



Semantics of Security

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Abstract

This presentation explores semantics as an enabling technology to solve the daunting security problems of preparation and response as applied to Maritime Domain Awareness (MDA). Maritime Security depends upon the fusion of intelligence across thousands of diverse organizations (International, Federal, State, Local, and Commercial), processing large volumes of information, and interconnecting multitudes of sensors and systems. Traditional methods for interoperability and data exchange will not achieve the desired coordination between agencies, especially to prevent and/or respond to a major incident (natural disaster or terrorist attack). Ontologies, machine-processable semantics, will be examined for their ability to solve interoperability problems and provide predictive analytics for MDA missions. Additionally, management and development of the semantic web and MDA semantic layers will be discussed.

Objectives:

- **How ontologies would assist the Maritime Security Problem**
- **What are the data quality attributes that will allow creation of data context**
- **A Framework for the development of MDA Semantic Layer**
- **Emphasis on data security as an element of data context**
- **How System of System (SoS) methodologies can develop required ontologies**

Maritime Security Problem

Maritime Domain Awareness (MDA) ... Maximizing awareness of security issues in the maritime domain in order to support U. S. forces and improve United States Government actions in response to identified threats (*NSPD 41*, p. 2)* ... It is critical that the United States *develop an enhanced capability to identify threats* to the maritime domain as early and as distant from our shores as possible. (*NSPD-41*, p.5)*

- **Maritime security response and counterterrorism operations**
- **Maritime intercept operations**
- **Prevention and detection of, and response to, mining of U.S. ports**
- **Detection, interdiction and disposition of targeted cargo, people, and vessels**
- **Attacks on vessels with U. S. citizens aboard or that effect U. S. interests anywhere in the world**

** National Security Presidential Directive NSPD-41
Homeland Security Presidential Directive HSPD-13,
The White House, December 21, 2004*

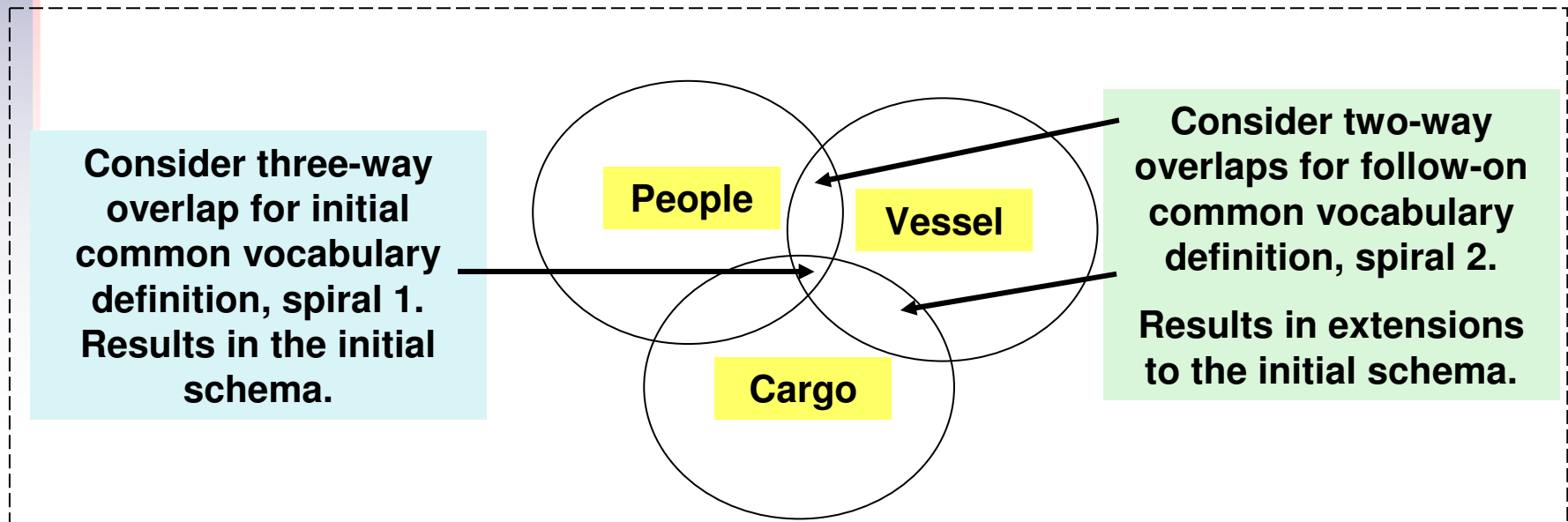
Scope of the Maritime Data Management

Describe the initial community vocabulary that is necessary to Maritime Security.

