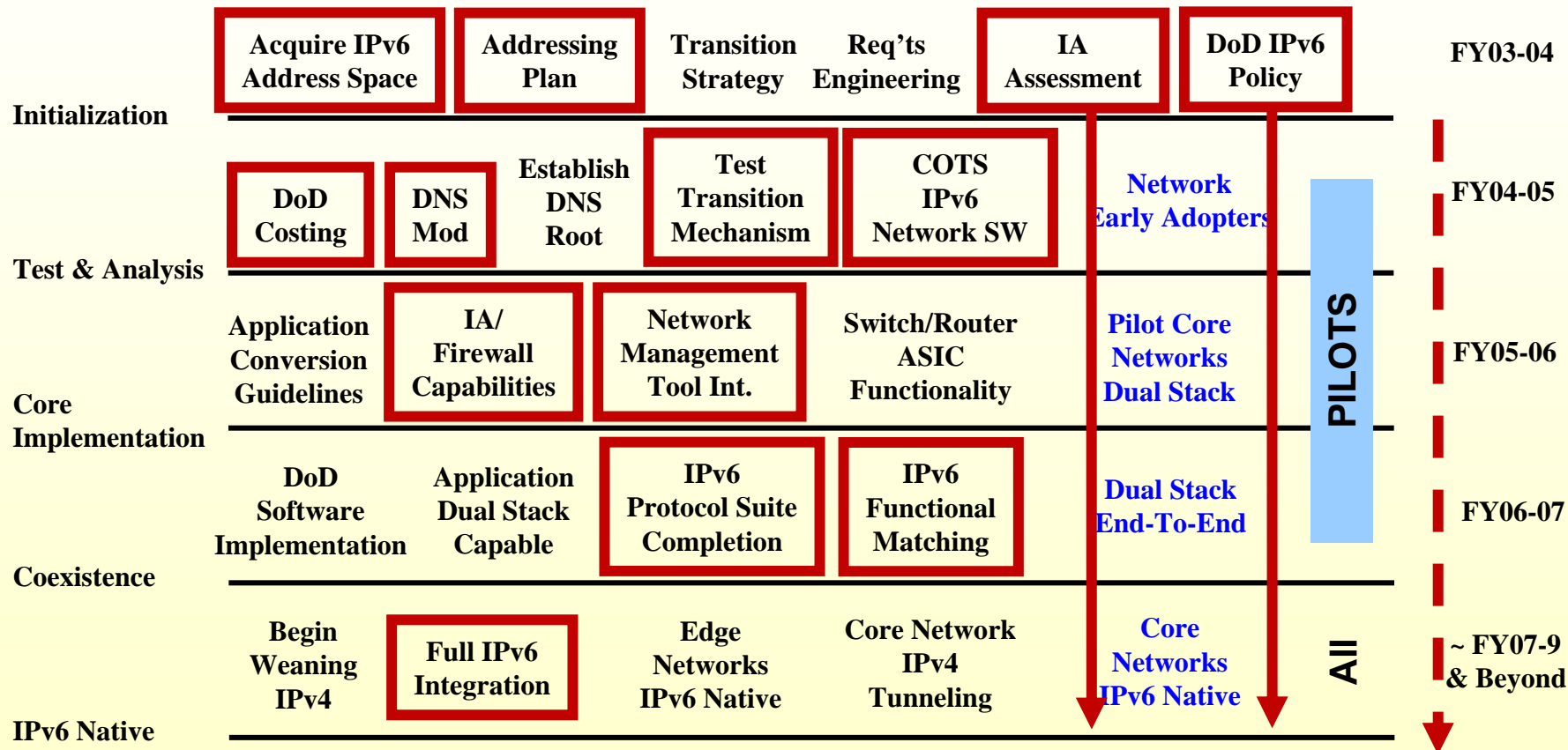
UNCLASSIFIED



UNCLASSIFIED

DoD IPv6 Program

Transition Strategy & Critical Path Milestones



UNCLASSIFIED



UNCLASSIFIED

Transition Challenges For DoD

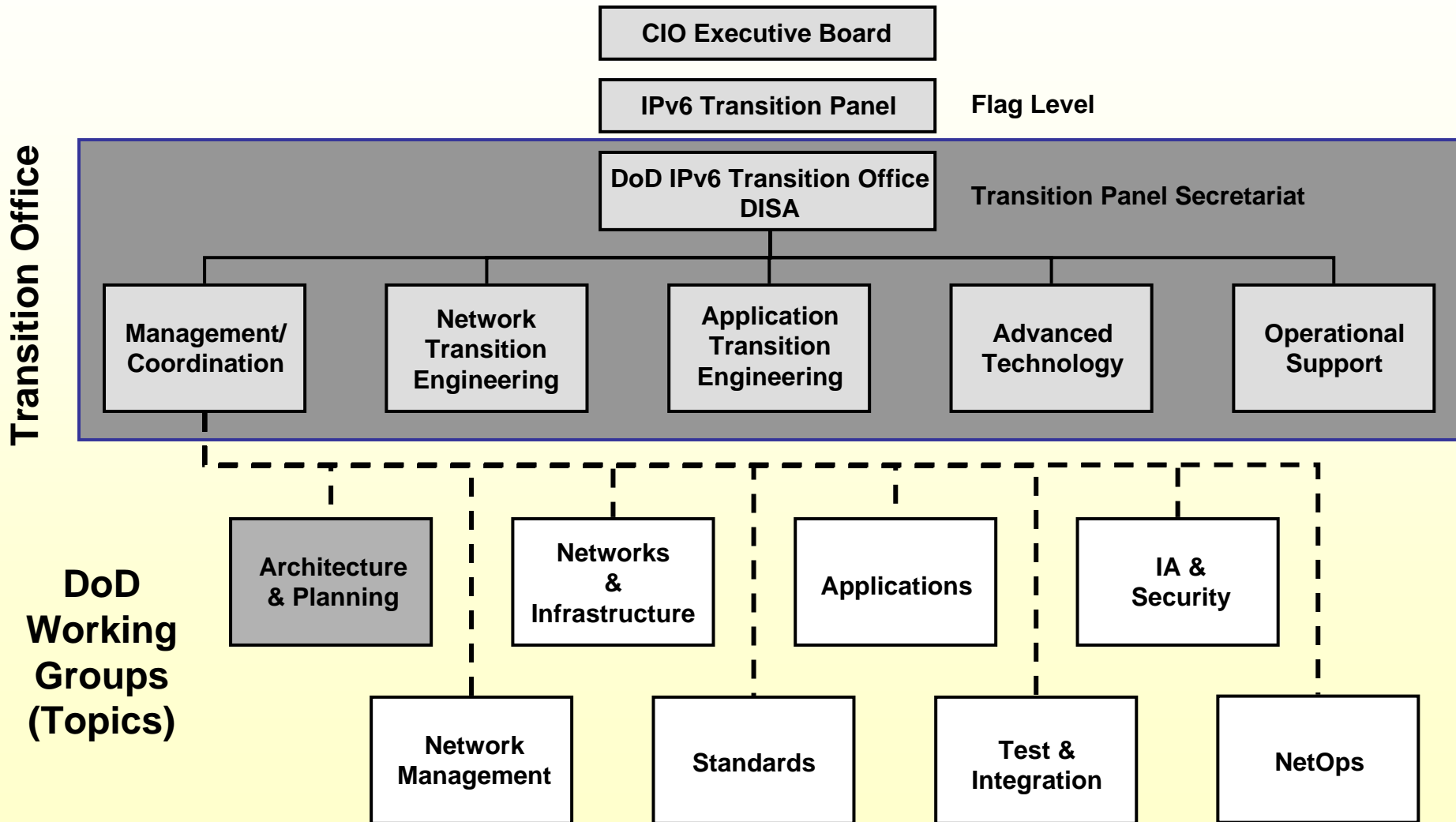
- **Managing/Resourcing the Transition**
- **Maintaining Interoperability and Security During Transition (and after)**
- **IPv6 in the low-bandwidth/mobile environment**
- **Evolving IPv6 standards/products**
- **Residual Legacy**

