NCOIC™'s Systems of systems, Capabilities, Operations, Programs, and Enterprises (SCOPE™) Model Tutorial

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Lockheed Martin
Chair, SCOPE Working Group, NCOIC
25 October 2010

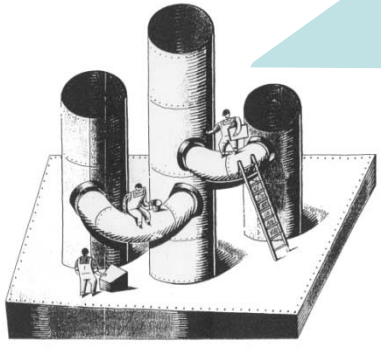
Network Centric Operations Industry Consortium

Vision

Industry working together with our customers to provide a network centric environment where all classes of information systems interoperate by integrating existing and emerging open standards into a common evolving global framework that employs a common set of principles and processes.

Net-Enabled Future

Today: Stovepiped Systems, Point-to-Point Networks



Mission

Our mission is to facilitate the global realization of Network Centric Operations. We seek to enable interoperability across the spectrum of joint, interagency, intergovernmental, and multinational industrial and commercial operations. NCOIC is global, with membership open to those who wish to apply the vast potential of network centric technology to the operational challenges faced by our nations and their citizens.

NCOIC is a Unique Organization

NCOIC™ exists to facilitate the global realization of Network Centric Operations/Net Enabled Capability. We seek to enable interoperability across joint, interagency, intergovernmental, and multinational industrial and commercial operations.

- Global Organization
- Voice of industry
- Cadre of technical experts
- Dedicated to interoperability
- Advisory Council of senior advisors who help prioritize our work in a non-competitive environment

In the photo: BrigGen Dieter Dammjacob (DEU AF)-J3 NATO Supreme Headquarters, Allied Powers Europe; Lt.Col. Danut Tiganus-CIS Directorate, EU Military Staff; Dr. Tom Buckman-NC3A Chief Architect; Gen Harald Kujat,-German AF (Ret.) former Chief of Staff of German Armed Forces & head of NATO Military Committee, Marcel Staicu-European Defense Agency NEC Project Officer .

NCOIC Members

- 80+ Member Organizations

including leading IT and Aerospace & Defense companies, government organizations, non-governmental organizations and academic institutions

- Members from 18 Countries
- Advisors from 26 key stakeholders

from Australia, EDA, France, Germany, Italy, NATO, The Netherlands, Sweden, UK and US

Working Group collaboration

Executive and Advisory Council joint meeting

Technical Council

Terry Morgan honors outgoing Advisory Council Chair, Keith Hall

Collaboration

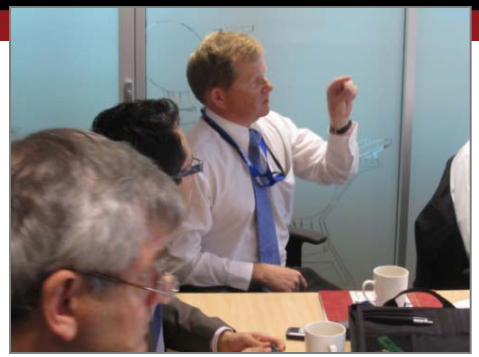
- NCOIC facilitates interoperability by collaboration
  - Member organizations & Advisory Council
  - Our member's customers
  - Agencies of global governments
  - Other NCO stakeholders

- Collaboration occurs through
  - Invited Review of developing documents & architectures
  - Joint demonstrations and white papers
  - Joint and hosted forums, symposia and workshops
  - Joint technical development with stakeholders
  - LOI, LOA, MOU, CRADA and other agreements

Photo and screen captures from member lab interoperability demonstration, Rome, May 2010

NCOIC provides guidance for network centric standards and their patterns of use.

Global Stakeholders



Members develop a SCOPE™ workshop for Australian Department of Defence with Rapid Prototyping Development & Evaluation organization

CDR Fred van Ettinger, (NLD N) C2 Centre of Excellence, signs Letter of Agreement with NCOIC

Members speak with Carlo Magrassi, European Defence Agency Deputy Chief Executive for Strategy

- **“**The Australian Department of Defence is a keen supporter of NCOIC, its principles and tools. We aim to apply NCOIC’s products to our acquisition process to better define interoperability requirements and improve through-life systems integration prospects.” **John McGarry, Australian Air Commodore.**
- "We have used NCOIC’s NCAT™ tool to assess levels of interoperability during NATO Response Force exercises. Our Centre of Excellence found the tool to be very useful in establishing the level of interoperability." **Commander Fred van Ettinger, Section Head of the Multi National Command and Control Centre of Excellence.**
- **“**NCOIC has four characteristics which make it unique. The organization is solely dedicated to network-centric operations and interoperability; its membership stimulates discussions about global interoperability; it serves as a ‘vendor neutral’ forum, and it has a cadre of industry’s top technical experts who are available to do its work.” **Jack Zavin, U.S. Office of the Assistant Secretary of Defense, Networks and Information Integration.**

Relationships

- **Government**
  - Australia Defence Organization (ADO)
  - Eurocontrol
  - European Defence Agency
  - NATO
    - ACT
    - NC3A
    - NCSA
  - Netherlands Command & Control Centre of Excellence
  - Sweden Civil Aviation Authority (LFV)
  - Sweden Defence Materiel Administration (FMV)
  - US Defense Information Systems Agency (DISA)
  - US Department of Homeland Security (DHS)
  - US Federal Aviation Administration (FAA)
  - US Joint Forces Command (JFCOM)
  - US NAVAIR
  - US SPAWAR
  - OSD(NII)
- **Organizational**
  - Australia Defence Information & Electronic Systems Association (ADIESA)
  - NATO Industry Advisory Group (NIAG)
  - OASIS
  - World Wide Consortium for the Grid (W2COG)

2008 IDGA Award:
Outstanding Contribution
to the Advancement
of Network Centric Warfare

NCOIC Key Deliverables

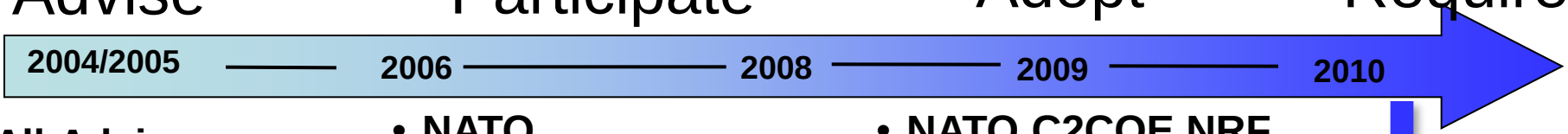
Addressing Inter-Agency, Cross-Industry NCO Gaps

- **Systems, Capabilities, Operations, Programs, & Enterprises (SCOPE™) Model**
  - Characterization of commercial, civil, and government requirements for interoperable systems
- **NCOIC Interoperability Framework™ (NIF) and Net Centric Patterns**
  - Recommendations for open standards and their patterns of use to obtain interoperable systems
- **Building Blocks**
  - Catalog of COTS & GOTS open standards based products compliant with NIF recommendations
- **Network Centric Analysis Tool™ (NCAT)**
  - Netcentric analysis of system architectures, including System-of-Systems and Federation of Systems architectures
- **NCOIC Lexicon**
  - A glossary of terms and definitions that lay the foundation for meaningful discussions. Provides a common language for the disparity of ideas concerning key terms, including "NCO."
- **Systems Engineering best practices and processes**
  - These best practices and processes include tools, process and maturity models, modeling techniques, and collaborative environments for NCOIC integration.

These products, combined with NCOIC member expertise in NCO/NEC, measure netcentric capabilities ,requirements, gaps and provide recommendations for interoperability

Sustained Effort to Make NCOIC Products Part of Procurement Process

Overarching Goal: NCOIC deliverables are adopted, utilized and required by customer agencies



- **All Advisory Council Members**
- **US Defense Science Board**

- **NATO**
  - C3 IPT
  - NCA FT
- **DISA (US)**
  - CRADA
  - OSWG
  - NCAT
- **OSD-NII (US)**
  - NCAT
  - OSWG
  - Cybersecurity
- **FAA/JPDO (US)**
  - Aviation IPT (NextGen/NEO)

- **NATO C2COE NRF**
  - NCAT
- **USAF SPACECOM**
  - NCAT
- **FAA/Eurocontrol**
  - SCOPE/NCAT/Patterns
  - FAA OTA
- **US DoD**
  - Net-Centric Attributes
- **Australian DoD**
  - SCOPE/NCAT
  - Patterns/BBs

- **US DOD/DAU**
- **Aus DoD/RPDE**

NCOIC is Pursuing Plans to Further Increase Influence in Future Procurements

NCOIC Terms

- Network-Centric:
  - Related to systems and patterns of behavior that are influenced significantly or enabled by current and emergent networks and network technologies. Often these center around IP-based internetworking, but the term is sometimes used to include any type of enabling network.
- Network-Centric Operations (NCO):
  - An information superiority-enabled concept of operations that generates increased combat power by networking sensors, decision makers, and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability and a greater degree of self-synchronization.

