BAA 10-018 Industry Day

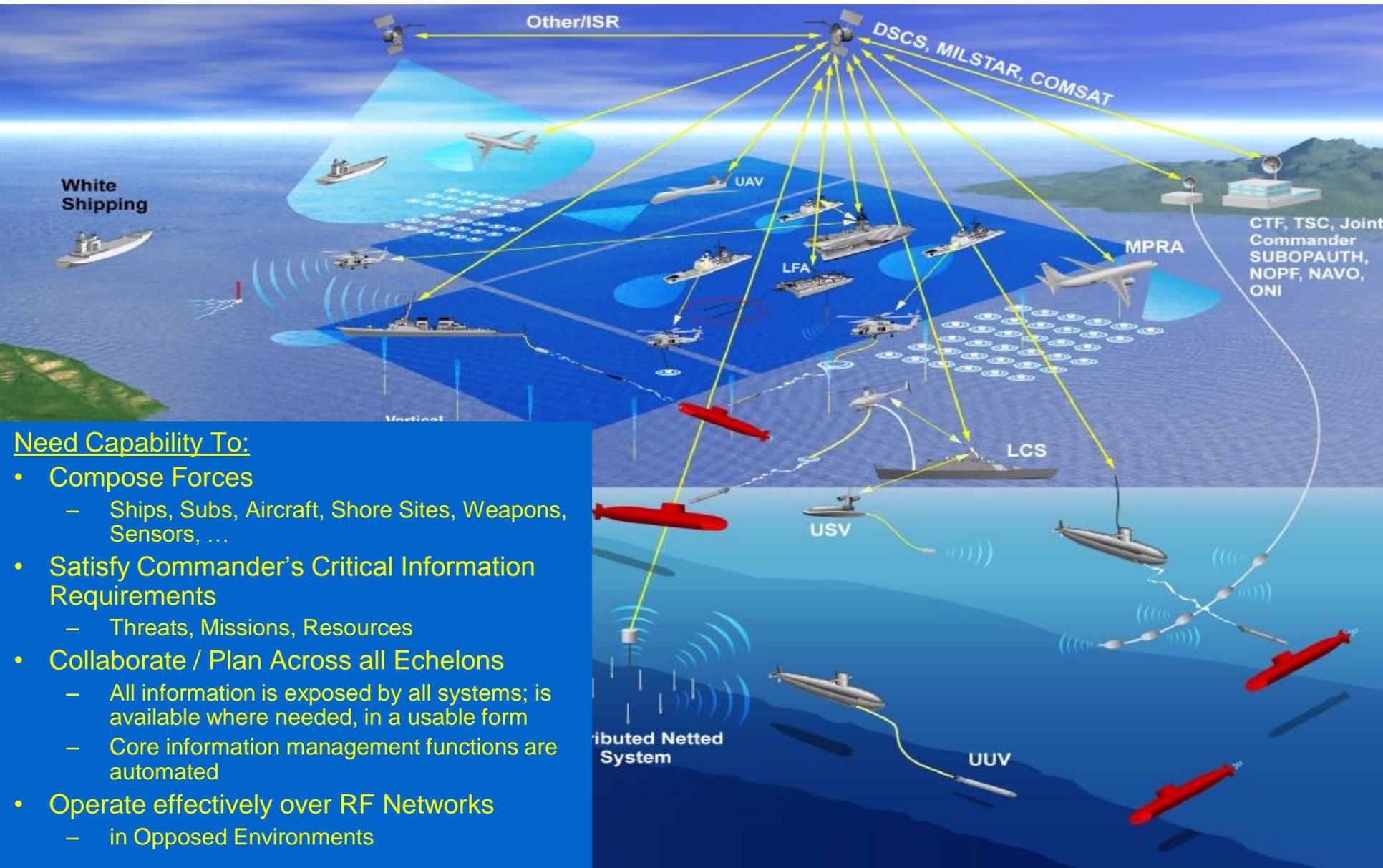Revolutionary Research . . . Relevant Results

FNT-FY09-04 Dynamic Command and Control (C2) for Tactical Forces and Maritime Operations Center (MOC)

BAA Technical Overview

21 May 2010

High Level Operational Concept: Dynamic Command and Control

Need Capability To:
- Compose Forces
  - Ships, Subs, Aircraft, Shore Sites, Weapons, Sensors, …
- Satisfy Commander's Critical Information Requirements
  - Threats, Missions, Resources
- Collaborate / Plan Across all Echelons
  - All information is exposed by all systems; is available where needed, in a usable form
  - Core information management functions are automated
- Operate effectively over RF Networks
  - in Opposed Environments

# Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC)

Product Description:

Software for Command Control and Combat Systems that provides dynamic and responsive management and control of net-centric enterprise theater and tactical Anti-Submarine Warfare (ASW).