UNCLASSIFIED



UNCLASSIFIED

IPv6 Implementation Management

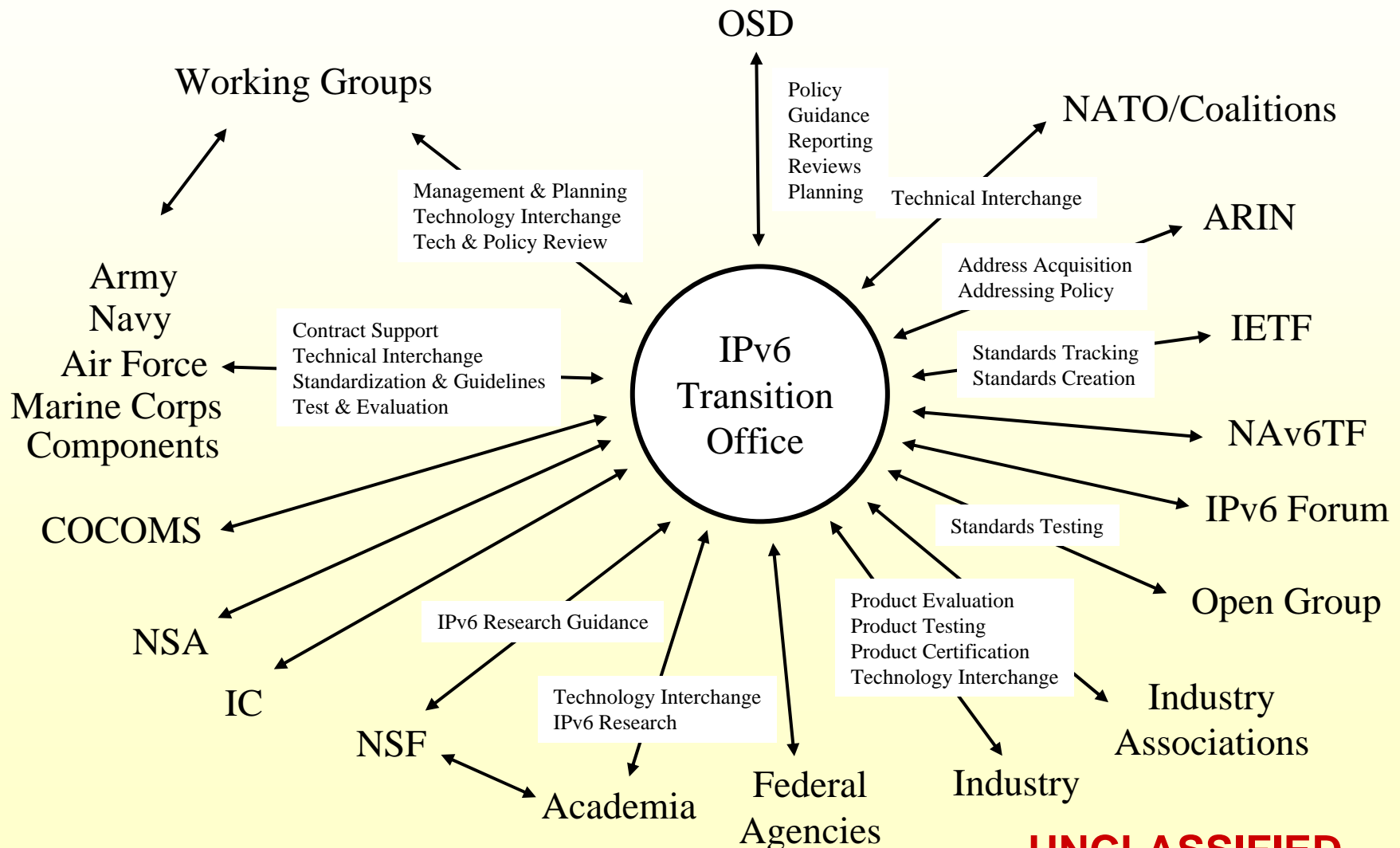


UNCLASSIFIED



UNCLASSIFIED

TO ConOps - Context Diagram



UNCLASSIFIED

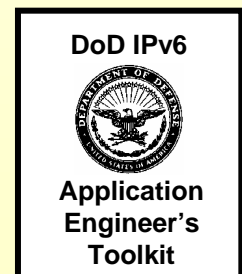
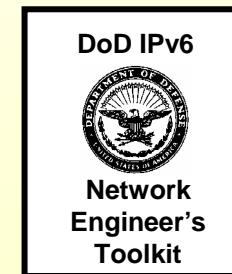
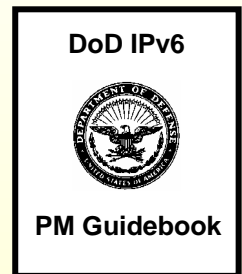