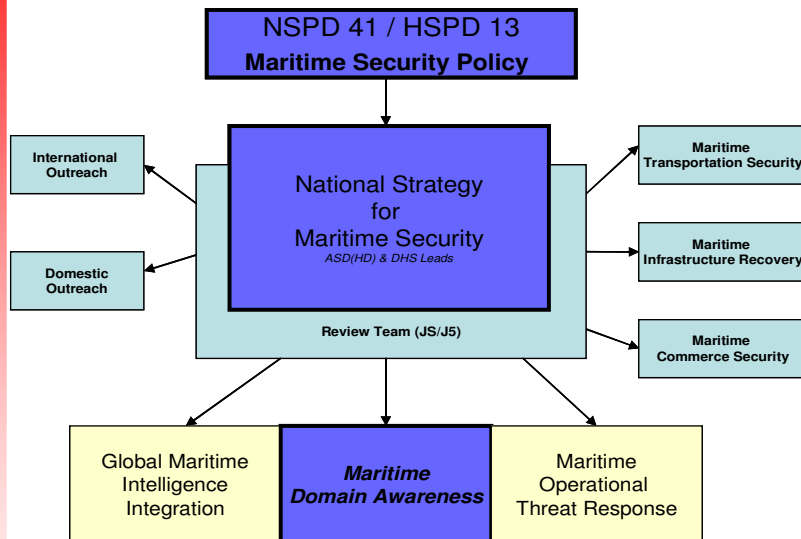
Maritime Situation Awareness (SA):

What, When, Where, and Why?

Consider data related to people, vessels, and cargo...?



Data Strategy Requirement



Maritime Domain Awareness (MDA) is effective understanding of anything associated with the global maritime domain that could impact the security, safety, economy, or environment of the United States ...

Goal: Improve our ability to *collect, fuse, analyze, display, and disseminate* actionable information and intelligence to the operational commander.

Understanding the Complexity

- **On-demand Data Access**
 - Understanding of anything associated with global maritime domain
- **Managing Uncertainty**
 - Threat vs. Capability Based Response Plan
- **COI to COI Integration**
 - No established Core COI Structure (data or processes) to leverage

On-demand Data Requirement

Maritime Domain Awareness (MDA) is effective *understanding of anything associated with the global maritime domain* that could impact the security, safety, economy, or environment of the United States (NSPD-41, p. 5).... It will be achieved by improving our ability to collect, fuse, analyze, display, and disseminate actionable information and intelligence to operational commanders.