- Flexible command and control (C2) among tactical units (air, surface, subsurface, and shore including tactical mobile shore C2) & MOC

- Ability to operate in a severely degraded comm environment

- Allow all echelons of command (from individual ship or aircraft mission commander to Joint Force Maritime Component Commander) to conduct dynamic missions in a coordinated and effective manner

Co-evolve technology with tactics techniques & procedures through experimentation

Transition through acquisition partner's Peer Review Process
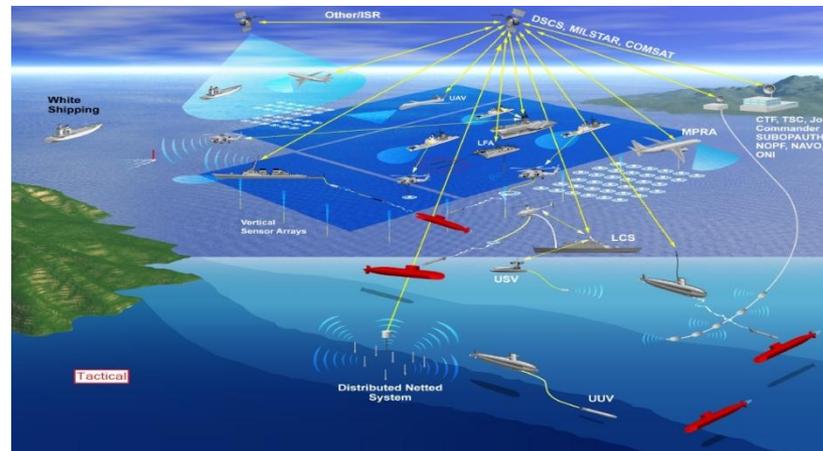
Warfighter Payoff:

- Increased access and shared awareness of relevant data, activities, and enterprise status among tactical forces and the Maritime Operations Center.

- Automated support for synchronized planning, coordination, and execution of network enterprise resources to meet evolving mission demands.

- Visualization of critical performance indicators of networked force capabilities, and ability to manage the complex problem spaces.

|	FY09	FY10	FY11	FY12	FY13
Phase 1 – *In Progress*					
Phase 2 – BAA 10-018 – *Current Solicitation*					
Demos - ◆ **Transitions -** ▲					

Common Tactical Picture Synchronization Over Disconnected, Intermittent or Limited Communications Networks (CTPoDIL)

Objective:

Develop automated and distributed services that:

(1) Create an accurate and near-zero latency Relevant Common Tactical Picture (RCTP) on each node based on all available information from all nodes and theater and national sensors.

(2) Optimize the transmission of relevant information among nodes, within the constraints of disconnected intermittent, or limited (DIL) communications links, while maintaining critical pedigree and both kinematic and non-kinematic attribute data.

IFPC = Information Flow Prioritization and Control Service
RCTP = Relevant Common Tactical Picture
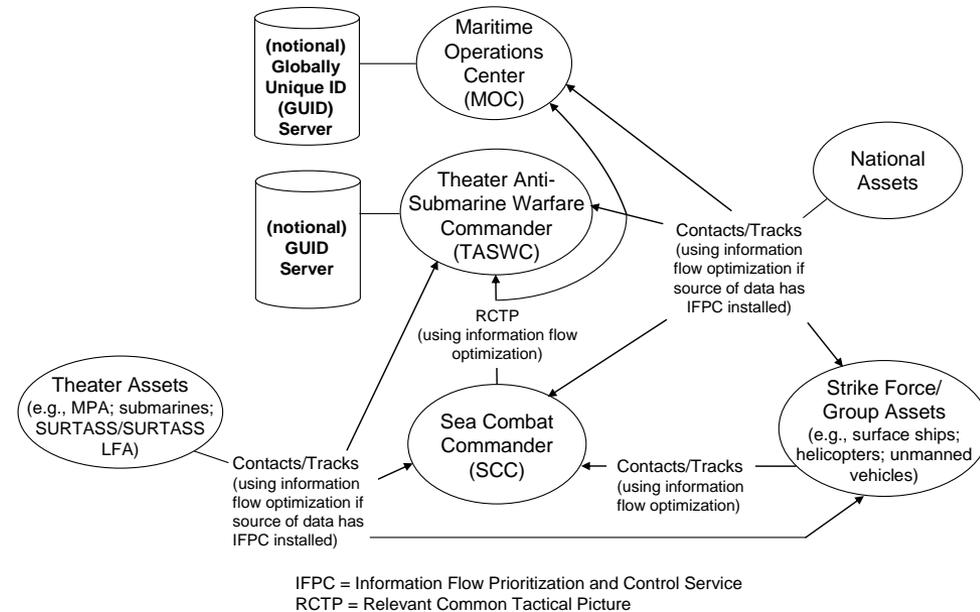
Deliverables:

- Relevant Common Tactical Picture Generation (RCTPG)
- Track-to-Object Multiple Hypothesis Data Association and Fusion Module (TOAM)
- Own-Node Fused Picture Generation (ONFPG)
- Information Flow Prioritization and Control (IFPC)
- Common Tactical Picture Synchronization (CTPS)
- Redundant Track Filtering (RTF)
- Object Classification, Alerting, and Information Utility (OCAIU)

