PROGNOS

Integration Strategy for PROGNOS Knowledge Exchange Module Interface (ISP-KEMI)

FINAL PRESENTATION

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Agenda

- Introduction
- Problem Statement
- Objectives and Scope
- Assumptions
- Ontology Introduction
- Methodology & Approach
- Future Way Ahead
- Conclusion
- Acknowledgement

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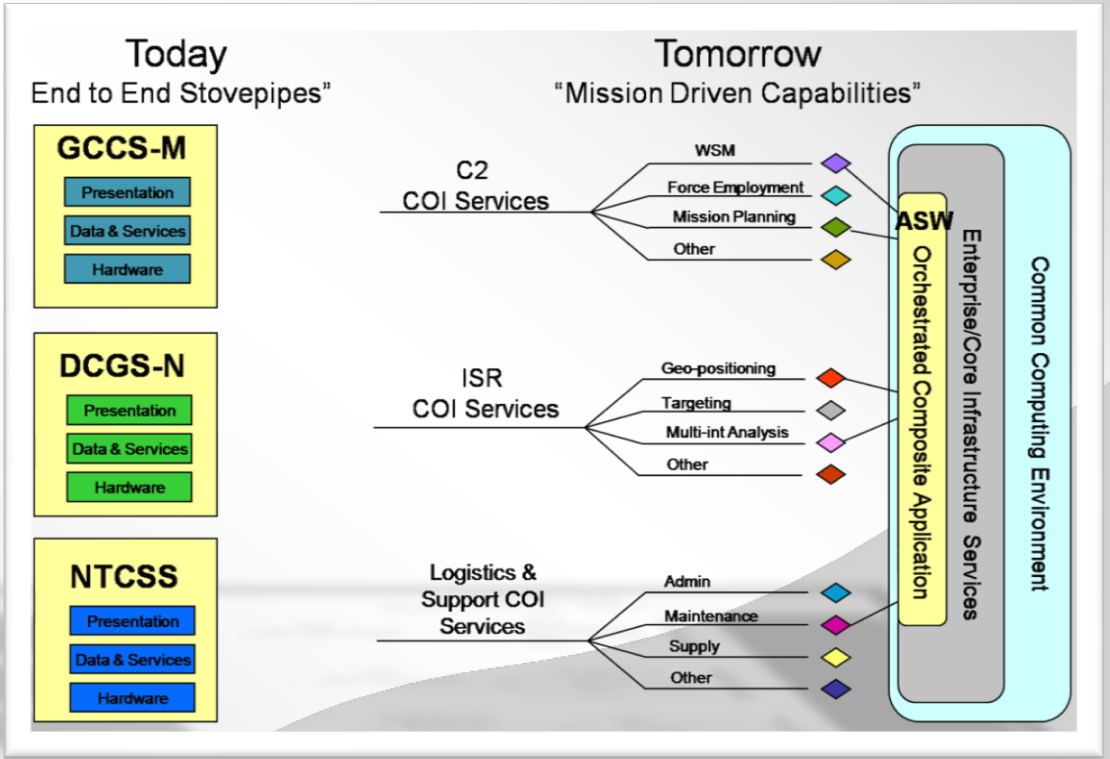
What is the Problem?

- New “fog of war”
- Lack of information sharing among systems
  - “Stove piped” systems developed by separate government PMs with little incentive for data sharing
  - Incompatible protocols
  - Incompatible formats
  - Disparate security levels
- Information overload
  - Too much information
  - Need automated system to distill knowledge from the megabytes to gigabytes of data
  - Lack of metadata