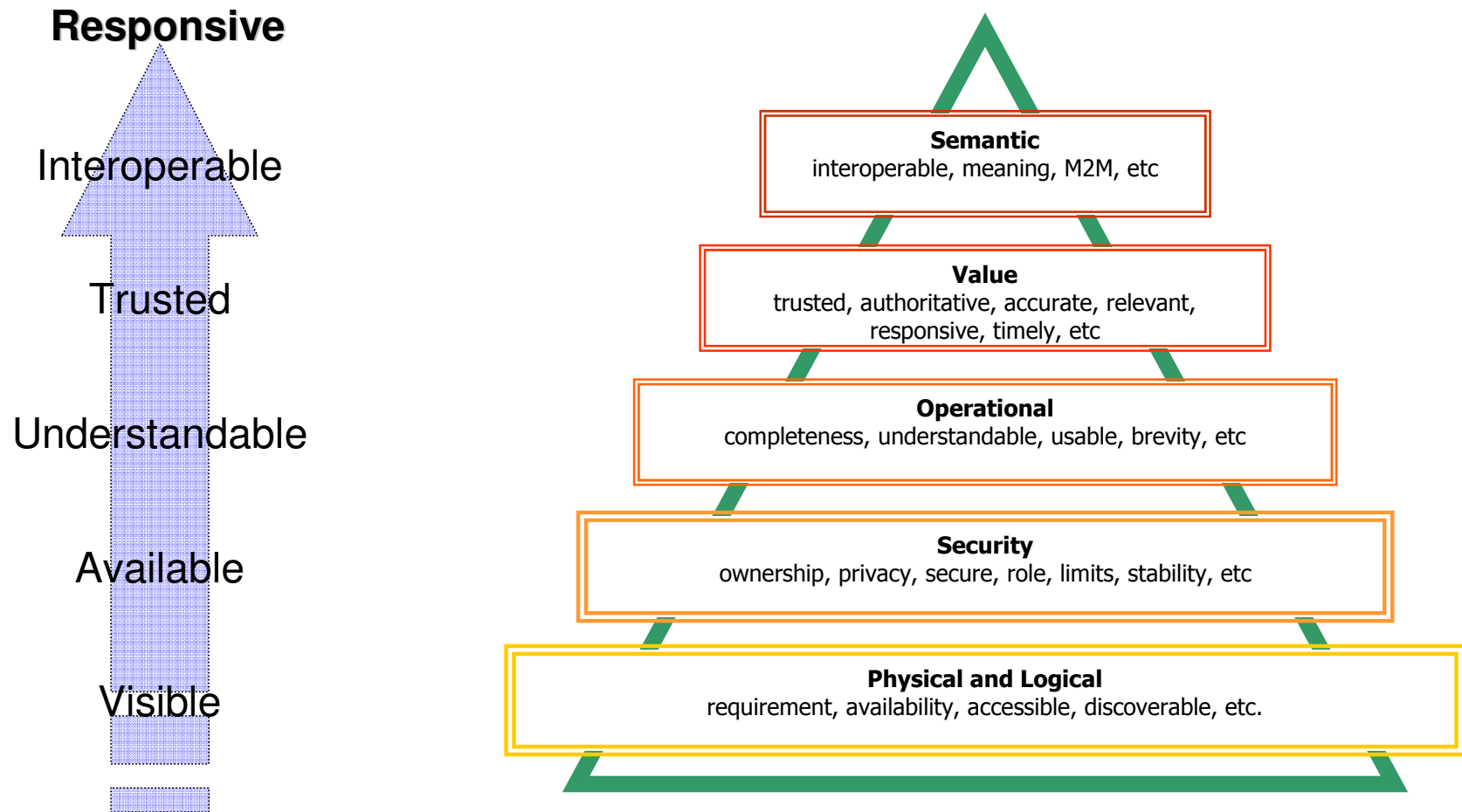
In other words; *Right data, right place, right time, all the time.*

This implies the “right” data:

- Exists,
- Is visible (i.e., discoverable),
- Is accessible
- Is understandable
- Is trusted

DoD 8320.2-G Guidance to COIs for Implementing Net-Centric Information Sharing, dated November 7, 2005.

Hierarchy of Data Needs



****Modified from Maslow's Hierarchy of Needs
(original five-stage model)**

DoD 8320.2-G Guidance to COIs for Implementing Net-Centric Information Sharing, dated November 7, 2005.

Data Understandability

Net Centricity: DoD is moving to a net-centric environment in which all elements of the DoD are able to seamlessly share information, resulting in dramatic improvements in combat power and decision superiority.

Data Understandability Elements

- A context for the information can be understood
- Metadata (e.g. XML), which provides a way to describe data assets and the use of registries, catalogs, and shared spaces
- Mechanisms to understand data context
- Discoverable Services that enable data tagging, sharing, searching, and retrieving