Dr. Reynolds Monach, reynolds@va.wagner.com, 757-727-7700

Naval Interoperability Network (NION)
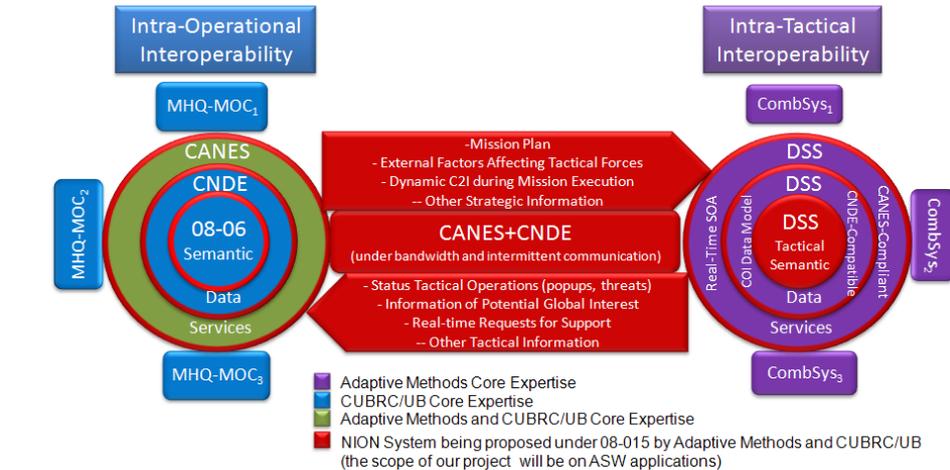
Objective:

Automated collaborative data exchange of timely, relevant, and prioritized enterprise data to enable increased operational tempo between the MOC and Tactical Assets

- **Information Exchange**: Automate collaboration among heterogeneous data providers and provide adaptive content-based routing and prioritization of information in DIL environment
- **Tactical Overwatch**: Provide *tactically relevant* threat, planning, and resource information from the MOC to tactical platforms
- **Tactical Insight**: Provide *operationally relevant* information (contacts, negative information, and status) from tactical platform(s) to MOC(s)

IntelIEx (CUBRC): Assess information *relevance* using Interest Models

Data Dissemination Manager (Adaptive Methods): Assess information *priority* using Context/Situation

Technical Challenges:

ASW Extensions:

- Design for easy integration of new domain knowledge
- ASW ontology development to capture domain knowledge
- Identification of significant MOC/Tactical Use Cases

DIL Extensions:

- Partial data updates using subset of payload
- Optimization with multiple data payload sizes at runtime
- Optimal transmission of multi-connected peers

POC: Jim Farrell, jfarrell@adaptivemethods.com, (703) 968-4061

Tactical Data Management Services for Disconnected, Intermittent and Limited (DIL) Communications Paths (TDMS)
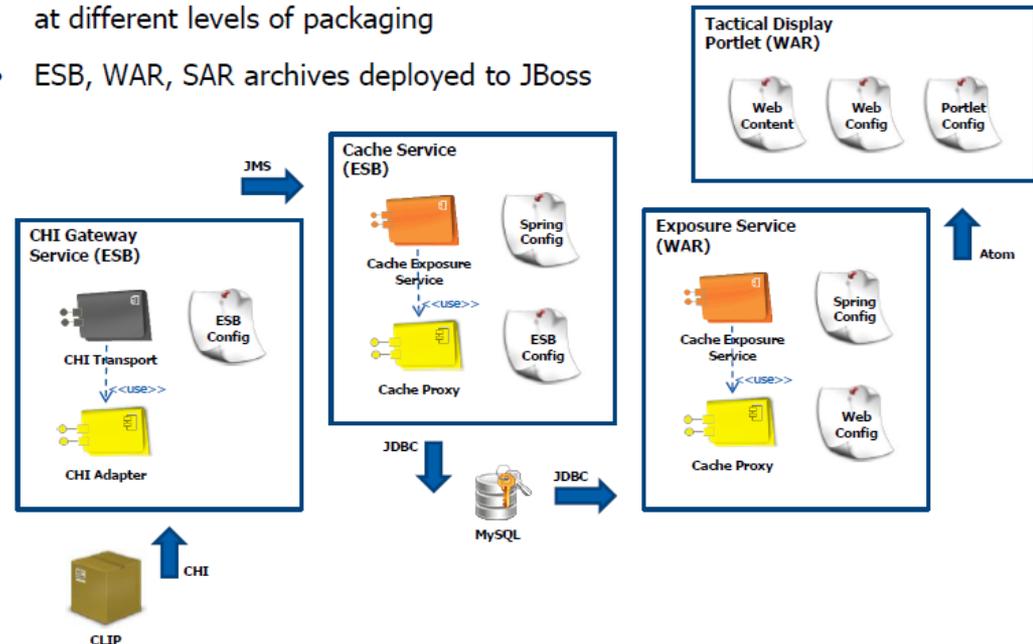
Objectives:

- Share data across enterprise and tactical environments in a scalable, adaptable manner
- Support dynamic decision making by providing commanders with highest quality data possible
- Simplify awareness, organization and consumption of tactical data sources

- Different artifacts referred to as "services" at different levels of packaging

- ESB, WAR, SAR archives deployed to JBoss

Deliverables:

- Distributed Cache Service.
- Distributed Exposure Service
- Tactical Data Enrichment Service
- Tactical Data Broker Service

POC: Dale McKay, dale.mckay@ngc.com, (858) 514-9394

Federated Collaborative Decision Spaces (FCDS)

Objective:

Enable Commanders and staffs to collaborate and dynamically control forces from the operational through the tactical levels:

- Focus on their own tasks while facilitating automated horizontal and vertical collaboration
- Automatically coordinate tasks and resources across multiple decision activities
- Easily assess the impact of individual courses of action to the larger force.

Federated Collaborative Decision Space (FCDS)
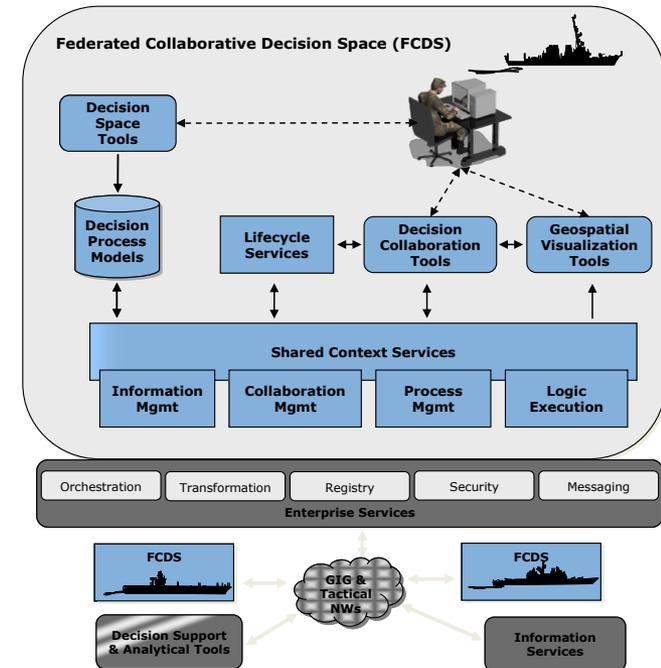
Deliverables:

A decision support tool that will enable Fleet personnel to define, implement and manage decision processes, including:

- Inter-DPM Collaboration
- Utilization of Open Agent Architecture

- Ability for Decision Processes to Dynamically Find and Communicate with One Another
- Ability to Aggregate Decision Process Instances Employing Heterogeneous Missions and Resources

POC: Brad DiDio, Brad.Didio@solers.com, (617) 448-8881

# Unified Pedigree Services Integrated Data Environment (UPSIDE)

Objective:

Pedigree management capability including:

- Software and enterprise business logic for the generation, propagation, and collection of pedigree information
- Inferencing, analysis, and visualization tools for use of pedigree information
- Use of national and tactical SIGINT (ELINT & COMINT) data for the organic Carrier Strike Group Anti-submarine Warfare Mission

Pedigree Modeling

Source	Service	Process

Pedigree Generation | **Pedigree Propagation**

Pedigree Visualization

Confidence	Workflow	Reachback

Pedigree Analysis Tools

Verify	Query	Sensitivity

Deliverables:

- Metadata for sources, services, and processes
- S/W for the generation and reporting of metadata
- Designs for pedigree propagation in a DIL network
- Ontology for Information Pedigree for SIGINT

- Tools for validation and consistency checking
- User Facing Tools for Pedigree Analysis: Inferring confidence, reach-back and drill-down,
- Analyst software tools for reconstituting the information process with new assumptions

POC: Dr. Michael Hultner, michael.hultner@lmco.com, (858) 795-1379
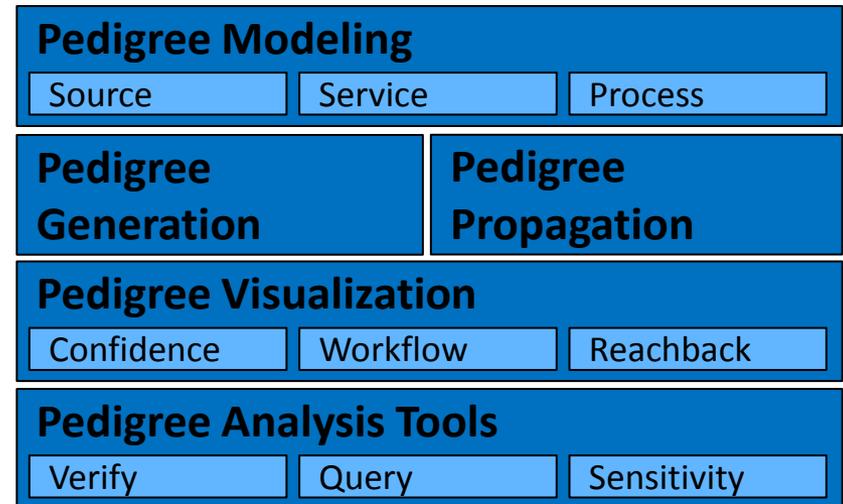
EC Products, Objective Implementation