Navy FORCEnet C2, ISR, and Logistics Systems

***Miller, Chris, “PEO C4I Overview and Way Ahead for AFCEA NOVA”, 5 April 2007, slide 13.*

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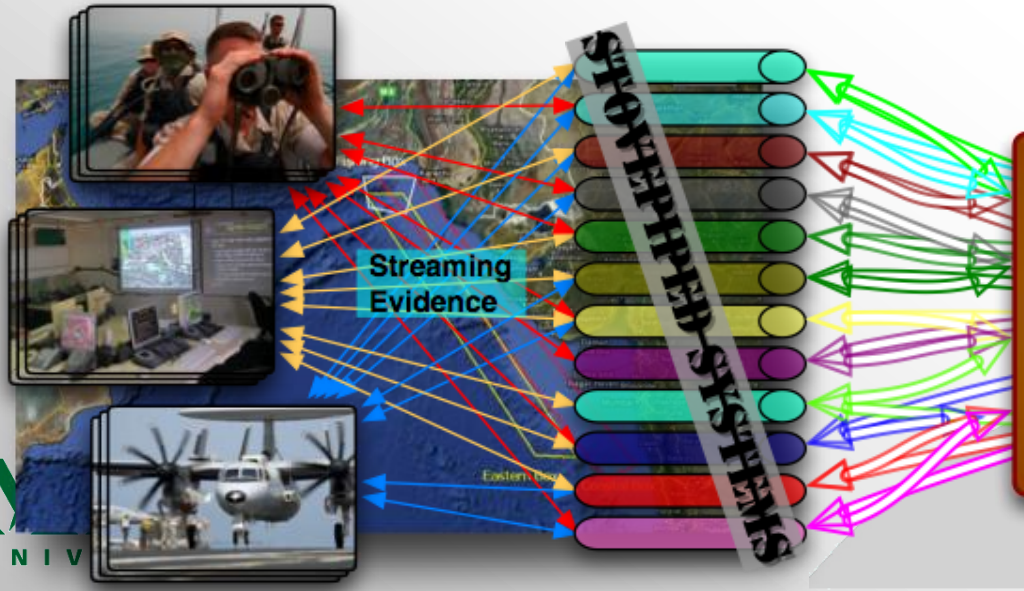
What is PROGNOS?

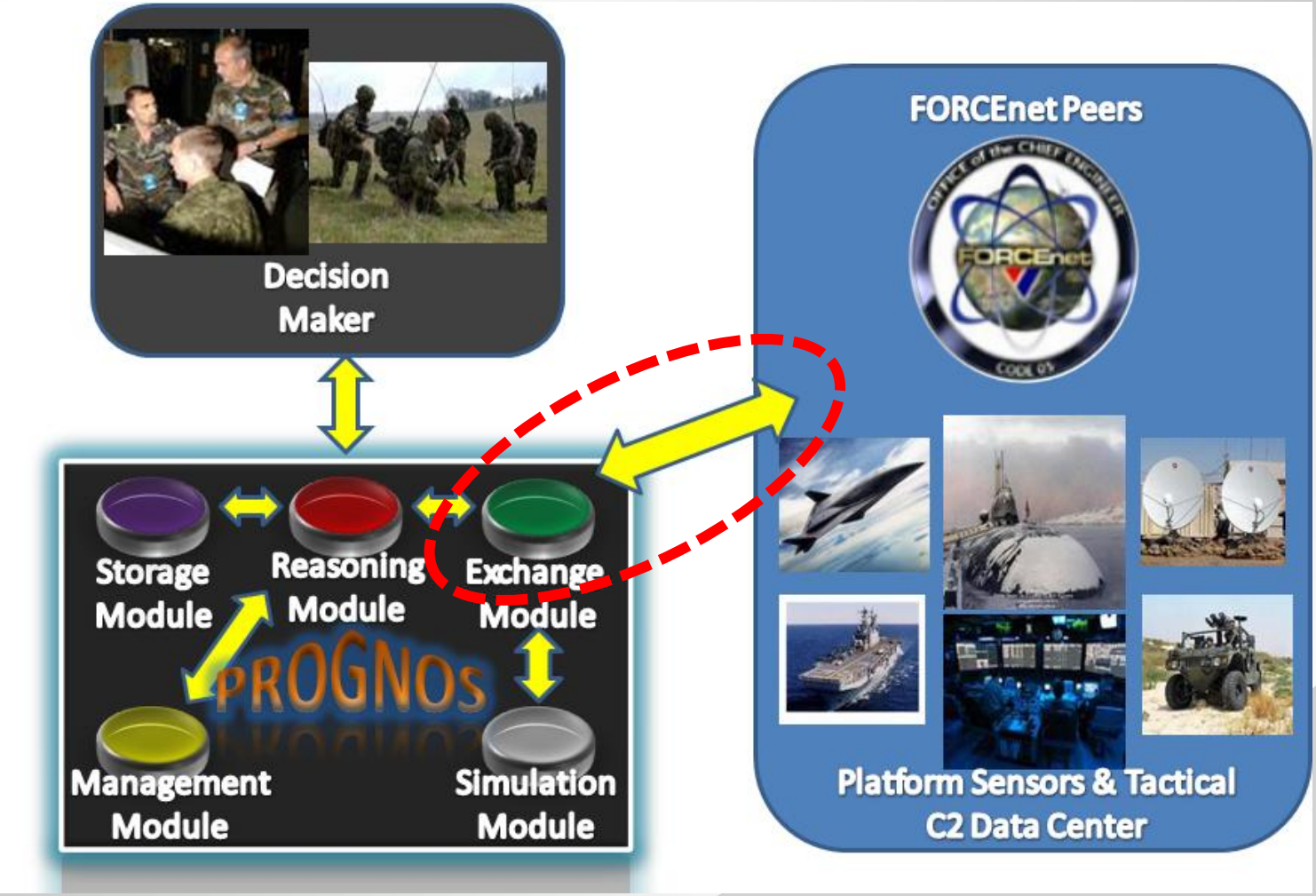
- Predictive naval situation awareness system that will:
  - Support decision makers by providing actionable, decision relevant information
  - Provide reliable high level data fusion and situation awareness
  - Bridge gap by providing knowledge interchange from data interchange
  - Prevent information overload allowing optimal decision making
  - Integrate with Navy lower level multi-sensors data network fusion, FORCEnet