UNCLASSIFIED

TO ConOps

Service Support

- **Requirements Derivation (Engineering)**
 - Develop DoD-Wide Interoperability Requirements
 - Develop DoD-Wide Derived System Requirements
 - Promulgate DoD Requirements to Industry & Standardization
- **Technical Guidance & Infrastructure**
 - IPv6 Addresses & DNS
 - Transition Mechanisms
 - Network Architecture Guidance
 - Application Development Guidance
 - IPv6 Capable COTS Availability
- **Acquisition Guidance**
 - Develop Acquisition Approach and Mechanisms
 - Develop Procurement Strategy
 - Develop Statements of Work



UNCLASSIFIED



TO ConOps

Services Support (cont)

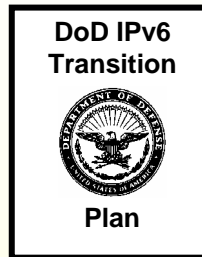
- **Stand up DoD Test Bed**
 - Implement DoD IPv6 Transition Office Node
 - Implement ipv6.mil Domain
 - Develop IPv6 Exchange
 - Integrate DoD IPv6 Labs
 - Utilize Integrated DoD & Industry/Academic Labs
 - Multiply DoD Testbed Capabilities thru Vendor Support (HW/SW/People)
- **Execute Knowledge Management Procedures**
 - Implement SoA IPv6 Knowledge Management System
 - DoD Internal
 - IPv6 Community External
 - Collect, Organize, Sanitize, & Distribute IPv6 Information Resources
 - Policy/Document Repository
 - Technical Guidance Repository
 - Acquisition Repository
 - Guidance
 - Hardware/Software Capabilities



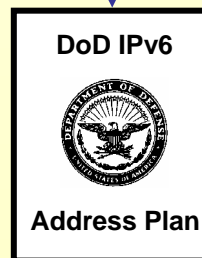
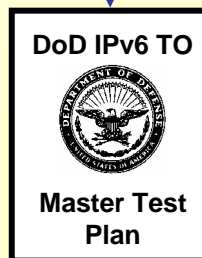
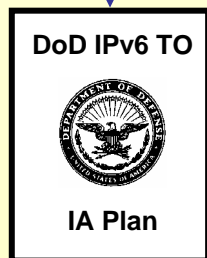
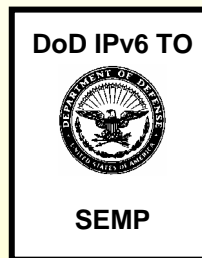
UNCLASSIFIED