Dynamic C2 for Tactical Forces and Maritime Operations Center
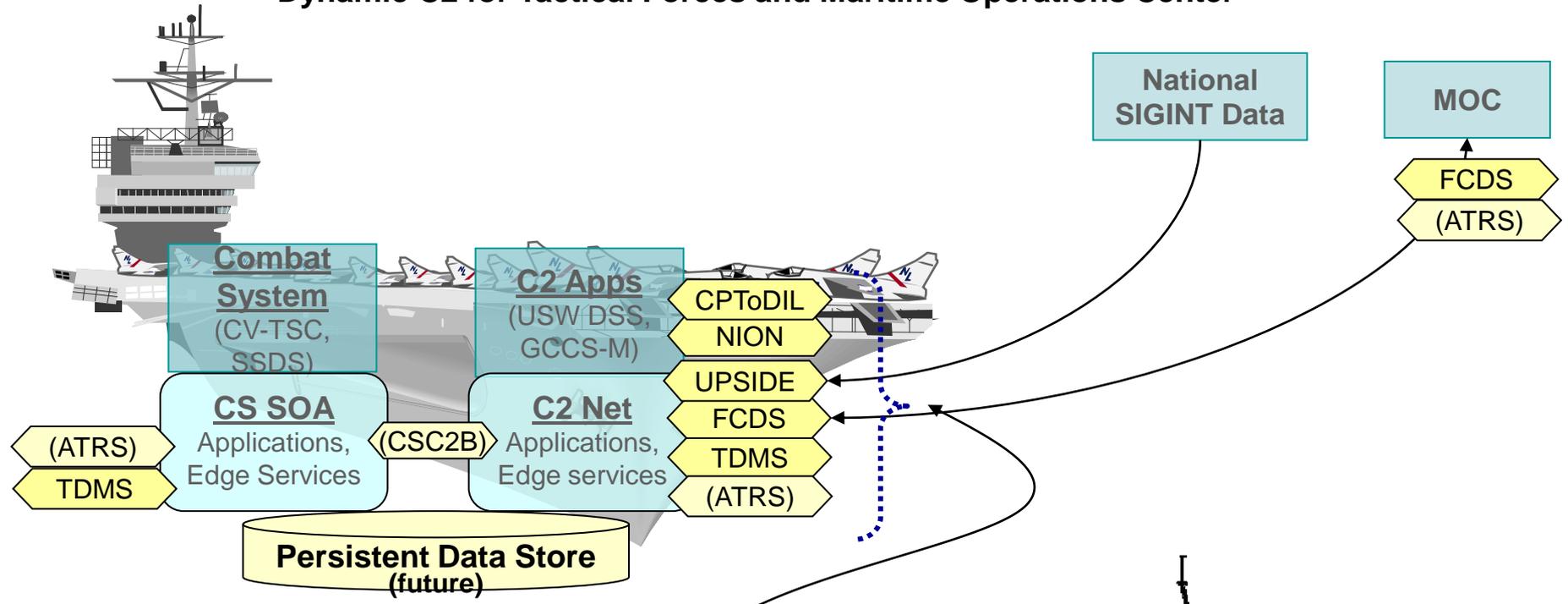
Thrust Areas:

- **Automated data access and shared awareness**
- **Automated synchronized planning and execution (Tactical to MOC)**
- **Visualization of critical performance indicators**
- **Combat System to C2 Network Integration**
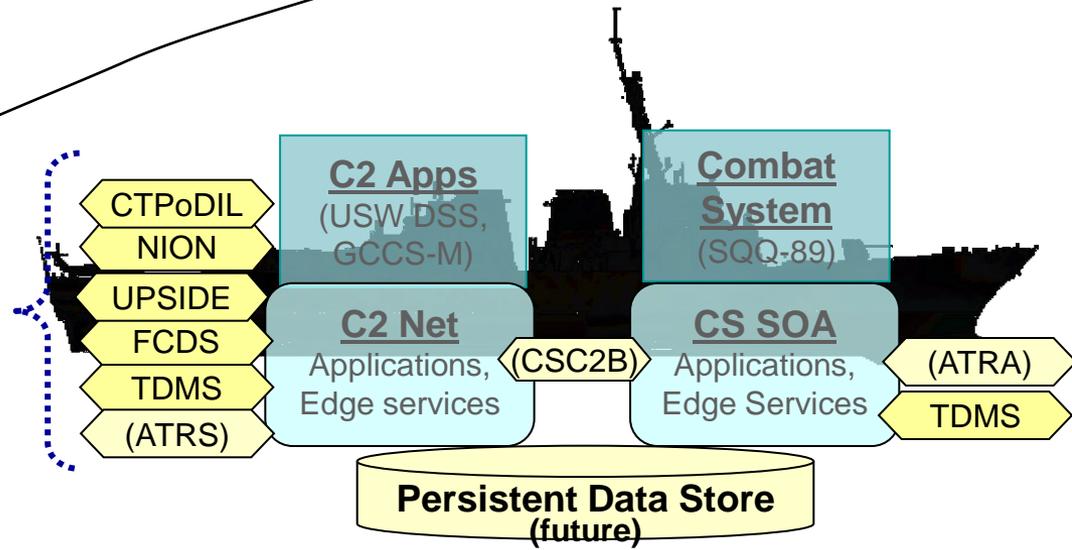
BAA 10-018 Key Objectives