Net-Centricity Requires Interoperability

Interoperability Definitions

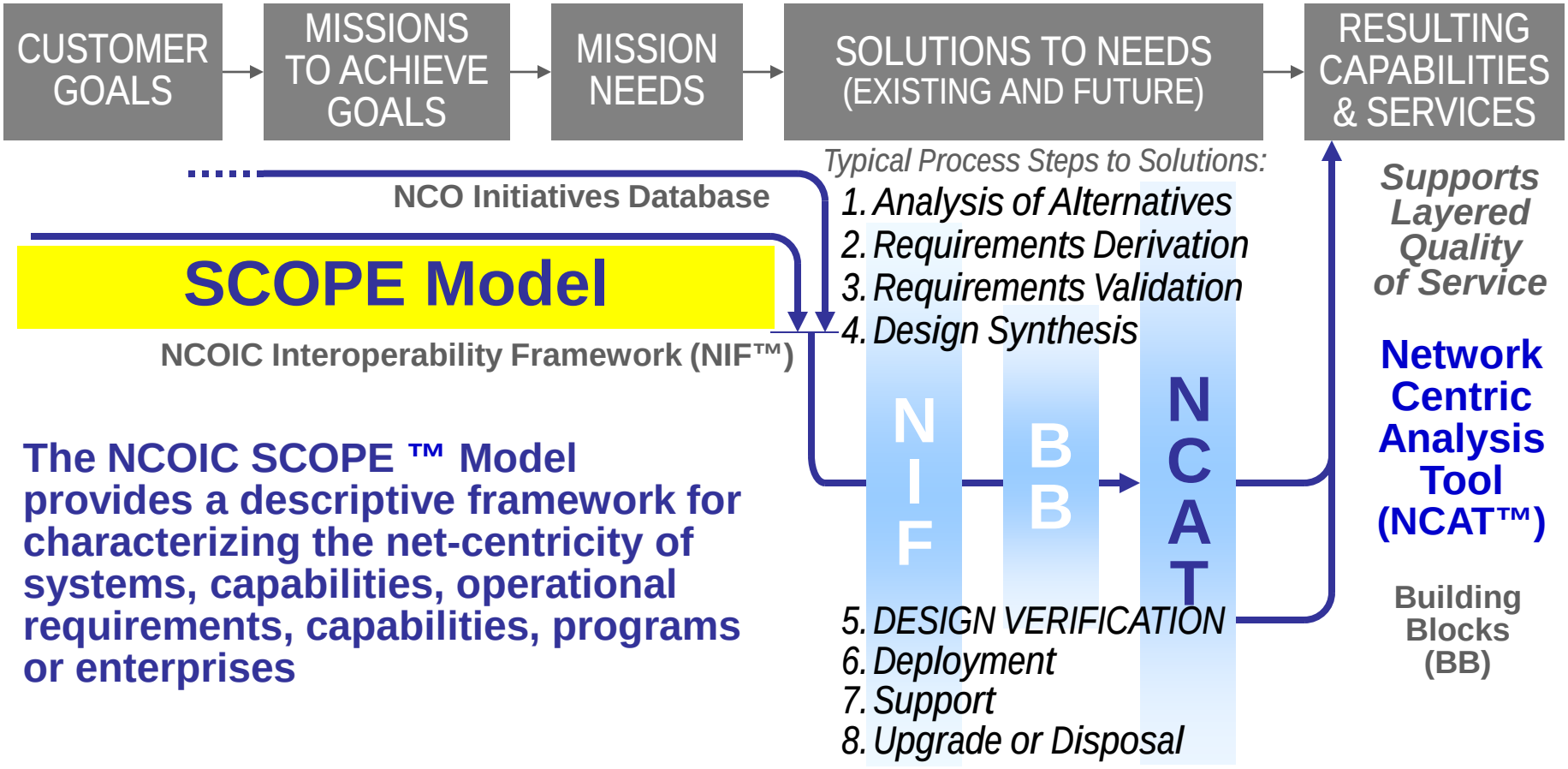
- (**DOD/NATO**) *The ability of systems, units, or forces to provide services to, and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together. (Joint Pub 1-02)*
- **(DOD only)** *The condition achieved among communications-electronics systems or items of communications-electronics equipment when information or services can be exchanged directly and satisfactorily between them and/or their users. The degree of interoperability should be defined when referring to specific cases. (Joint Pub 1-02)*
- (**NATO**) *The ability to operate in synergy in the execution of assigned tasks. (AAP-6 [2005])*
- (**IEEE**) … the ability of two or more systems or components to exchange information and to **use the information that has been exchanged**
- (**Wikipedia**) **Interoperability** is connecting people, data and diverse systems. The term can be **defined in a technical way or in a broad way, taking into account social, political and organizational factors.**

The Essence of Net Centricity

- It's the opposite of system-centricity and enterprise integration
- It's about dynamic crossing of system and organizational boundaries to achieve objectives
  - Greater operational effectiveness through better use of what already exists – not just what you "own" or control
- It's not about the network – it's about who and what you can interact with via the network for your purposes when you need to
- It challenges existing business/acquisition and doctrinal paradigms and incentive models – more revolutionary than most realize
- It challenges system-centric system engineering and architecture paradigms
  - It similar to the relationship between ecology/evolution and biology
  - How do you engineer parts that support a variety of architectures?

Net-Centricity – a full contact social sport

NCOIC Assists Customers
in obtaining interoperable solutions



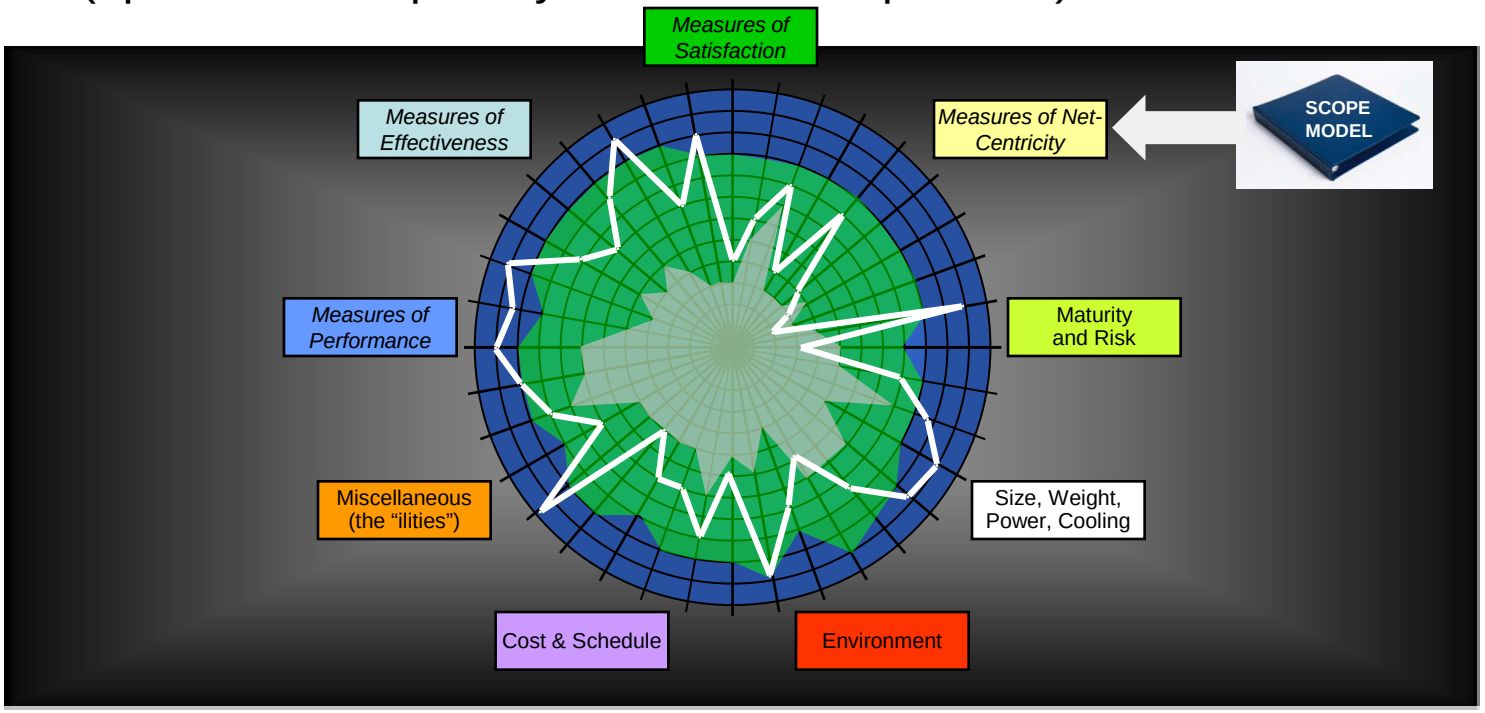
SCOPE MODEL OVERVIEW AND RATIONALE

What is the SCOPE Model?

- Systems, Capabilities, Operations, Programs, and Enterprises (SCOPE) Model
- SCOPE gives customers and companies the means to characterize interoperability requirements for network centric systems
  - How isolated or connected are the systems to each other?
  - How isolated or connected are the systems to their environment?
  - What are the intended purposes of the connection between systems?
  - What portion of operational space do the systems address?

SCOPE Working Group Charter

- Charter:
  - Develop and evolve a means to characterize requirements for network centric systems, capabilities, operations, programs and enterprises
  - Work with Functional Teams, IPTs and WGs to enable and learn from application of this characterization to actual pattern development (operational, capability, and technical patterns)



Why SCOPE?

- First need to understand Net-Centricity and what is driving it
  - A single system can't be net-centric; other systems provide context for its net-centricity
- Also need to understand what systems are and how they relate to institutions that sponsor them
  - Objectives and Contexts
  - Scope of those objectives and contexts
  - Perspectives on those contexts, including externally driven contexts
  - Frames of reference used to describe contexts and perspectives in systems that support them
- Need to understand that all systems having information service or communication capabilities are models of operational space
  - All models are wrong and incomplete (authoritative or not)
  - Some models are useful in some contexts for some objectives
  - Degree of model coupling to various contexts can vary
  - Models have institutional and operational scope and context

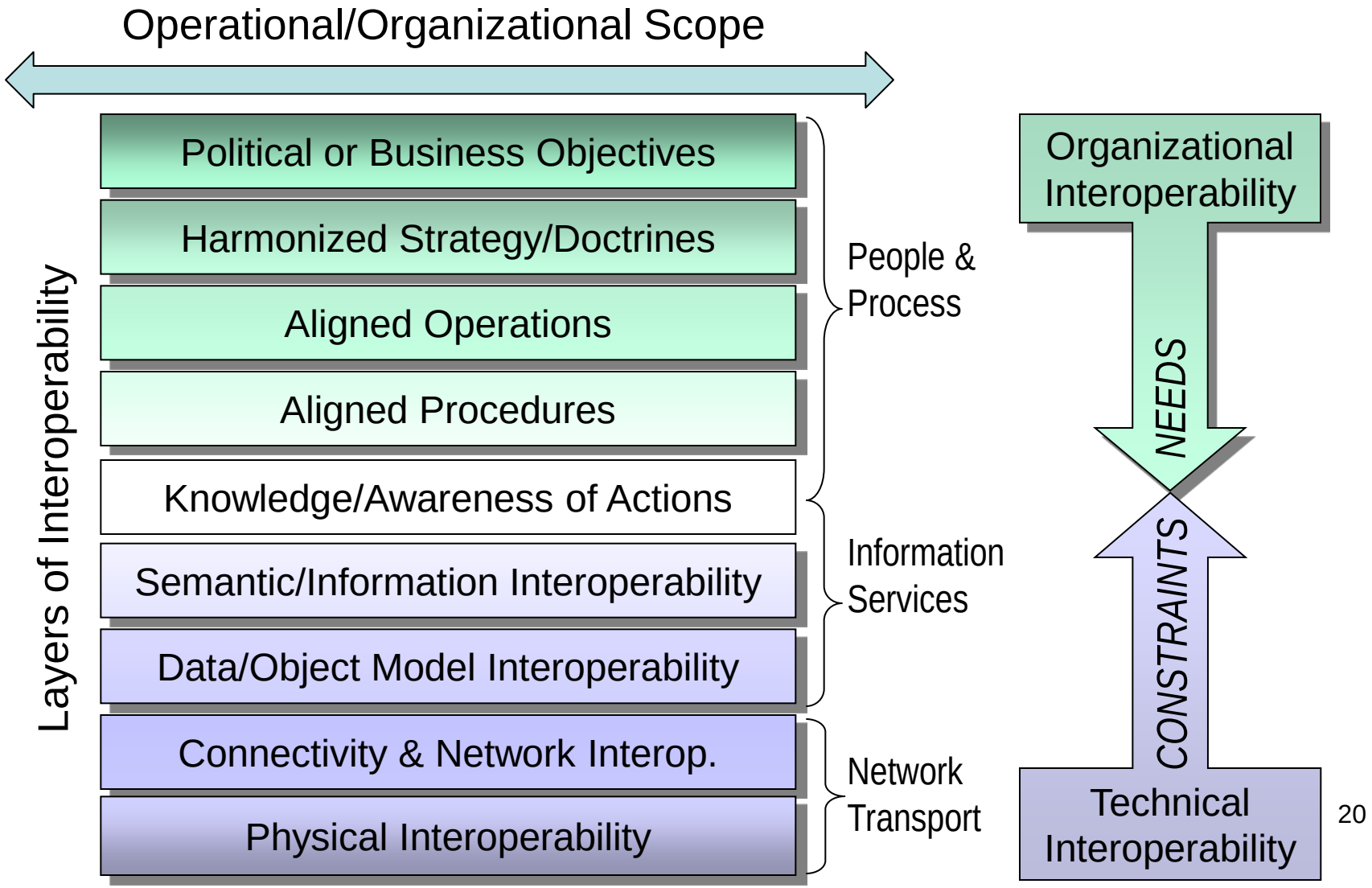
SCOPE Evaluates System/Organizational Interoperability Requirements (Not Just Technology)

How we Organize, Operate and Interact in a net-enabled environment

Our willingness to change, trust, delegate and enable – and why!