Planning

- Strategic Objectives
- Governance
- Operational View



- DoD IPv6 TO ConOps
- Technical Plan
- Schedules
- Reviews



ENTERPRISE ARCHITECTURE - A FRAMEWORK™

	DATA	Where	FUNCTION	How	NETWORK	Where	PEOPLE	Who	TIME	When	MOTIVATION	Why	
SCOPE (CONTEXTUAL)	List of Things Important to the Business		List of Processes the Business Performs		List of Locations in which the Business Operates		List of Organizations Important to the Business		List of Business Events Significant to the Business		List of Business Goals/Strat		SCOPE (CONTEXTUAL)
Planner	Entity = Plans of Business Things		Function = Class of Business Process		Node = Major Business Location		People = Major Organizations		Time = Major Business Event		End/Mean = Major Bus. Goal/Critical Success Factor		Planner
ENTERPRISE MODEL (CONCEPTUAL)	e.g. Semantic Model		e.g. Business Process Model		e.g. Logistics Network		e.g. Work Flow Model		e.g. Master Schedule		e.g. Business Plan		ENTERPRISE MODEL (CONCEPTUAL)
Owner	Ent = Business Entity Rel = Business Relationship		Proc = Business Process IO = Business Process		Node = Business Location Link = Business Linkage		People = Organization Unit Work = Work Product		Time = Business Event Cycle = Business Cycle		End = Business Objective Means = Business Strategy		Owner
SYSTEM MODEL (LOGICAL)	e.g. Logical Data Model		e.g. "Application Architecture"		e.g. "Distributed System Architecture"		e.g. Human Interface Architecture		e.g. Processing Structure		e.g. Business Rule Model		SYSTEM MODEL (LOGICAL)
Designer	Ent = Data Entity Rel = Data Relationship		Proc = Application Function IO = User Views		Node = I/O Function Processor/Storage, etc. Link = Link Characteristics		People = Role Work = Deliverable		Time = System Event Cycle = Component Cycle		End = Structural Assertion Means = Action Assertion		Designer
TECHNOLOGY MODEL (PHYSICAL)	e.g. Physical Data Model		e.g. "System Design"		e.g. "System Architecture"		e.g. Presentation Architecture		e.g. Control Structure		e.g. Rule Design		TECHNOLOGY MODEL (PHYSICAL)
Builder	Ent = Segment/Table/etc. Rel = Normal/Key/etc.		Proc = Computer Function IO = Screen/Device Format		Node = Hardware/System Software Link = Link Specifications		People = User Work = Screen Format		Time = Event Cycle = Component Cycle		End = Condition Means = Action		Builder
DETAILED REPRESENTATIONS (OUT-OF-CONTEXT)	e.g. Data Definition		e.g. "Program"		e.g. "Network Architecture"		e.g. Security Architecture		e.g. Timing Definition		e.g. Rule Specification		DETAILED REPRESENTATIONS (OUT-OF-CONTEXT)
Sub-Constructor	Ent = Field Rel = Address		Proc = Language Stmt IO = Control Block		Node = Addresses Link = Protocols		People = Identity Work = Job		Time = Interval Cycle = Interval Cycle		End = Sub-condition Means = Step		Sub-Constructor
FUNCTIONING ENTERPRISE	e.g. DATA		e.g. FUNCTION		e.g. NETWORK		e.g. ORGANIZATION		e.g. SCHEDULE		e.g. STRATEGY		FUNCTIONING ENTERPRISE

Zachman Institute for Framework Advancement - (810) 231-0531

Copyright - John A. Zachman, Zachman International

IPv6 Standards Profile

MANDATED

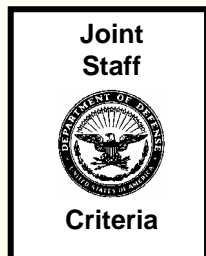
IETF RFC 1886, DNS Extensions to Support IPv6
IETF RFC 3152, Delegation of IPv6. ARPA
IETF RFC 2428, FTP Extensions to Support IPv6 and NATs
IETF RFC 2470, OSPF for IPv6
IETF RFC 2858, Multiprotocol Extensions for BGP-4
IETF RFC 2545, Use of BGP-4 Multiprotocol Extensions for IPv6 Inter-Domain Routing
IETF RFC 2460, Internet Protocol, Version 6 (IPv6) Specification
IETF RFC 2461, Neighbor Discovery for IP Version 6, (IPv6)
IETF RFC 2462, IPv6 Stateless Address Autoconfiguration
IETF RFC 2463, Internet Control Message Protocol (ICMPv6) for the IPv6 Specification

UNCLASSIFIED



UNCLASSIFIED

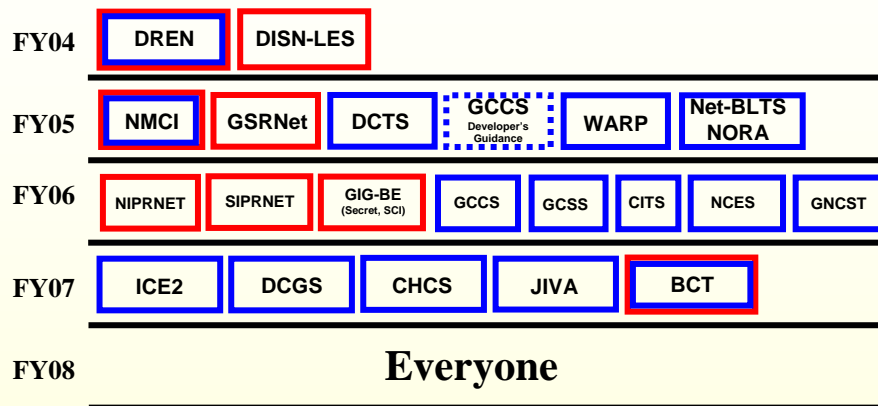
Planning



- Demonstrate security and IA.
- Demonstrate end-to-end interoperability
- Verify IPv6 performance
- Demonstrate voice, video, data integration
- Demonstrate effective operation in low-bandwidth environments
- Demonstrate scalability of IPv6 networks
- Support mobile terminals (voice, data, and video)
- Demonstrate transition techniques
- Demonstrate ability to provide netops of networks
- Demonstrate tactical deployment and ad-hoc networking