- Maximize Information Transparency
  - Between combat systems networks and C4I networks aboard U.S. navy combatant ships, and
  - Between U.S. navy combatant ships, and between ships and shore sites, while
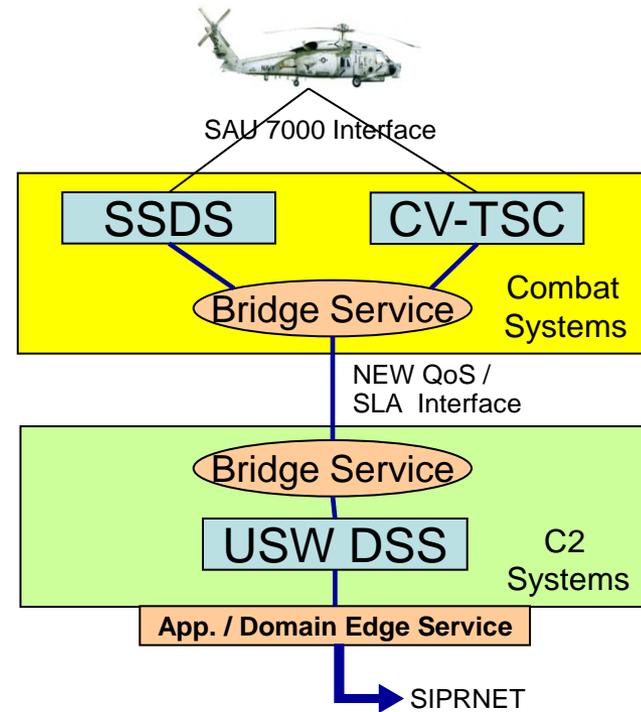
- Minimizing the Level of Design Complexity
  - imposed on individual applications developers for both combat systems and C4I applications

SAU 7000 Interface

SSDS   CV-TSC

Bridge Service   Combat Systems

NEW QoS / SLA Interface

Bridge Service

USW DSS   C2 Systems

App. / Domain Edge Service

SIPRNET

Technology Challenges

- ## Domain Bridge Services
  - Enable information exchange between the shipboard Combat Systems (CS) network and shipboard Command and Control (C2) systems network
- ## Domain Edge Services
  - Optimize information exchange between ships, aircraft, and shore sites over naval radio frequency (RF) communications networks
- ## Common Information Functions
  - Data Quality Attributes (context and usability)
  - Service Level Agreements / Quality of Service (QoS)
  - Information Assurance (IA)
  - User Facing Services (UFS)
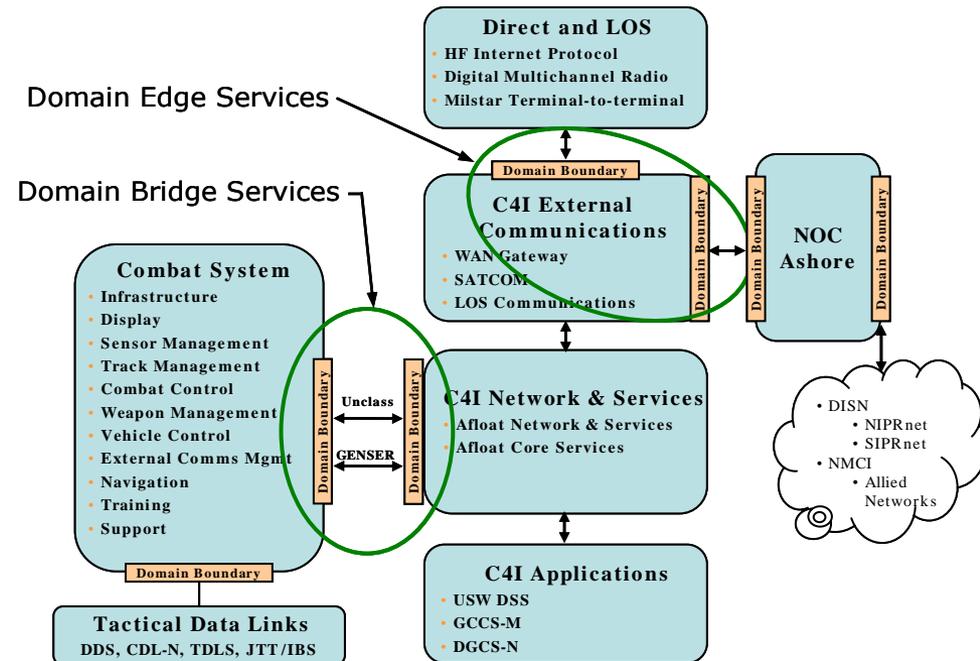
Domain Bridge Services