Predictions & Impact Assessments

Queries



System Context Diagram



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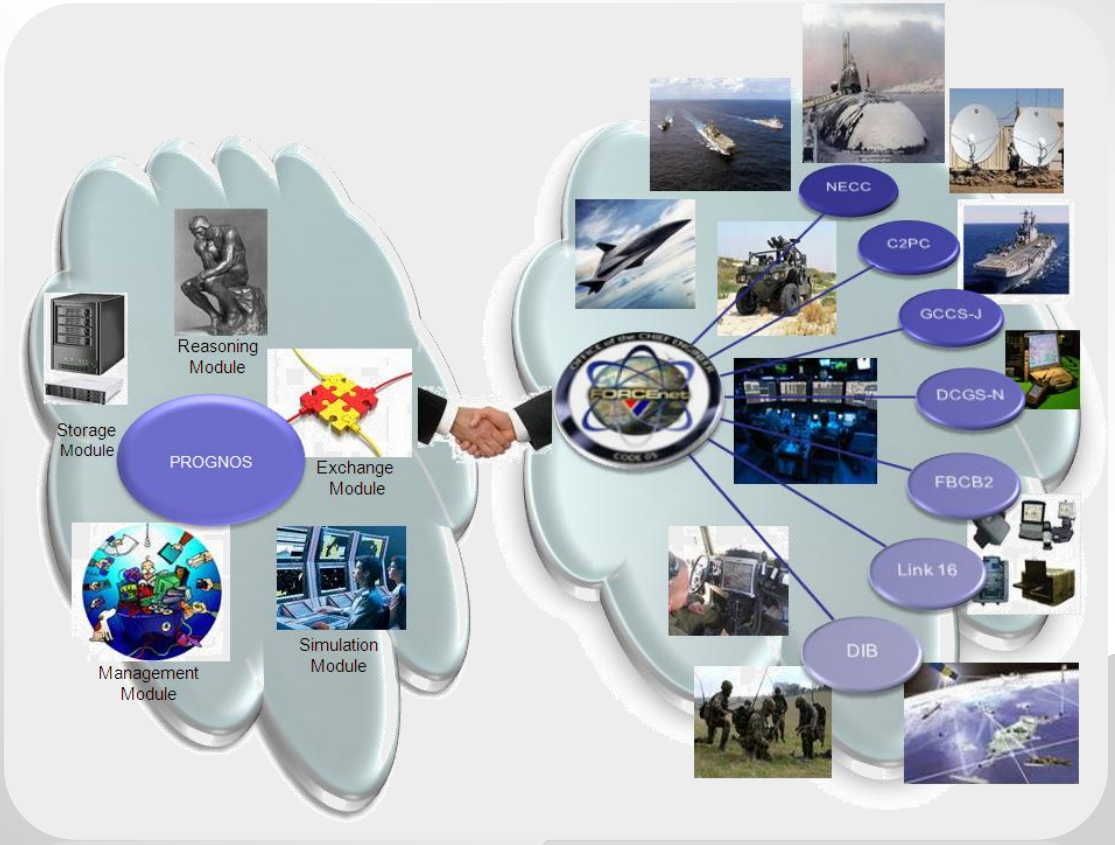
Problem Statement