Derived Requirements

Verification/Demonstration Matrix



- Derive Engineering Requirements
- Develop Demonstration Matrix
- Validate JS Criteria
- Validate Pilot programs
- Develop Validation/Demonstration Milestones
- Integrate Into:
 - Transition Plan
 - SEMP
 - Master Test Plan
 - IA Plan

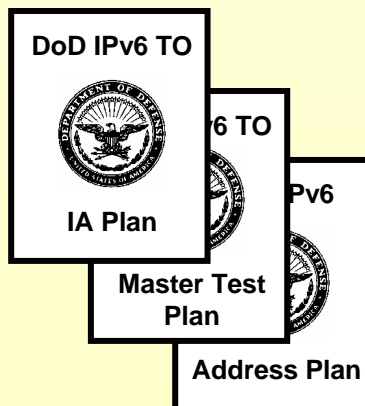
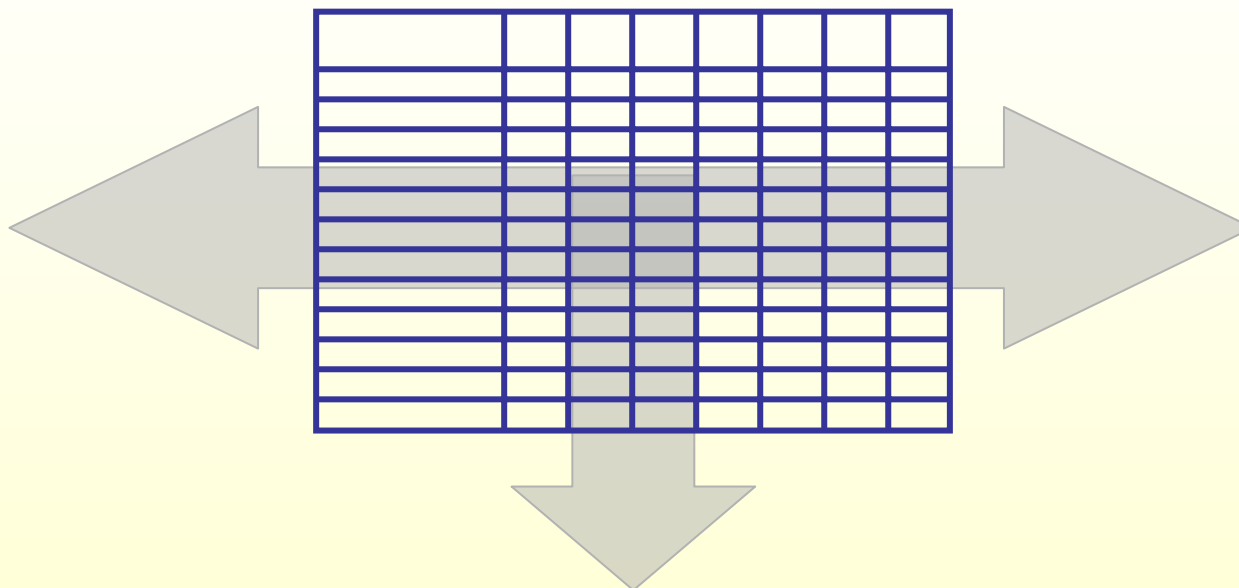
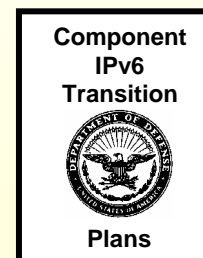
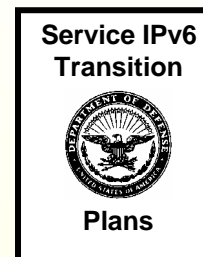
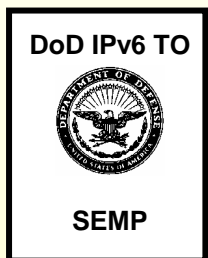
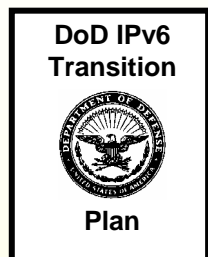
UNCLASSIFIED



UNCLASSIFIED

Planning

Correlation Matrix



UNCLASSIFIED