- Avoid C2 loading on CS network
  - Provide gateway service
  - Consolidate C2 queries
- Provide Protocol conversion
  - DDS (Data Distribution Service) on CS Net
  - Advanced Message Queuing Protocol (AMQP) on C2 Net
- Provide Quality of Service
  - Provide support for limited CS pedigree needs
  - Mediate between DDS QoS parameters and future C2 QoS parameters (including edge services)
- Provide Information Assurance
  - Limit access to CS from C2

Enable information exchange between the shipboard Combat Systems (CS) network and shipboard Command and Control (C2) systems network

Communications Reality

- **DIL** – Disconnected, Intermittent, Limited
  - A useful characterization of navy communications

- Factors impacting communications
  - Readiness Status
  - Weather
  - Operations (location, course, EMCON)
  - Impacts of opposing forces (jamming, damage, etc.)
  - Competing Demand (operational, tactical)

Domain Edge Services

- Support distributed decision makers with the means to collaborate using shared information space.

- Allow individual nodes (of a distributed enterprise) to function while temporarily disconnected from internal and external domain services.

- Automatically and adaptively monitor and manage the functioning of the domain edge services to diagnose problems and make repairs as needed.

- Provide information to the applications to enable the applications to be network aware and respond accordingly.

Optimize information exchange between ships, aircraft, and shore sites over naval radio frequency (RF) communications networks

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Domain Edge Services

- Today
  - Systems "discover" remote systems by loading IP addresses
  - No specific guidance on how to handle Naval WAN characteristics
  - Systems compete for resources based on static governance (ADNS Differential Service Code Points)

- Future (desired)
  - Dynamic Identity / role – based "discovery"
  - Abstraction Layer provides smart WAN interface
    - Network aware, smart queues, persistent connections
    - Dynamic policy-based competition for resources
  - Developers are provided with standards, patterns and practices to enable design for effective use of limited communications resources

Common Information Functions:
Data Quality Attributes

- Need to identify standards and best practices for implementation by PEO IWS and PEO C4I
  - Address employment of data quality attributes in qualifying sensor/processor information products
  - Representation of uncertainty associated with such information products in a way that aids user understanding.
  - Develop the appropriate form and function for efficient enterprise sharing of data models and data representation
  - Standards and guidance for developers to achieve standardized data quality usage in machines
  - Effective methods for visual representation to aid understanding by humans.

Common Information Functions:
SLA / QoS

- # Develop standards, patterns, practices and software tools for managing SLA/QoS handling
  - ## between shipboard CS and C2 networks, and
  - ## between shipboard C2 networks and off-board networks (ship, shore, aircraft)

- # Deliver standardized models and utilities for
  - ## capturing SLA/QoS properties and for
  - ## negotiating and maintaining services between dissimilar networks and across RF WAN environments

Real-time CS Network

SOA C4I Network

DIL WAN Environments
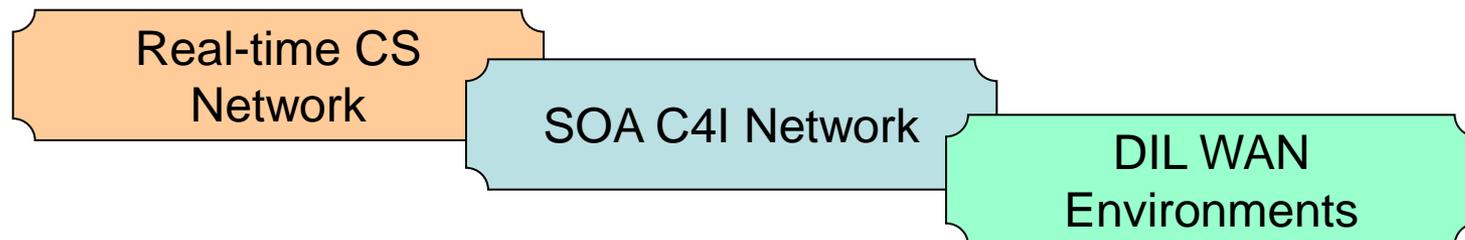
Information Assurance

- ## At the Combat Systems Domain Boundary

  - Control loading to the CS network

  - Access (authorization)

  - Pedigree (Provenance)

  - Accuracy (traceable error calculation)

- ## At the C4I Network Domain Boundary

  - Secure "discovery" (authentication)

  - Access, Pedigree, Accuracy

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User Facing Services

- **Provide visualization of critical network performance indicators**
  - Spanning CS, C2 and ADNS networks
  - Tailored, role relevant presentation
  - Support monitoring, tuning and mission alignment of the network capabilities
  - Conditions-of-Interest alerting and monitoring
  - Statistical measures and graphic display
  - Support remote WAN/LAN access

- **Provide access to the following information, minimally:**
  - Utilization of the data stores,
  - Timing of data exchange operations,
  - Density of operations (parallel and overlaying operations),
  - Size of data exchanges,
  - timing of repeat data store access, and
  - time to complete operations.