Net Centricity Wants Information

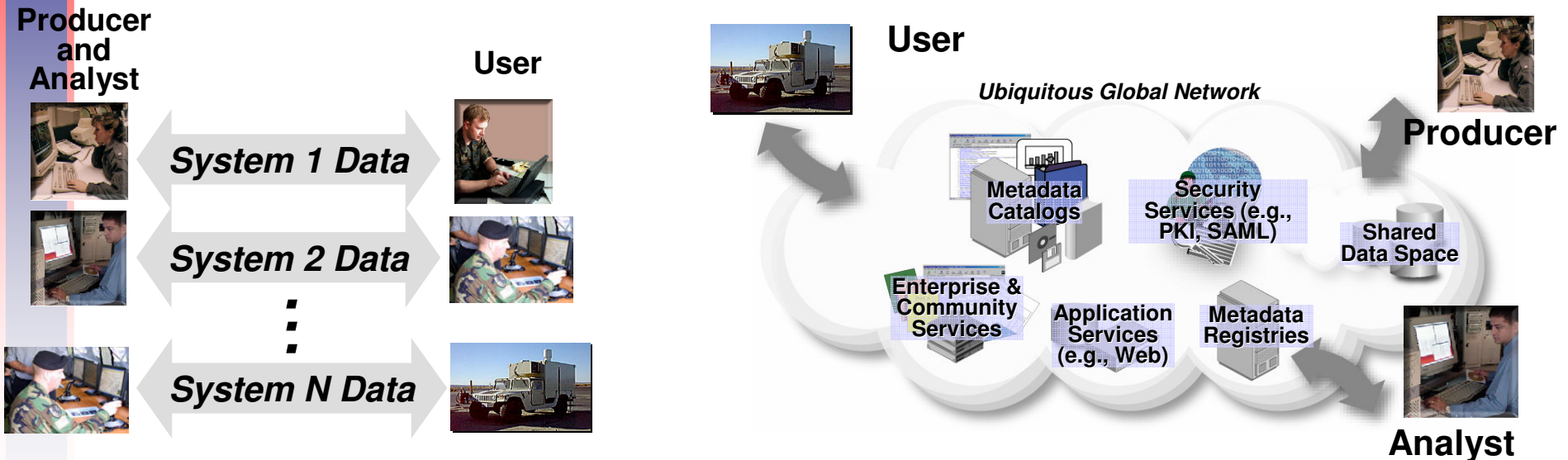
- **Joint Chiefs of Staff (JCS) Joint Pub 6-0 (Doctrine for Command, Control, Communications and Computer (C4) Systems Support to Joint Operations) describes data with a combination of seven information quality criteria (JCS Joint Pub 6-0 Page 1-5) as usable information:**
 - **Accuracy - Information conveys the true situation**
 - **Relevance - Information applies to the mission**
 - **Timeliness - Information that is available in time to make the decision**
 - **Usability - Information that is in common, easily understood format and displays**
 - **Completeness - All necessary information is required by the decision maker**
 - **Brevity - Information only has the level of detail required**
 - **Security - Information that has been afforded adequate protection where required**

“Information is data collected from the environment and processed into a usable form” (JCS Pub 6-0 page 1-3)

Net-Centricity Depends Upon a Data Strategy

Under Net Centricity, Data is to be:

- Visible, Accessible, and Understandable
- Shared to supports planned and unplanned consumers
- Have a shared meaning for understanding (independent of System)



From System centric:

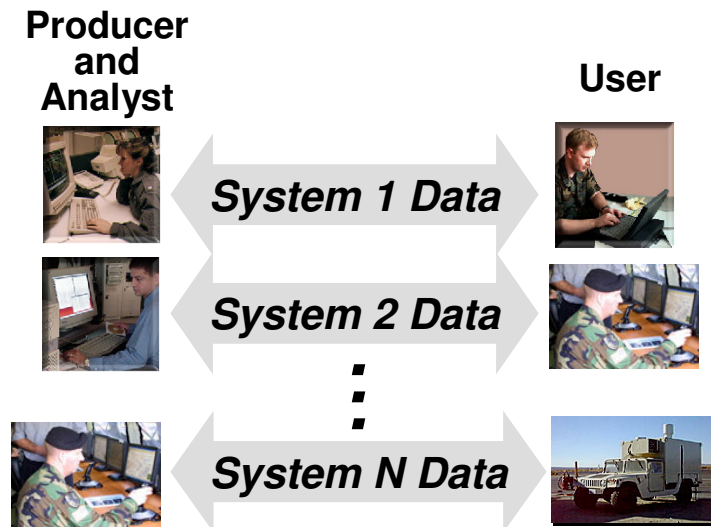
- Multiple systems to find data
- Private data – only supports user of system
- User translates data as needed for mission accomplishment across multiple sources

To Net Centric:

- Data is visible, accessible and understandable
- Shared data – supports planned and unplanned consumers
- Shared meaning of the data enables understanding for a given purpose

Pre-Net-centric: User

- **User concerned with:**
 - Usable,
 - Brief (Appropriate level of detail), and
 - Timely
- **User assumed:**
 - Relevant
 - Accurate
 - Complete
 - Secure



From *System centric:*

- Multiple systems to find data
- Private data – only supports user of system
- User translates data as needed for mission accomplishment across multiple sources