Technology is important, not in itself, but as an ENABLER (and a limitation) for achieving the benefits of NCO

Layers of Interoperability



The Role and Value of the SCOPE Model

High Level Models

Models of Customer Objectives

Domain General Architectures

Specific Node Architectures

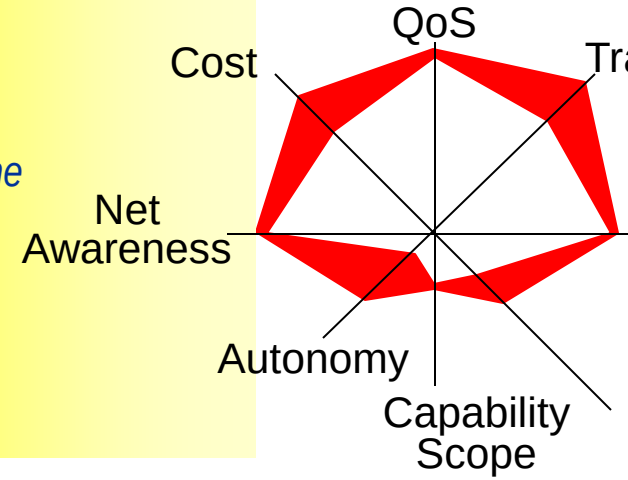
On-time Cargo Delivery

Architecture A

Tailored

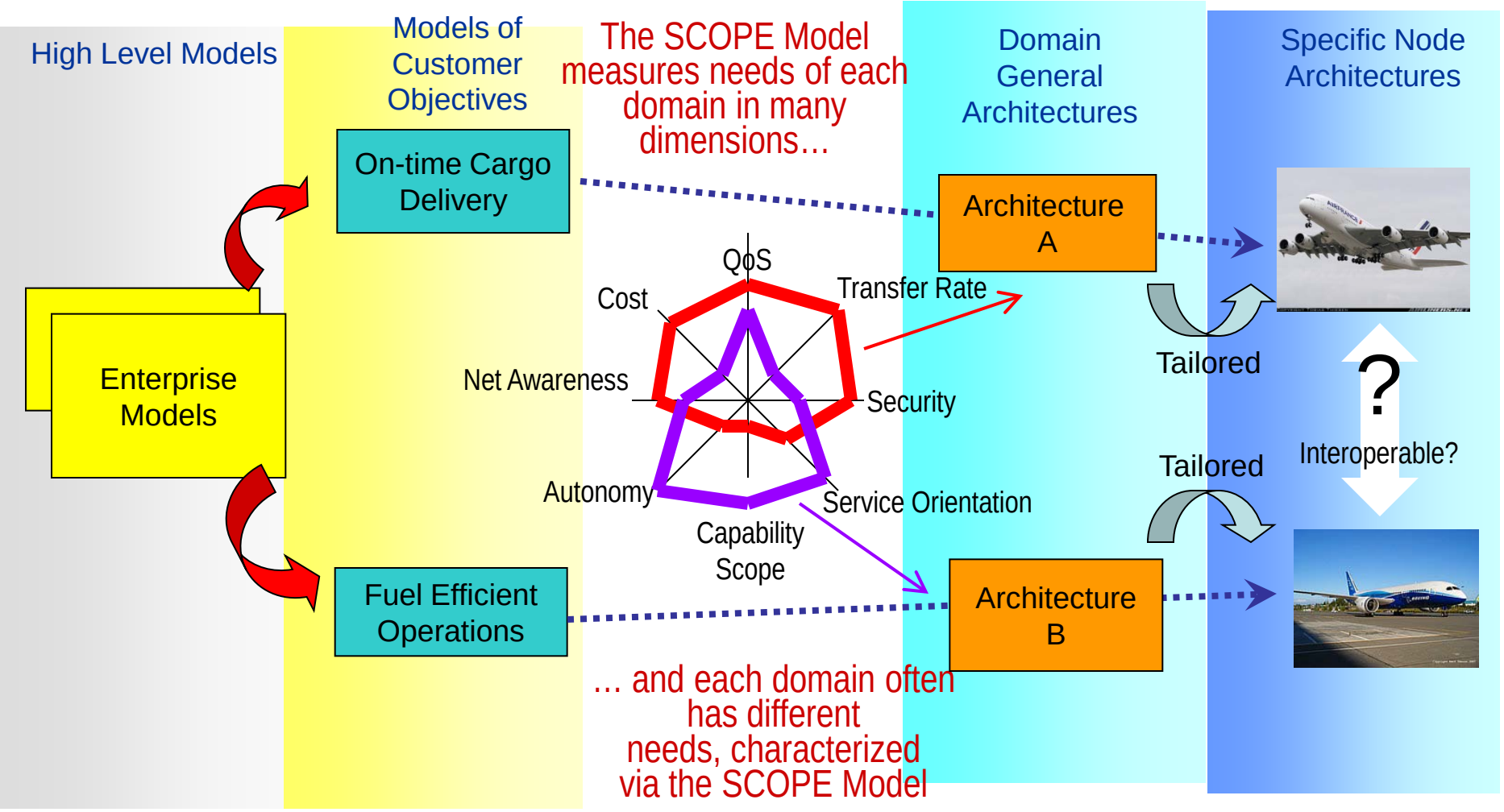
Enterprise Models

The SCOPE Model measures RANGES of a domain's needs and capabilities in many dimensions that relate to interoperability



(Illustrative of a greatly simplified SCOPE analysis; the actual SCOPE Model and associated tools cover many dimensions in more depth)

The Role and Value of the SCOPE Model



SCOPE Model Overview

Systems, Capabilities, Operations, Programs, Enterprises (SCOPE)

- An enterprise has scope in operational, time, resource and other domains
- So does a capability, which may involve multiple enterprises
- A capability is the potential to conduct operations of a certain type and scope
- Most enterprises have multiple capabilities and use them to varying degrees to achieve enterprise goals in conducting operations
- An operation is a kind of enterprise, usually with more limited time span and goals
  - But some operations dwarf many traditional “enterprises” – e.g., Iraqi Freedom, WW II
- A program is a mini-enterprise/operation focused on building a system that provides some capability fragment for a larger enterprise
- A program may be responsible for developing multiple systems needed for a capability (e.g., a Lead System Integrator (LSI) program)
  - More often a capability is implemented through multiple systems under heterogeneous sponsorship (Lead Capability Integrator?)

Net-Centric Architecting encompasses both single program capability engineering and multi-program/system/enterprise interoperability

SCOPE Purpose

- Provide a measurement framework for describing to what degree a set of Systems/Services supports a Capability, Operation, Program or Enterprise (SCOPE) over a network
  - Whether the set constitutes a family of systems, a system of systems, or just an ad hoc grouping is contextual and a matter of degree
  - Can involve multiple capabilities, programs, or enterprises
  - Helps define the scope and diversity of the systems in a given context
    - Highlights nature of issues affecting system interoperation
  - Helps identify how a given system could better support the larger context in a net-centric ecosystem (“scope creep”)

How open are the systems to each other and to their enviroment and what purposes do they support?

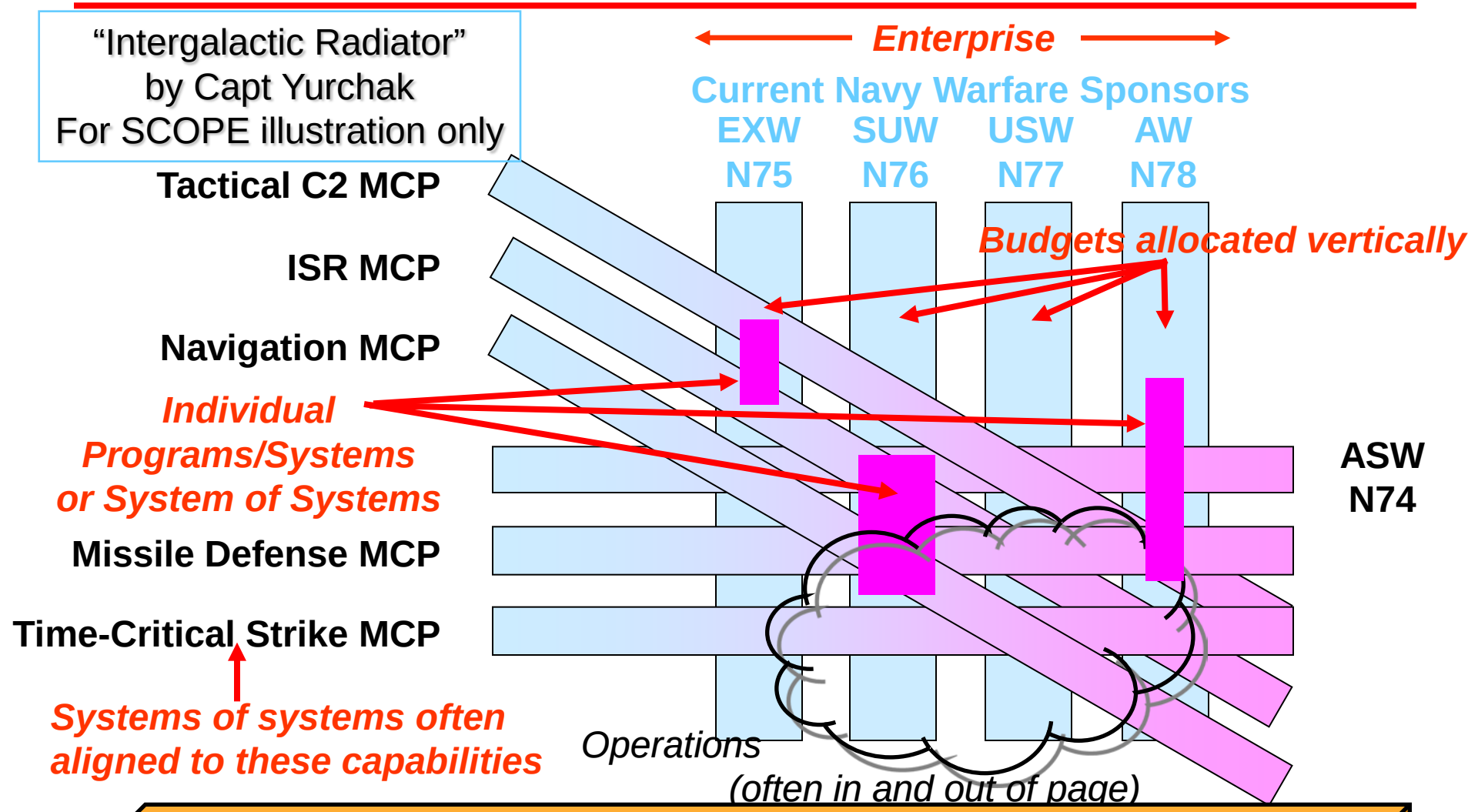
SCOPE Model Features

- Net Readiness Dimension set
  - Measures how open and adaptable component systems are to working with each other over the network
- Capability/Operational Scope Dimension set
  - Measures how broad, deep, and diverse the operational architectures are that the systems are designed to support
- Technical Feasibility Dimension set
  - Measures how feasible it is to achieve desired operational capabilities, given the systems and their information exchanges over the available network using established technical standards and infrastructure services