Identify standards and best practices that can be used by both PEOs, specifically to provide awareness of the near-real-time performance of the navy's distributed warfighting network.
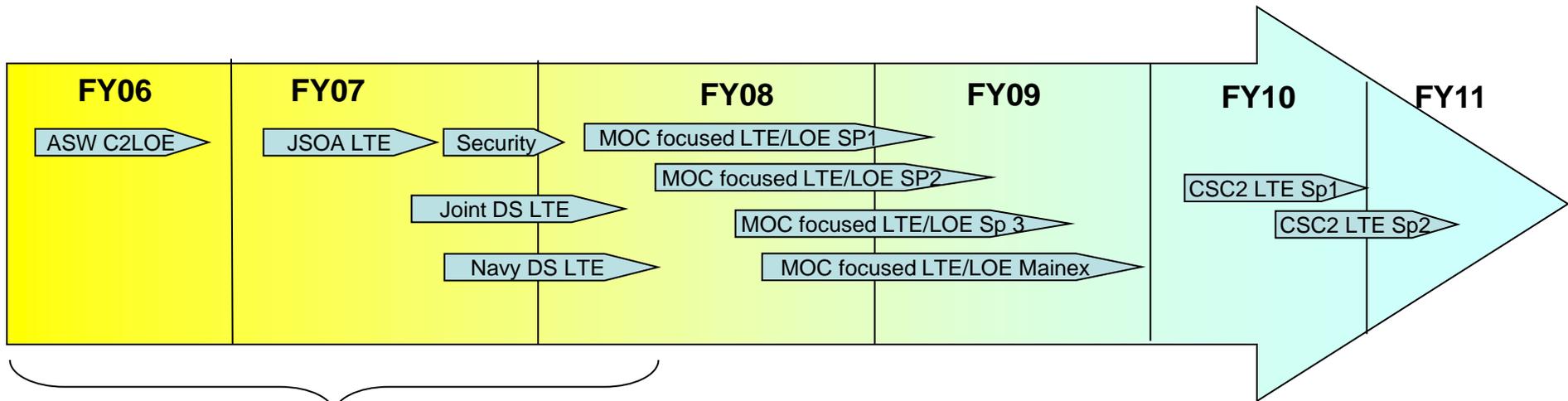
BAA Intent

- Augment significant ongoing efforts to build an information management infrastructure across Navy PEOs, that will enable operational Forces to
  - Compose Forces
  - Satisfy Commander's Critical Information Requirements
  - Collaborate / Plan Across all Echelons
  - Operate effectively over RF Networks
- Develop software tools, standards, patterns and practices that will
  - Enable effective CS – C4I network information sharing
  - Enable effective WAN information sharing
  - Enable developers to effectively deploy capability to navy networks, without becoming experts in those networks
  - Provide for reliability, maintainability and extensibility over time

Contract Execution Approach

- Work in a Team environment
  - With Government and other contract Performers
- Actively participate in Experimentation
  - At the contractor site, at Government sites, and potentially at sea
- Actively develop a transition-able product
  - Develop a Concept of Employment (CONEMP)
  - Support development of Technology Transition Agreements (TTA) with potential sponsors
    - Including exit criteria
  - Minimize the use of proprietary middleware products

Current Experimentation Continuum

FY06 | FY07 | FY08 | FY09 | FY10 | FY11

ASW C2LOE

JSOA LTE → Security

MOC focused LTE/LOE SP1

MOC focused LTE/LOE SP2

Joint DS LTE

MOC focused LTE/LOE Sp 3

CSC2 LTE Sp1

CSC2 LTE Sp2

Navy DS LTE

MOC focused LTE/LOE Mainex

SOA Technology Development

MOC Automation

Tactical-to-MOC Automation

Focus:
- Joint / Maritime Operational - to - Tactical C2 Challenges
- Rapid, Smooth & Dynamic, Agile Joint / Maritime Force Integration

Summary

- The promise of "FORCEnet" in terms of Dynamic C2 is still yet to be achieved. Key Challenges are:
  - Ability to dynamically compose forces
  - Information sharing over naval RF networks in a challenged environment
  - Architectures, patterns and practices that result in an open information environment across all platforms, networks, systems

- FNT-FY09-04 is one of several technology development projects that are addressing related issues
  - Consider proposed solutions in the larger context
  - Plan to participate in Navy & Joint experimentation

- Information architecture and automation is key
  - Enable developers to rapidly deliver solutions
  - Enable warfighters to dynamically construct solutions (Apps)
  - In an environment where available WAN bandwidth is very, very limited.

- Pay attention to the "Research Opportunities Description" (Section I.6.) articulated in the BAA