The burden was on the User to transform “Data” into “Mission Information”

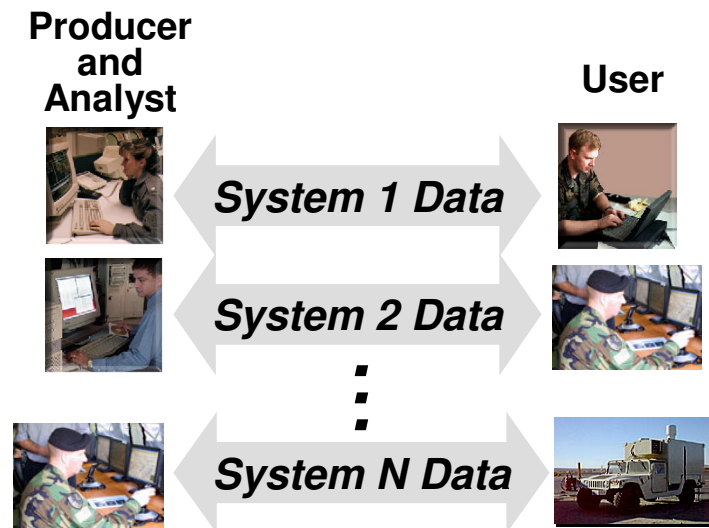
Pre-Net-centric: Analyst

- Analyst concerned with:

- Relevant
- Accurate
- Complete
- Secure

- Analyst traded off:

- Usability
- Timeliness
- Brevity



From *System centric*:

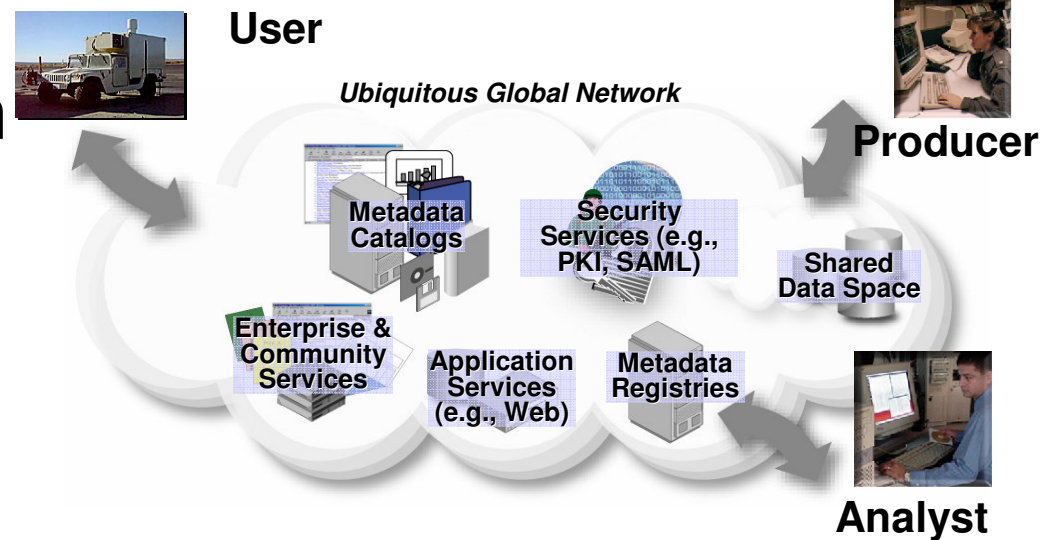
- Multiple systems to find data
- Private data – only supports user of system
- User translates data as needed for mission accomplishment across multiple sources

The Analyst processed “Data”
to create “Mission Information”

Net-Centric

- “Data” to “Mission Information”:

- Brief
- Timely
- Usable
- Relevant
- Accurate
- Complete
- Secure



To *Net Centric*:

- Data is visible, accessible and understandable
- Shared data – supports planned and unplanned consumers
- Shared meaning of the data enables understanding for a given purpose

MDA Data Strategy strives to automate the transformation of “Data” to “Mission Information”