Net-centricity is not free, adaptability is purpose-driven, and the network is only somewhat transparent

Relating Systems of Systems, Capabilities, Operations, Programs, and Enterprises (SCOPE)

"Intergalactic Radiator"
by Capt Yurchak
For SCOPE illustration only



Illustrates Complex Dependencies in Capability Acquisition

Capability Scope Dimension Overview

Value / Dimension	Narrower Scope → Broader Scope			
Overall Scope and Types of Enterprise	**Single Unit**	**Single Service or Agency**	**DoD-Wide**	**World-Wide**
Capability Breadth	**Single Functional Domain/Service**	**Multi-Domain, Multi-Service**	**Multi-Dept, NGO, Industry**	**Coalition, Multi-Enterprise Type**
Capability Depth	**Single Level**	**Two Levels**	**Three Echelons**	**Four or More Echelons**
Organizational Model and Culture	**Rigid Hierarchy, Vertically Integrated**	**Adaptive Hierarchy, Interact Horizontally**	**Flat, Empowered, Open to Partnering**	**Adaptive, Social, Interdependent**
Unity of Life Cycle Control/Alignment	**Single DoD Acquis. Exec**	**Multiple DoD Acquis. Exec**	**DoD & US Syst. Owners**	**Multi-National Syst. Owners**
Acquisition Congruence (SD)	**All Systems on Same Timeline**	**Timeline within 2 years**	**Timeline within 5 years**	**Timelines >5 years apart**
Semantic Interoperability	**Single Domain Vocabulary**	**Multi-Domain Vocabulary**	**Single Language**	**Multiple Languages**
Operational Context (SD)	**Single Ops Context**	**Multiple Ops Contexts**	**Future/Past Integration**	**Hypothetical Entities**

Program X Capability Scope Dimension Example

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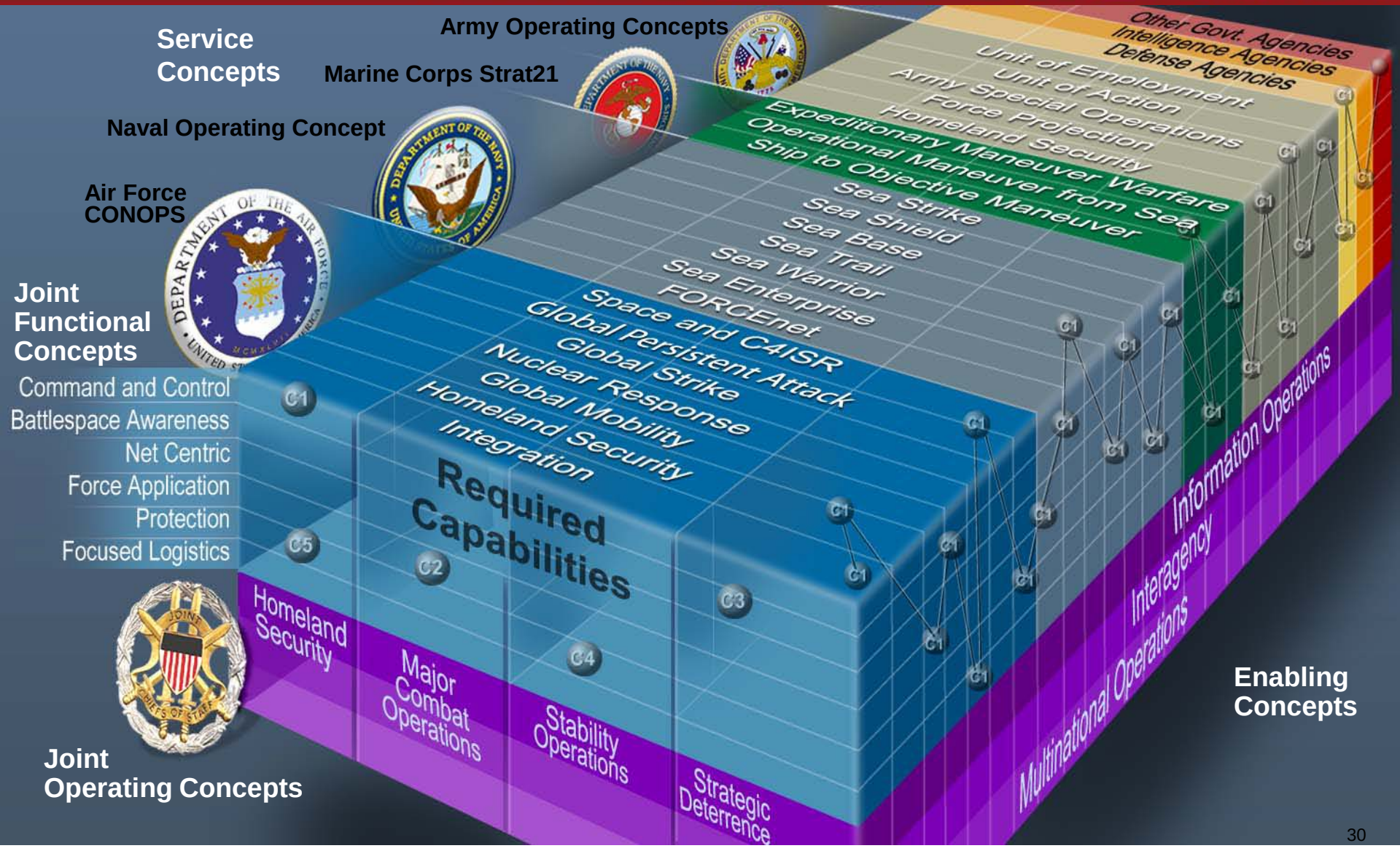
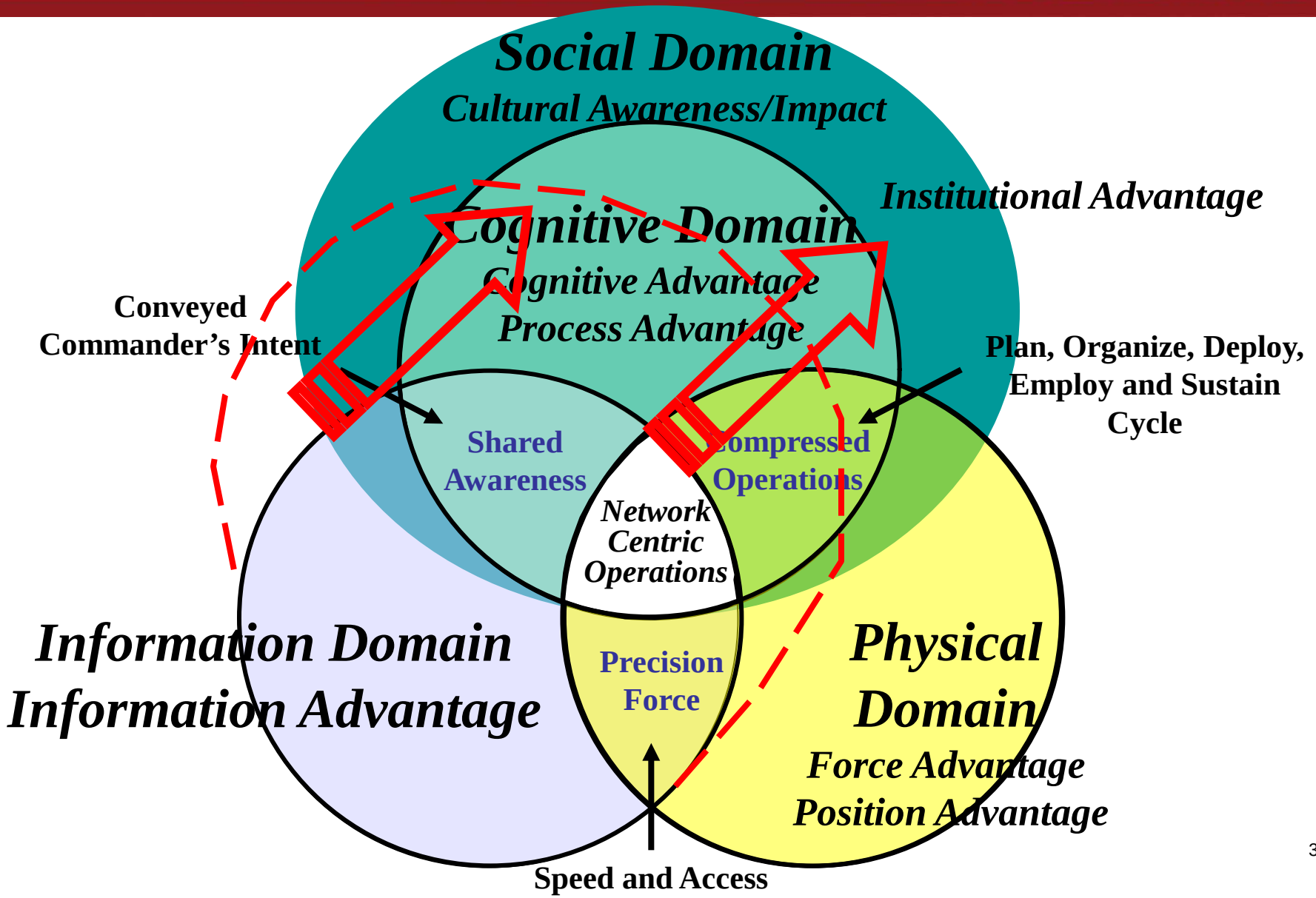
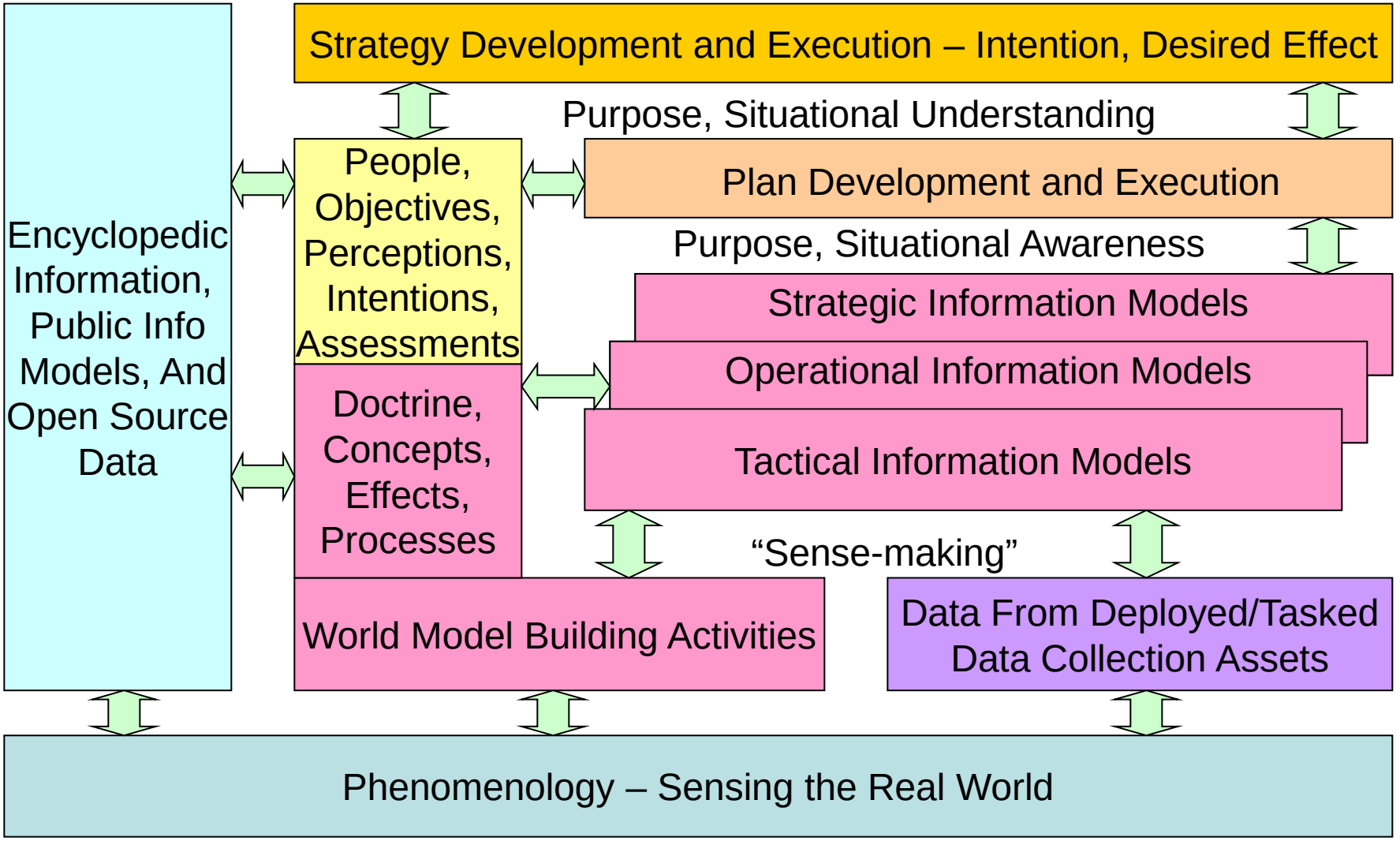
One Possible Enterprise Breadth "Hypercube"



Net Enabling the Social and Cognitive Domains Through the Information Domain



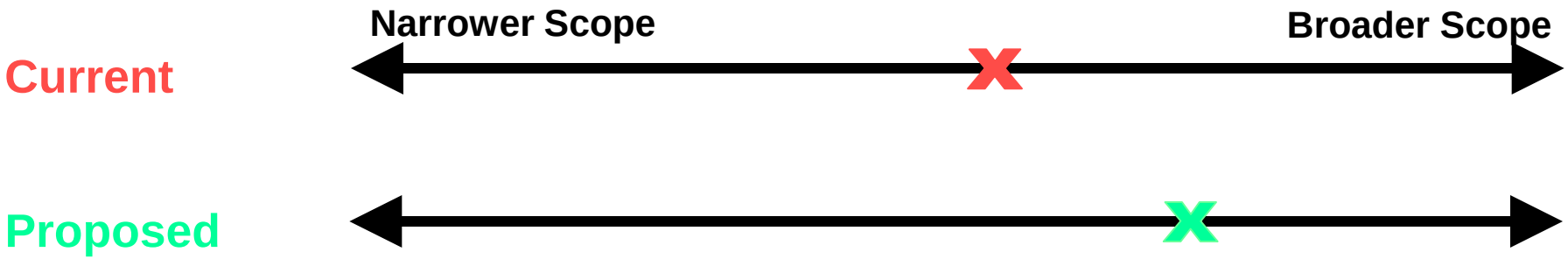
Capability Information Domains



Sample Capability-Specific Scope Dimensions

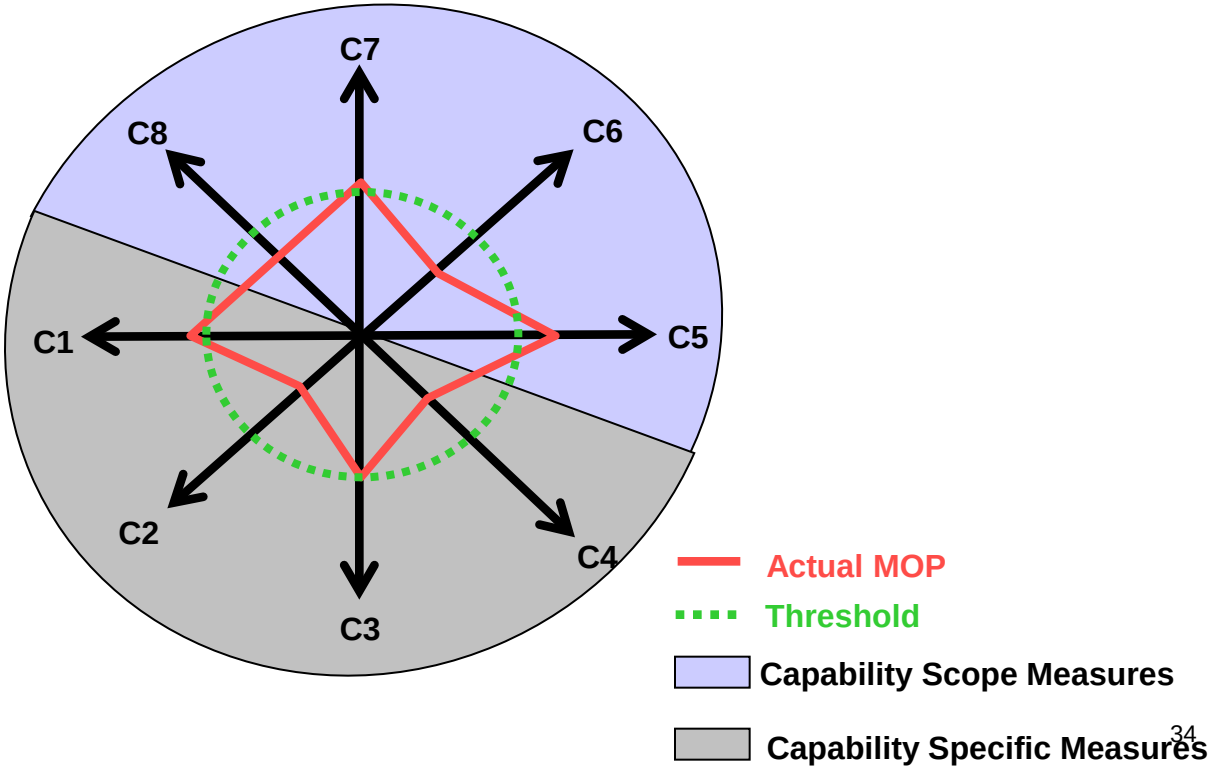
Value / Example Dimensions	Less Capability			More Capability
Time to Target Engagement	1 Hour	30 Minutes	10 Minutes	1 Minute
Stryker Bde Deploy Time	30 Days	7 Days	72 Hours	24 Hours
Total Lift Capacity	Single aircraft type	Multiple aircraft types	Multiple lift types	All lift types
Target Detection	Single sensor	Multiple sensor	Multiple sensor types	All source
ISR Management	Single Platform	Multiple Platforms	Multiple platform types	All platform types
Logistics Support	Single Weapon System Type	Fixed Wing Air Support	Multi-Class Supply	All Classes of Supply

Sample Functional Capability Profile



Key Improvement Areas

- Tactical Nets
- Local Gov Interface
- Rail modes
- Support for Cross Domain Services



Net Ready Dimensions and Levels

Value / Dimension	Tighter Coupling / Less Net-Readiness			Looser Coupling / More Net-Readiness
Service Discovery	Service specs pub at design	Service specs pub run-time	OWL spec for Services	Comparative service select
Information Discovery	Static Indexes	Metadata Navigation	Relevance Measures	Context-driven Search
Info Model Pre-Agreement	Complex data & doctrine	Standard XML Schemas	Business Object	ASCII, URLs
Information Assurance	Link encrypt - SSL	Single sign-on support	DoD-Wide PKI support	MSL, cross-domain spprt
Autonomic Networking	Design Time Configuration	Run Time Re-Configuration	Dynamic Net Management	Adaptive Net Management
Semantic Interoperability	No Explicit Semantics	Semantic Metadata for Interfaces	Ontology-based interfaces	Dynamic Ontology mapping

Technical Feasibility Dimensions

Value / Dimension	Smaller Risk → Larger Risk			
Inter-System Time Binding to Achieve Capability	Strategic	Tactical	Transactional	Real Time
Run-Time Computing Resources Needed	<1% of existing system resources	1-10%	10-50%	>50% of existing system resources
Service Mgmt. Resources Needed	Negligible	Within Current Net Service Capacity	Within Planned Net Service Capacity	Beyond Planned Net Service Capacity
Net Resources Needed (FD)	Negligible	Within Current Net Capacity	Within Planned Net Capacity	Beyond Planned Net Capacity
Interface Development Complexity	<1% of system size	1-10%	10-50%	>50% of system size
Technology Readiness Level For Net Use	TRL Levels 8-9	TRL Levels 6-7	TRL Levels 4-5	TRL Levels 1-3

SCOPE Model Summary

- SCOPE is a comprehensive, balanced approach to assessing sets of systems from a net centric operations perspective
  - Evolved through application against real programs
  - Yet has an overarching perspective on the problem space, semi-orthogonal to architecture frameworks (FEAF, DoDAF, Zachman, etc.)
- SCOPE is a “Goldilocks” model
  - No preconceived value for any given degree of net-centricity
  - Value depends on operational objectives of target system sponsors
    - Desired degree of agility
    - Desired degree of operational/resource scope
- SCOPE has potential to be a net-centric content-based complement to CMMI to characterize what is built vice how
  - But focused more on “best fit” to the problem domain rather than “maturity” or “level” based

Helps position programs/systems in the larger net ecosystem of institutional capabilities; identifies interoperability gaps among them

SCOPE Relationships

- Relationship to other NCOIC Teams/Products
- Perspective, Context, Scope, Domain, Frame of Reference, State
- Net Centric Principles and Attributes
- SCOPE & Net Centric Principles and Attributes
- SCOPE & Acquisition
- Architecture, Patterns, and SCOPE
- SCOPE & Systems Engineering
- SCOPE & Operational Effectiveness
- NIF & SCOPE
- SCOPE & Net Centric Principles and Attributes

Relationships with Other NCOIC Teams

- NCOIC Interoperability Framework FT
  - Characterize ODs in “size” and relationship space (to each other)
  - Help develop/scope Operational Description (OD) content
  - Provide way to characterize relevance of patterns to ODs
  - Owns autonomic dimensions (structure of information needed about the network and participants) jointly with SIF WG and Mobility WG
- Specialized Frameworks FT
  - SIF WG Owns Discovery and Semantic Interoperability dimensions
  - Service WG owns Service related sub-dimensions
  - IA WG Owns IA Dimensions
  - Cloud Computing WG is developing domain-dependent dimensions
  - MN WG Owns Network Utilization Dimension and supports autonomic dimensions involving network mobility (e.g., COOP, QOS)
- Network Centric Attribute FT
  - Primary internal source of criteria for analyzing degree of net-centricity in requirements contexts
  - Drives NCAT Tool features to support SCOPE workshop processes