Ontology: An Enabling Technology

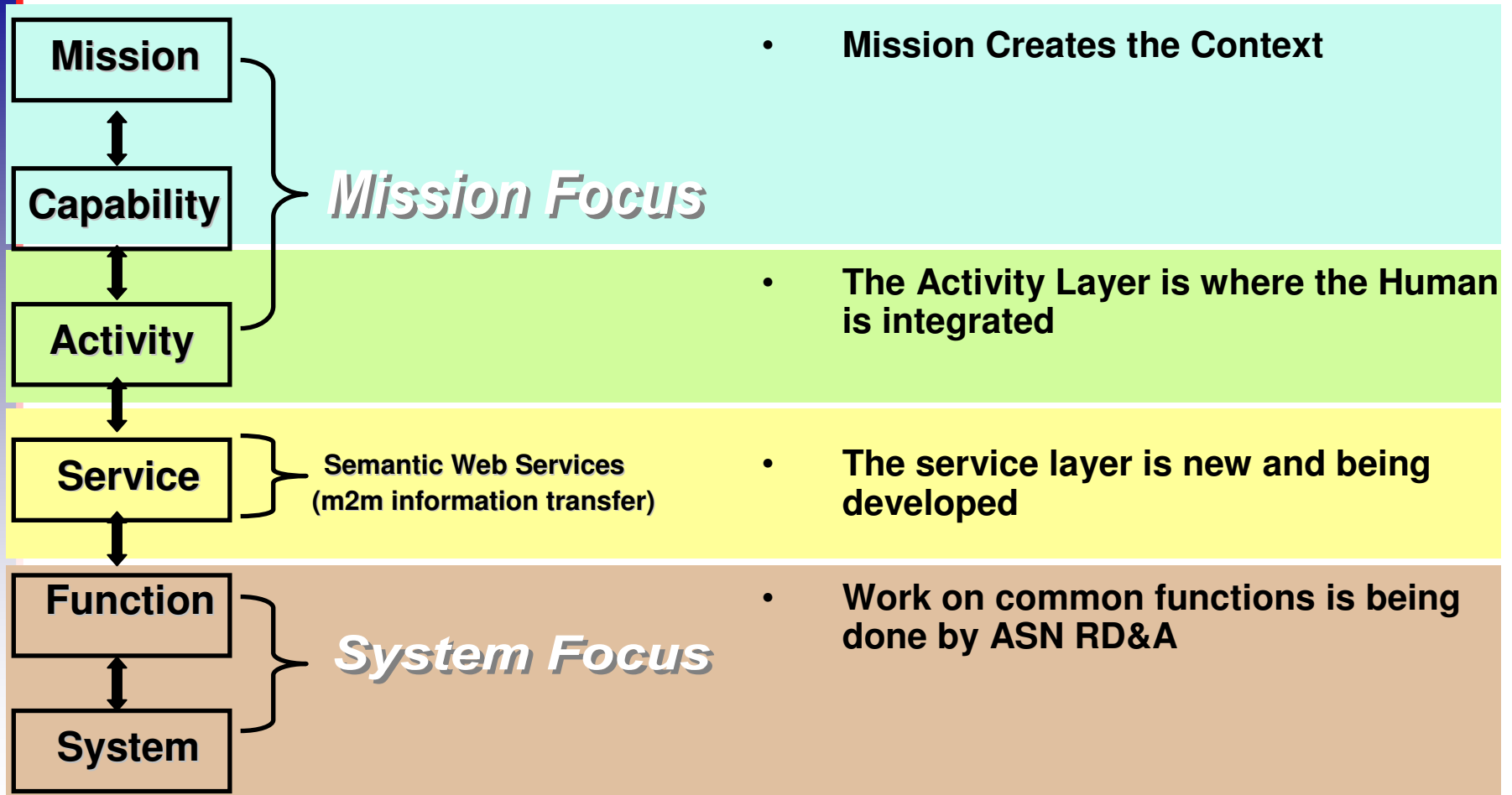
- **We will focus the aspects of Data Understandability and the development of shared meaning**
- **Ontology – An Enabling Technology**
 - **An ontology models the vocabulary and meaning of data domains**
 - **Objects in the domains and relationships among objects**
 - **Properties, function and processes involving those objects**
 - **Constraints and rules about the objects**
 - **Defines a Core Lexicon, Taxonomy, data dictionary, data schema**
 - **Ontologies permit fine, accurate, consistent, meaningful distinctions to be made between classes, instances, properties, attributes and relations in the data domain.**

Mission Context

- **Mission Context allows the user to use data to complete their mission**
- **Mission completion and the information for that completion is the central concept**
- **The MDA Data framework has to capture the data requirements, guidelines, and procedures for Mission Completion**

Ontologies will Implement our Context

Information Flow Stack



Ontologies Development

Attributes

Who, How, What,
Where, When, Why

Mission

“ “ “ “ “ “

Capability

“ “ “ “ “ “

Activity

“ “ “ “ “ “

Service

“ “ “ “ “ “

Function

“ “ “ “ “ “

System

Mission Ontology

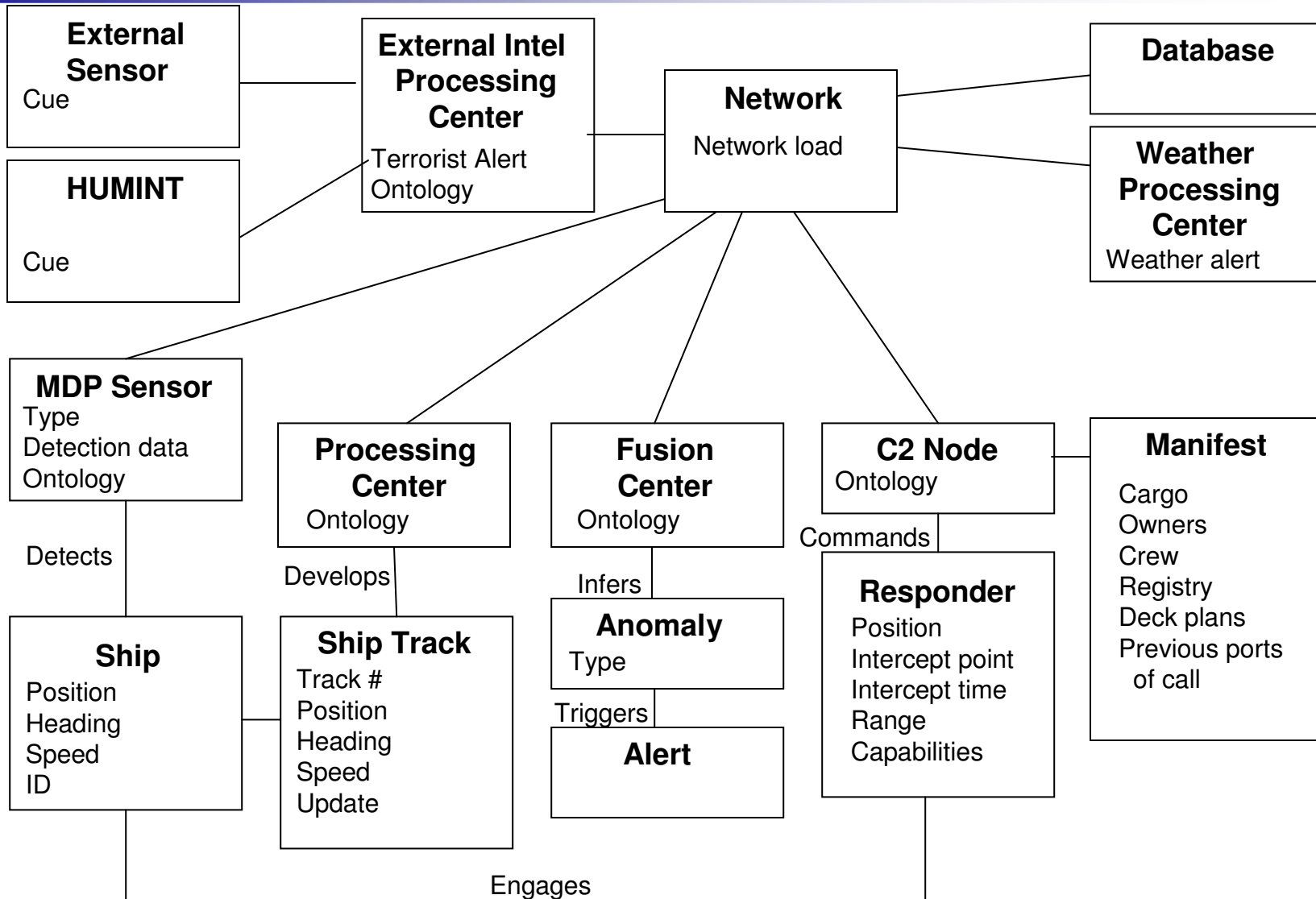
Semantic Web Services
(m2m information transfer)