Relationships with Other NCOIC Teams

- System Engineering & Integration FT
  - Support conceptual and process integration of SCOPE model into overall NC engineering process model (e.g. Practitioner's Guide)
  - Support development of net-centric attributes appropriate to Test and Evaluation contexts
- Modeling and Simulation FT
  - Owns dimensions/attributes related to "alternate reality" contexts
- BB FT
  - Uses selected SCOPE dimensions to characterize scope of applicability of Building Blocks to specific ODs, use cases.
- IPTs
  - Apply SCOPE analysis within each IPT to define bounds of IPT charter or OD and help decide degree of net-centricity appropriate for each use case (apply "Goldilocks" principle)
  - Determine degree of applicability of net-centric patterns developed by an IPT – e.g. Sense & Respond Logistics OD and patterns

Key Definitions

- Operational Context: The attributes which characterize an entity's purpose & state, within some scope, often shared with other entities
- Perspective: a particular system's or individual's version/view of some context/entity for its purposes
- Frame of reference: The representational convention used to describe some entity along one or more attribute dimensions, including context attributes
- Scope: the portion of possible real world and conceptual entity space a given system, context, perspective, or frame of reference includes
- State: The value of context and other variable attributes for an entity at some time or interval in some frames of reference
- Domain: A named subset of functional/operational space with specified scope and specialized perspectives and frames of reference for describing operational context and state, shared among some entities

Key Definitions
Principles and Attributes

- Principle -- A basic generalization that is accepted as true and that can be used as a basis for reasoning or conduct.
- Attribute, property, dimension -- a construct whereby objects or individuals can be distinguished from each other
  - I.E., They are observable, and, ideally, measureable
- Characteristic, feature -- A prominent aspect of something; a distinguishing quality

- Simply put, ‘principles’ allow the selection of ‘attributes’ or ‘characteristics’ that are deemed useful for certain contexts
- ‘Characteristics’ or ‘Attributes’ are used to distinguish or select systems
- Thus, in identifying the core principles of net-centricity the goal is that these ‘principles’ may be used to select essential and relevant characteristics and attributes of net-centricity.

Net Centric Principles and Attributes

- NCOIC has a multiplicity of principles, e.g.:
  - NIF Architecture Principles
  - Net-Centric Services and SOA Principles
  - Mobile Networking Principles
  - Information Assurance Principles
- All these principles assume a specific application context, namely:
  - Architecting, services/SOA, mobile networks, security architectures
- NCOIC also has a Position Paper with a definition of net-centric operations
- But all these principles and definitions still represent net-centricity from a somewhat scope constrained perspective
- Review of the DoD Net Centric Attributes drove the development of a draft set of principles that are fairly scope/context independent

Net Centric Principles

- ***Explicitness***
  - **An entity should make all information about itself explicit**
- ***Symmetry/Reciprocal Behaviors***
  - **Relations and entities should exhibit symmetric characteristics and behaviors**
- ***Dynamism***
  - **Entities should support dynamic behaviors**
- ***Globalism***
  - **There should be no a priori bounds on the scope of applicability**
- ***Omnipresent/Ubiquitous Accessibility***
  - **Entities should have omnipresent or ubiquitous access to resources (i.e., each other)**
- ***Entity Primacy***
  - **Entities have existence distinct from the contexts in which they participate**

Net Centric Principles

- ***Relationship Management***
  - **Relations among entities should be explicitly represented and provide for negotiation, creation, change, and termination**
- ***Open World***
  - **Entities should allow for open-ended representations and interactions with other entities; extensibility and scalability**
- ***Pragmatism***
  - **The ability to improve operational effectiveness is paramount**
  - ***Trumps the other principles***

Net Centric Attributes

Attribute	Description
Internet & World Wide Web Like	Adapting Internet & World Wide Web constructs & standards with enhancements for mobility, surety, and military unique features (e.g. precedence, preemption) .
Secure & available information transport	Encryption initially for core transport backbone; goal is edge to edge; hardened against denial of service.
Information/Data Protection & Surety (built-in trust)	Producer/Publisher marks the info/data for classification and handling; and provides provisions for assuring authenticity, integrity, and non-repudiation.
Post in parallel	Producer/Publisher make info/data visible and accessible without delay so that users get info/data when and how needed (e.g. raw, analyzed, archived).
Smart pull (vice smart push)	Users can find and pull directly, subscribe or use value added services (e.g. discovery). User Defined Operational Picture vice Common Operational Picture.
Information/Data centric	Information/Data separate from applications and services. Minimize need for special or proprietary software.
Shared Applications & Services	Users can pull multiple applications to access same data or choose same apps when they need to collaborate. Applications on "desktop" or as a service.
Trusted & Tailored Access	Access to the information transport, info/data, applications & services linked to user's role, identity & technical capability.
Quality of Transport service	Tailored for information form: voice, still imagery, video/moving imagery, data, and collaboration.

NCOIC Net Centric Attributes

- Based on Invited Review of the US DoD Net Centric Attributes
- To be published shortly
- Generally **less implied US DoD context**, more “generic”
- Rearranged some attributes and split them into multiple attributes
- Recommended adding some attributes for **human interoperability and more non-technical attributes related to organizational relationships**
  - No major changes from current DoD set otherwise
- Recommended developing a more comprehensive set of explicit **assessment contexts** for selecting and specializing attributes
  - Enterprise context (US DoD, NATO, NCOIC, RPDE, etc.)
  - Life Cycle Phase (of system/capability being assessed)
  - Type of System/Capability (Infrastructure, mission application, etc.)
  - Attribute Application Purpose (why are the attributes being applied)

NCOIC Recommended Attributes

Title	Description
Media Independence	Information used, produced, published, or disseminated by the services or systems is decoupled from transport mechanisms.
Open-Ended Pervasive Accessibility	Ability of system(s) or service(s) to find, use, and control information (which requires an ability to identify and distinguish entities and the publication of information with minimal a priori constraints).
Open Standards Based	To support interoperability programs/projects, systems, and services must maximize the use of openly available and unencumbered technical and process standards that support media independence, pervasive accessibility, and trustworthy control of access to information and services.
Protected and Assured Transport Services	Program/project, system, or service makes use of existing specified assurance, protected, and defended transport services where feasible/available. Infrastructure systems provide specified assurance, protected, and defended transport services that are accessible and available wherever and whenever needed
Producer/Publisher Trust Relationships [with users and services]	Program, system, and/or service(s) has mechanisms for establishing and maintaining appropriate trust relationships with users and services on the network. Measures are taken to comply with any security labeling, data protection, and access control requirements entailed by the trust relationships and monitor the environment to ensure that conditions on which the trust relationships were established have not changed

NCOIC Recommended Attributes

Title	Description
Post Data/Information for Network Access	Program/project, system, and/or service(s) has made their products discoverable and accessible on the network in a manner and timeframe appropriate to the nature of the information/data.
Adaptive Information Access	Program/project, system, and/or service(s) has provided users and services access to information and data in ways most appropriate for their context while allowing them to negotiate access arrangements and understand the associated costs.
Information and Data Independence	Program/project and/or system has separated its information and data from applications and services (dependencies) and is provided with sufficient context (i.e., metadata) to enable users to use the information/data correctly for their purposes.
Tailored Resource Access	Service levels can be modified, tailored, or negotiated to meet needs as represented by identities, roles, and/or contexts.
Social & Cognitive Integration	Programs/projects and/or systems include measures of social and cognitive integration that facilitate their effective use.

SCOPE and Net-Centric Principles and Attributes

- SCOPE provides a way to be more explicit about the scope assumptions under which a particular system/entity operates
- Also identifies hierarchical or other asymmetric relationship assumptions in capability scope and net ready dimensions
- Net ready dimensions focus on dynamism while capability scope define operational range across which one needs to be dynamic
- Capability scope dimensions encourage global thinking
- Net ready dimensions look at accessibility over the network while technical feasibility dimensions look at constraints the network imposes on ubiquitous accessibility
- Capability scope dimensions are the primary means of exploring the application of the entity primacy principle
- Both net ready and capability scope support application of the relationship management principle
  - Organizational Business Model and Culture dimension in particular

SCOPE and Net-Centric Principles and Attributes

- The technical and economic feasibility dimensions support application of the scaling principle
  - So do the net ready autonomic and semantic interoperability dimensions
- They also support the application of the pragmatism principle
  - So do the acquisition alignment capability scope, the net ready autonomic and semantic interoperability dimensions

- Similar mappings of the principles to the Net Centric Attributes are provided in the Net Centric Attributes Invited Review paper
  - Also includes assessment context model, which is basically a subset of the SCOPE capability scope dimensions
  - Mapping is not surprising since the SCOPE model was influenced by the DoD Net Centric Attributes during its development

SCOPE & Acquisition

- Most system/capability acquisitions have defined scope
  - However, not all scope dimensions are typically specified
  - Many are implicit in the acquisition source/context
  - Some are encouraged to be “flexible”, “agile”, or “adaptable”, usually with little specificity as to type and range of flexibility desired
  - SCOPE provides a way to be more explicit about scope and about degree of flexibility/agility desired and affordable
- Some acquisitions are subject to external forces that can lead to changes in scope during or post acquisition
  - Can lead to significant ECPs and rework
  - SCOPE allows developers to consider such possible scope expansions/changes and anticipate them in the architecture/design
    - May not need to actually implement this flexibility
    - But anticipation reduces cost of implementation if the risk becomes reality

Integrated Architectures, Patterns & SCOPE

- Integrated architectures represent a tight coupling between:
  - Specifically scoped operational views,
  - Operational functionality allocated to specific systems/components
  - Constrained by technical standards and infrastructure
  - And, presumably, available budget
- How this coupling would change if any of the view content changes is typically not explicitly represented/captured
  - May be done as architecture is being developed
  - Usually driven by the scope of the operational architecture
  - Other coupling factors do have some influence (e.g., available infrastructure, budget)
- Works well if the scope of each view type is fairly static for at least the development/implementation life-cycle

The Net-Centric Challenge

- Changes in desired operational architecture functionality occur faster than the development life-cycle
- Scope of operational architecture is also dynamic
- Technology evolution and changes/variability in available infrastructure also undercuts static coupling to specific network capacity and protocols
- Coupling between scope decisions in architecture view types not explicitly represented
  - Change management becomes slow, difficult, error-prone
- Few integrated architectures survive operational deployment intact for very long
  - Requirement/Environment changes apply pressure to different parts of the integrated architecture