Instance
Ontologies

- Workload Element Library
- Skill Object
- System Design Task

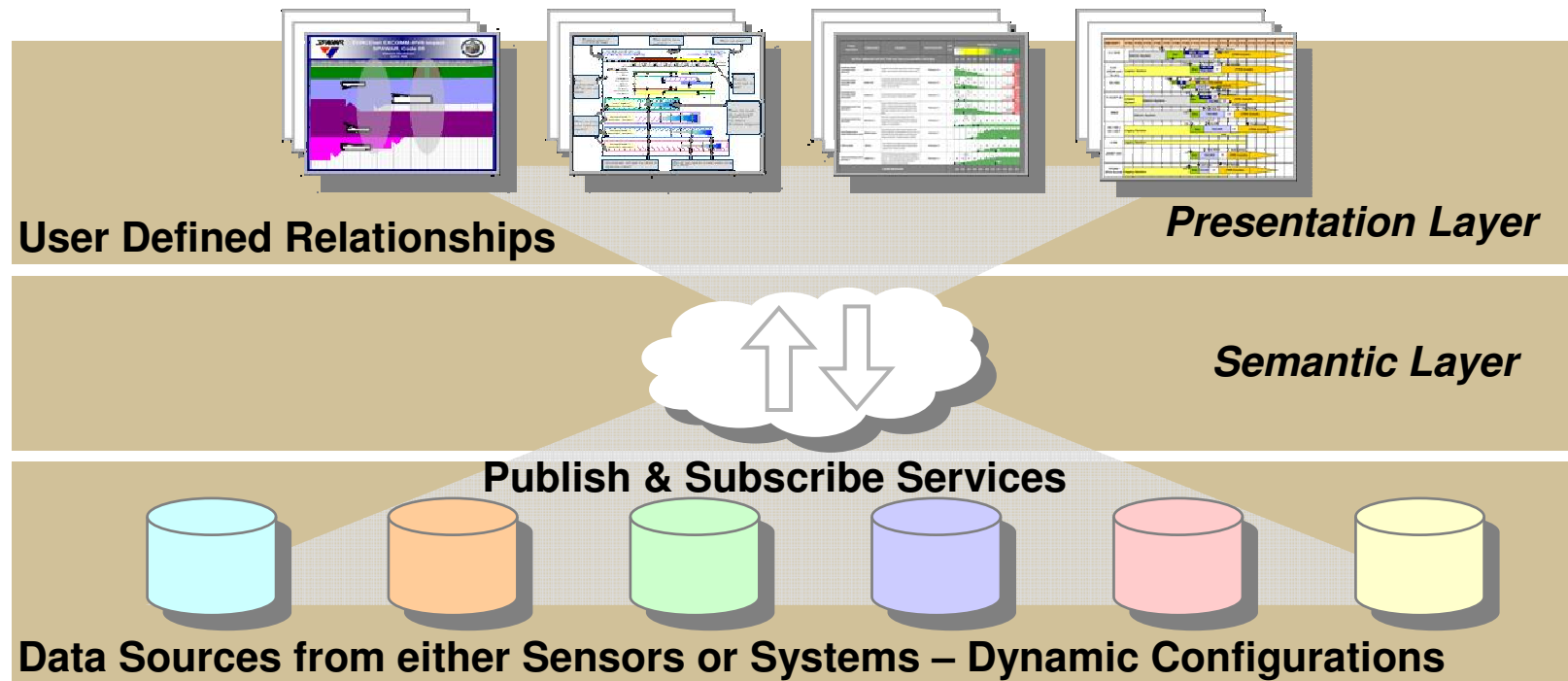
* Derived from the Navy Semantic Working Group proceedings, 27 July 2005, MITRE, San Diego, chaired by Brad Mercer and contributions by Paul Shaw

Sample Concept Diagram



MDA Data Fusion

- **Reduced Need for Point to Point Interoperability**
 - **Publish and Subscribe Enabled for Use**
 - **Dynamic Communities of Interest**



Semantics of Security

- **The MDA Data in a Net Centric Environment Poses New, Exciting Challenges**
- **The MDA “Missions” Provides the Necessary Context for our Data**
- **Technologies like the Semantic Web with the use of Ontologies are Key enabler for the achievement of our MDA Objectives**