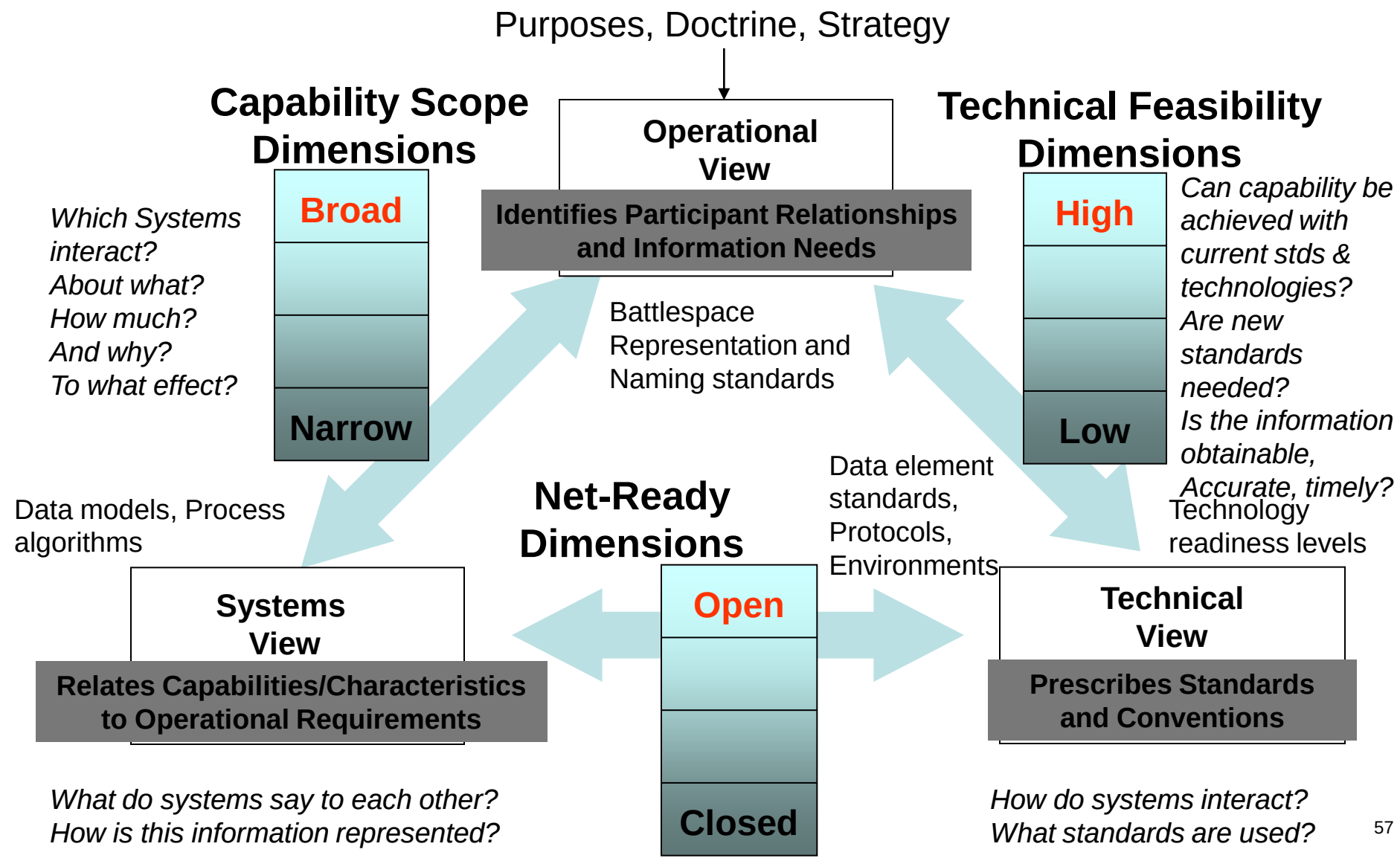
The Net-Centric Challenge (Cont.)

- One solution is to make the integrated architecture capable of dealing with dynamic scope changes
  - Complex and Expensive
  - Difficult to justify increased scope and flexibility based on "contingencies"
- Another common solution is to develop a "reference" architecture
  - Decouples and defers some operational scope decisions
    - E.g., specific country or force element types
  - May also decouple some specific system component decisions
    - E.g., specific vendor or equipment type
- But it's relatively unusual to find a new operational problem that is a complete match for the entire reference architecture
  - Difficult to use just "fragments" of the reference architecture because of implicit coupling between elements of the architecture

Enter Patterns and SCOPE

- All too often the solution to these challenges is to develop a new integrated architecture using ad hoc architecture fragments and accumulated domain knowledge
- Patterns are essentially partially (and explicitly) dis-integrated architecture fragments
- Explicit representation of pattern scope allows semi-dynamic adaptation and composition into dynamic integrated architectures
  - Degree of design, install, or run-time composability for patterns is itself a scope decision driven by expected/desired level of agility
- Different pattern types represent different coupling decisions between architecture view types
- SCOPE is a way to represent the strength and types of coupling between architecture view types in a pattern (or architecture, etc.)

DODAF Architecture Views and SCOPE



Pattern and SCOPE Dimension Types

- Operational Patterns
  - Specify a coupling among capability scope dimensions/value ranges and at least some technical feasibility dimensions (often implicit)
  - E.g., enterprise/capability type/scale, culture/business model, context flexibility, functional concepts, etc., and, say, time-binding dimension
  - Minimal coupling to net-readiness
- Technical Patterns
  - Specify a coupling among and between net-readiness dimensions/values and technical feasibility dimensions and values
  - E.g., specific service discovery mechanisms and technical standards
- Capability Patterns
  - Specify a coupling between all three SCOPE dimension types
  - E.g., specific functional services, naming standards, technical standards and infrastructure capacities required for a capability

Key Points

- Patterns are architecture fragments with explicit scope representation of their (limited) coupling between architecture view types and ranges
- Finer-grained than complete reference architectures
- Coarser-grained than individual components and services
- Net-Centric Patterns are those that rely on network connections and protocols, as well as net-centric principles, to connect components, services, people, and institutions to each other for some purpose(s) of defined scope
- Integrated architectures can be built/composed from patterns in less time and effort than from components alone
  - Patterns contain more domain knowledge than atomic components
- Such integrated architectures are less fragile and more interoperable than those built for a single defined set of scope values

SCOPE & System Engineering

- SCOPE is a system requirements elicitation tool with a pre-defined but extensible operational attribute model
- SCOPE provides a framework for defining the scope of one system in a way that allows comparison with the scope of another system
  - Provides a descriptive framework for augmenting system context diagrams with explicit scope
  - Also useful in being explicit about scope of system use cases
- SCOPE also provides a way to describe systems along a continuum from individual component to an enterprise of enterprises.
  - No hard definition of “System of Systems”, “Family of Systems”, or “Enterprise” needed
- SCOPE has limited SCOPE
  - It only applies to those aspects of systems that are manifested in information/service request exchanges over a network

SCOPE & Operational Effectiveness

- Operational Effectiveness is often an elusive, subjective quality
- Fundamentally, net-centricity is about increasing operational effectiveness by working with other systems/entities over a network
  - SCOPE does not measure operational effectiveness itself
    - That's best left to specific system/capability/process proponents
  - SCOPE does enumerate attributes that could be enablers or barriers to operational effectiveness in a given operational context and for specific purposes
  - Examining SCOPE dimensions of a particular set of systems/capabilities can help identify unforeseen barriers to, and enablers of, operational effectiveness
  - Adjacent domain analysis portion of SCOPE Workshops helps do this
- NIAG SG-76 includes a report that describes a way to use operational effectiveness measures to identify important SCOPE dimensions for a given operational scenario

NIF & SCOPE

- The NCOIC Interoperability Framework (NIF) recommends using SCOPE to develop and specify the context and scope of Operational Descriptions (ODs)
  - ODs are high level descriptions of an operational domain
  - OD template is defined by the NIF
  - Contain:
    - Capabilities important to the domain
    - Purposes for the capabilities
    - Significant adjacent domains and domain interaction issues
    - Operational patterns and capability patterns
- SCOPE Workshops are used to help develop ODs and the adjacent domain analyses
- The NIF also points out that when there are multiple architectures interacting over the network, it's important for them to explicitly represent their respective scopes to each other

SCOPE MODEL APPLICATION METHODS AND CONTEXTS

Methods

- Workshops
  - Facilitated workshops using dimensions as structured interviewing and discussion capture tool
  - Practitioner's guide for prepping and conducting workshops
  - Leverages facilitator expertise and broader perspective to help target understand net-centricity in target context
- Self-Assessments via questionnaire tool (NCAT, Spreadsheet)
  - May be helpful for targets already familiar with net-centric thinking
  - Generally not recommended for targets new to net-centricity
- Informal application of dimensions in other review contexts
  - SCOPE dimensions used as completeness check by reviewers
  - May also generate suggestions/recommendations

SCOPE Application Contexts

- Enterprise Integration, Strategic Planning, Re-engineering
- Program/System/Capability/Domain Requirements Elicitation
  - Operational Description Development
  - Pattern Development
- Inter-system/capability interface definition
  - Adjacent Domain Analysis
- Product Line Strategy/Design/Architecture development
- Characterizing scope of applicability of services and patterns
- Existing system/service re-engineering or evolution planning
- Standards development and characterization

NCOIC Resources for SCOPE Workshops

- Practitioner's Guide and training material for SCOPE Workshops
- SCOPE Excel Spreadsheet with SCOPE dimensions in the form of questions and potential answer values
- Sets of domain-dependent scope dimensions developed for specific operational and technical domains
- NCAT Tool capable of using SCOPE questions/answer content in a workshop format
  - SCOPE questions don't use NCAT scoring features
  - NCAT tool capable of importing Excel SCOPE questions/answers
  - Including new domain-dependent questions
- SCOPE training workshops
  - For NCOIC teams developing operational descriptions and net centric patterns
- SCOPE training material such as this tutorial

QUESTIONS? DISCUSSION?

Contact Information

- NCOIC Web Site: www.ncoic.org
- SCOPE Model document available for down load from NCOIC public site.
- Net Centric Attributes Functional Team email address:
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  - Chair: Hans Polzer, hans.w.polzer@lmco.com
  - Telephone 703 416-2308
  - Vice Chair: Jack Zavin, jack.zavin@osd.mil
  - Content WG Chair: Todd Schneider, todd.schneider@raytheon.com
  - Engine WG Chair: Leslie Anderson, Leslie_Anderson@raytheon.com

Backup Slides

SCOPE Planning Workshop Overview – FFT Example

- SCOPE Model Process and Overview presentation – 30 min
- Friendly Force Tracking Overview presentation and initial context/scope setting – 30 min
- Capability-specific SCOPE dimension development and selection of additional SCOPE dimension – 60 min
  - What are the aspects of FFT by which its depth and breath can be characterized in terms specific to FFT/defense capabilities
  - What are the important adjacent domains with which FFT needs to interact?

Identifying Initial Capability to be Profiled with SCOPE

- Overall FFT Capability Domain is very broad
- NCOIC focus on security operations still leaves this as a very broad domain
- Working with selected stakeholders, NCOIC C3 IPT will need to reach out to adjacent domains
- It's important when applying SCOPE to consider the larger environment in which a capability operates
  - Consider selective scope expansion to address interactions with adjacent and supported larger capabilities
  - End-to End Force Visibility, support from and to adjacent security operations, business and social incentive models for participating in a capability
  - Coalition versus Joint vs stability ops vs commercial/NGO

Applying SCOPE to FFT

- Identify stakeholders and domain experts for FFT
  - Focus on Operational Domain users and information architects more than system architects/developers/owners
- Use overview/reference material to identify relevant SCOPE dimensions
- Tailor SCOPE questionnaire/NCAT to focus on relevant dimensions – this is a judgment call!
  - Identify potential capability-specific SCOPE dimensions
  - Add questions that probe these dimensions to the questionnaire
- Schedule and conduct structured interviews using SCOPE questionnaire with identified stakeholders and domain experts
  - Capture specific answers as well as comments for “as is” operations
  - Probe for potential “to be” desires/possibilities in each question
- Conduct initial outbrief with FFT Initiative team

Applying SCOPE to FFTI

- Conduct post-interview analysis to develop both as-is and candidate to-be SCOPE analysis for FFT Operational Description
- Conduct follow-up validation/discussion session with FFT Initiative team on results of SCOPE analyis
  - Focus on larger context issues, identify any changes
- Use resulting to-be profile to characterize attributes, information models, service interfaces, and instance naming approaches, conventions, and authorities for FFT
  - Identify those that are driven externally to the FFT capability domain
  - Identify those that FFT Capability domain needs to establish as common to FFT systems over the network
- Sample Capability-Specific SCOPE dimensions to be considered:
  - Force Tracking granularity in entity and time dimensions
  - Types of forces to be tracked

Sample Capability-Specific Dimensions generated by FFT SCOPE Planning Workshop

Sample Capability-Specific Dimensions

- Generated in FFT SCOPE Planning Workshop, May 08 with input from domain experts and applying SCOPE concepts
  - Force granularity
  - Force element and track types
  - Reporting frequency and latency
  - Track location sensitivity
  - Location precision, accuracy
  - Degree of friendliness and force element affiliation
  - Reporting push/pull
  - Information types reported
  - Tracking purposes
  - Reporting architecture and business model
  - Identity and location assurance
  - Other ways that FFT can vary in depth/breadth?

Use of Capability-Specific Dimensions

- Demonstrate relevance to target SMEs
  - Don't claim expertise
  - NATO ACT SME's resonated with strawman set of FFT dimensions
- Stimulate target SMEs to think multi-dimensionally in scope space
  - ACT SME's identified 2 additional dimensions in subsequent SCOPE Workshop with them
  - Degree of penetration of force structure tracked via FFT
  - Degree of security accreditation required by FFT systems and services/features
- Drive net-centric interfaces/services specification/standards
  - NATO/ACT currently focused only on ground force FFT
  - Acknowledged need for tracking helicopters and potentially CAS force element types and vice versa
  - Averse to force element status data exchange as FFT capability due to bandwidth concerns

Adjacent Domain Exercise for FFTI

Candidate Adjacent Domains for FFT

- Command and Control (C2), RoE, Planning, Exercises, Execution
- Situational Awareness (often characterized as a sub-domain of C2, but also of Intelligence) – includes MDA as a subset
- Intelligence
- Targeting, Weapon/Target Pairing and Release Authority
- Logistics
- Transportation, especially in-transit visibility
- Asset Tracking/Inventory Management
- Force Structure, Readiness and Preparedness
- Force Deployment, “deploy to contact?”
- Civil, Emergency Response, Stability Operations
- Personnel Management
- Business Operations
- JAG, Host Nation Support, and International Legal
- Doctrinal Analysis and Development

Considerations For Adjacent Domains

- What information/services from adjacent domains could the focus domain use to help achieve its objectives?
- What are the scope and frame of reference issues with the information from the adjacent domain from the focus domain perspective?
- What information/services produced by the focus domain (FFT) could be used by the adjacent domain to help achieve it's objectives?
- What scope and frame of reference issues exist for this information from the perspective of the adjacent domain?
- Are there incentive or business model/policy issues associated with interacting across the domain?
- Are there other modality/context issues?

Maritime Domain Awareness

- Key Information/Service exchanges with FFT?
  - AIS on helicopters
  - Ground force location information to Naval forces in amphibious or other naval fire support contexts
  - Naval platform location info to ground/air forces
- Key data elements and frames of reference shared or mapped with FFT?
- Domain scope challenges?
  - Selective activation/availability of AIS info depending on operational context
  - Data aggregation of AIS system broadcasts?
  - Long Range Identification &Tracking System? (not yet obligatory)
  - Some FFT stakeholders don’t view maritime forces as part of FFT

Maritime Domain Awareness

- Key Information/Service exchanges with FFT?
  - Provide ship tracking data to FFT
  - Validate ship tracking data by independent means (ships often mis-report their track data or actual contents)
  - Help identify who is behaving abnormally
  - Identify nationalities of ship/crew/flagging, ship contents
  - Ships are not under central control
  - Avoid ship collisions
  - Intended destinations, routes, and estimated arrival times
  - Would like to be able to track smaller ships as well as over 300 tons (AIS limit), and ships that meet certain profiles.
  - Ships acting as network relays for position/state information
  - Ships become network providers and have to handle security concerns that this role creates.
- Key data elements and frames of reference shared or mapped with FFT?
- Domain scope challenges?

S&R Logistics

- Key Information/Service exchanges with FFT?
  - Location info regarding Logistics force elements/assets (trucks, etc.
  - Logistics needs to know where consumers are
  - Logistics needs to know what consumers need (or inferred from their state info). May also need to get some of this from C2/Planning
  - Time of arrival estimates/projections; degree of commitment
  - Logistics might want to know the contents of a friendly force element such as a truck or other vehicle
  - FFT may want to know if a force element is “in/out of Supply” – could also be a C2/Situational awareness issue.
- Key data elements and frames of reference shared or mapped with FFT?
  - Location date/time, GPS/WGS-84 for location data but may use UTM grid as well.
  - Mode of transportation for tracked element (ground, sea, underwater, air, etc.)
- Domain scope challenges?

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S&R Logistics

- Key data elements and frames of reference shared or mapped with FFT?
  - Location date/time, GPS/WGS-84 for location data but may use UTM grid as well.
  - Mode of transportation for tracked element (ground, sea, underwater, air, etc.)
  - Size/mass of tracked entity, containerization
  - Affiliations and priority of support for entity being tracked
  - Billing of tracked element owner for logistics support provided
  - Specification/direction from logistics or C2 regarding which FFT elements are to be tracked in some area or time period
- Domain scope challenges?
  - Tracking aggregation services may support multiple organizations
  - Creates privacy/restricted access considerations

Possible Cloud Computing SCOPE Dimensions

- Degree of coupling between operational responsibility and execution resource ownership for
  - Network resources
  - Computing platform resources (incl plant, power, etc.)
  - Data resources – including controlled/licensed data
  - Service resources – for proprietary IP or bundled platform/data
- Business model types connecting consumer with cloud provider
  - Relationship management, consequence management
- Dynamic range of cloud services (mainly scalability)
- Network infrastructure capacity between cloud provider and consumer
- Execution platform types provided by the cloud
- Degree of domain-specificity of cloud-based services offered
- Others?

Operational to Resource Coupling Types and Measures

- Resource Types: Network capacity, nodal capacities, data ownership; service IP, others? SLA management and QOS resource management resources
- Coupling types? Common organizational policy, two party business models, national affiliation, third party payer models, others? Degree of visibility into resources available and degree of control of allocating those resources. Different cloud models have different approaches to this dimension. For example, different cloud providers have different ways to manage resources at different levels of granularity and resource type decompositions for consumption models exposed to the consumer.
- Should we take the relationship piece of this and include it with the top level Business model dimension? A better nomenclature might be “Operational Model.” Agreed to keep this as part of the top level Relationship Management dimension. What are the motivators for the coupling?

Degree of Coupling Measures

- Degree of Coupling measures? For example, Public vs Private clouds is one degree of coupling measure, but is silent on the coupling type subdimension. It's also not a very fine-grained measure, in part because there is a presumption that a private cloud is enterprise-wide inside (i.e. private) the enterprise firewall. But that's not necessarily so, depending on the enterprise in question.
  - Responsiveness of coupling? (in time units from demand signal to satisfaction?)
  - Motivation for coupling? – e.g. money, operational need, shared ideology, dictatorship, others
  - Enterprise Scope dimensions?
  - Net Ready Dimensions for services?
  - Geographical coupling? Particular related to the aggregation of resources.
  - Degree of specificity of coupling to service consumers

Business Models connecting consumer with provider

- Fee for service model
  - Commercial Service Model - fee for service models
  - Public Service Model - free or fee for service (but fee need not fully support service – subsidized by a separate body)
    - Private Service Model – Enterprise/group membership constrained to something less than general public
- Required Service Model – consumer must use provider service (e.g. vehicle registration, tax filing) by force of law/jurisdiction
- Third Party payer service model – e.g., Google search
- Community Contributor model – e.g., SETI model, botnets?
- Other business models?
  - Legacy consolidation, infrastructure consolidation
  - Insurance model (for unplanned events)
  - Charity for goodwill

Dynamic Range of Cloud Services

- Platform scalability (number of platforms available)
- Storage scalability – how much can be made available and how quickly
- Network access capacity scalability – consider Network Entity Reach (who can I reach?)
- Types of applications supported by the cloud services
  - Storage services, persistence/access speed tiering
  - Computing platform services (generic platforms)
  - Domain-specific services (e.g, image processing, search services)
- Types of coupling to the physical environment (not common, but possible in, say, sensor networks or process control services.)
- Types of coupling to the political/social environment, e.g., state, international; different currencies, languages, legal constraints
  - Coupling to social/entertainment networks, You Tube, Facebook, etc.
  - See also Enterprise Breadth SCOPE dimensions

Network Infrastructure/type capacity between consumer and provider

- LAN Bandwidths (100Mbit to 10 Gbit)
- WAN Bandwidths and latencies
- Mobile network Bandwidths and latencies
- Dedicated communication links (point to point)
- Low bandwidth and intermittent links
- Asymmetric network links (e.g. satellite with high downlink speed and limited or no uplink capability)

- Others? E.g. Cost of network usage to consumer? To Provider? Dynamic (on demand) not to exceed some level?
- SCOPE Tech Feasibility dimensions capture this as a fraction of available bandwidth. Is absolute bandwidth more relevant? How about latency or even availability of the network?

Platform types supported

- Intel Instruction set
- Other PC instructions set (e.g, Power PC)
- Small platform set (smart phone, PDA)
- High Performance platforms such as massively parallel processors, very large word size instruction set processors
- User delivery platform specificity
- OS Types supported
- Application types coupled to platform types (portability)
- Fault tolerant

- Have someone brief the CC WG on different approaches to virtualization and how those might need to be represented in cloud services to support interoperability among different cloud providers – Kayvium KVM in Toronto Ca?

Degree of Domain-specificity

- General platform services
- General purpose services, e.g.
  - Search services
  - Semantic interoperability services
- Functional domain-specific services. e.g.
  - Retail storefront services (Amazon, Yahoo, E-Bay)
  - Business function services (Salesforce.com)
  - Records management service
  - Tactical vs. Enterprise
- Single-purpose services (e.g., SETI, Human Genome analysis)
- Other gradations or sub-dimensions

Other measures of Cloud variability

- QOS measures specific to Cloud Computing?
  - Levels of privacy/security/anonymity
  - Levels of redundancy and/or physical dispersion
  - Speed of allocation of resources
  - Level of management visibility/control
- Grid Computing and High Performance Computing?
- Cloud “outsourcing” services - “private label” cloud instantiation and operation? e.g., RACE – business model type?
- Dynamic formation of clouds? Possibly from other clouds? Virtual clouds? SETI, Human Genome analysis
- Data portability and service level interoperability (beyond net-ready dimensions?)

Adjacent Domain Analysis

- What adjacent domains have information/services that cloud computing may need to interact with?
  - E.g.: platform virtualization, business relationship management (e.g., IRM/ERP, CRM, billing, demand forcasting, network management, application management, DRM, regulatory compliance management (e.g., SOX), cyber security, etc.
- What information does cloud computing have/generate that other domains may be able to use?
  - E.g: volume of data access requests, data volume stored, number of service requests by service consumers, resource units in use, etc.
- Others?
  - Application development