- Systems engineering approach needed to integrate PROGNOS with FORCEnet systems due to:
  - Interface with multiple Naval platforms and C2 and ISR systems
  - Interoperate with multiple systems each with different formats and standards



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Objectives & Scope

- Objectives:
  - Provide an approach that will integrate PROGNOS with FORCEnet
  - Define external interfaces for the PROGNOS Knowledge Exchange Module
- Scope:
  - Provide an integration approach to integrate PROGNOS with DCGS-N and NECC
  - Provide an interface definition for PROGNOS with XML communication based C2 & ISR systems

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Assumptions & Limitations

Assumptions

- DCGS-N will support XML/SOAP based communication
- NECC will be implemented and will transition to an ontology-based approach
- External interface is focused only on FORCEnet systems

Limitations

- DCGS-N and NECC is still in development
- PROGNOS ontology is still under development

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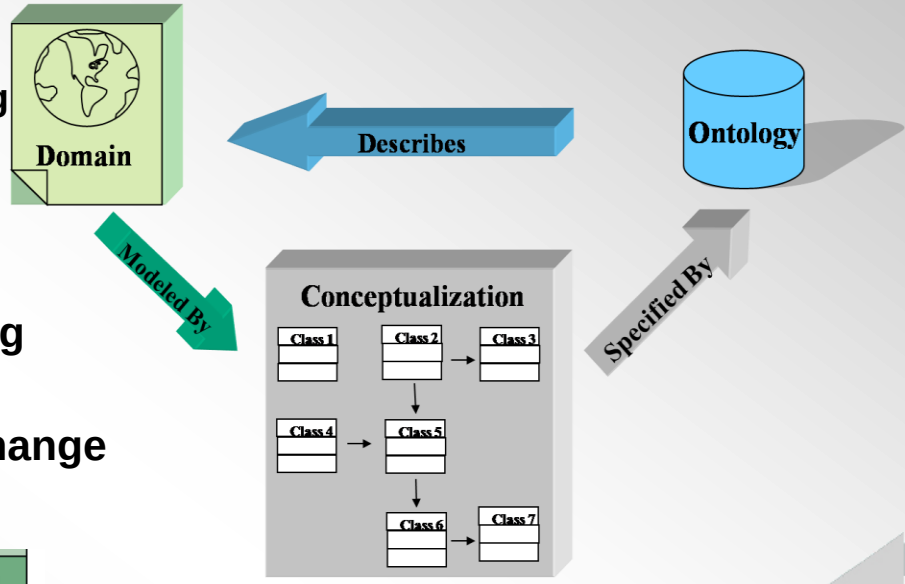
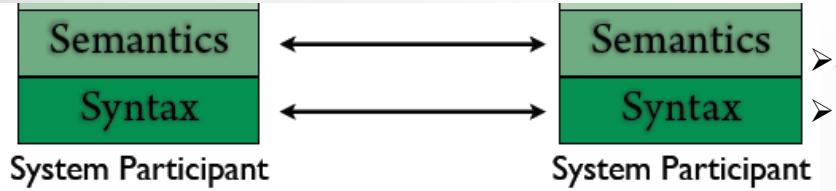
Ontology

- **A formal representation of the knowledge by a set of concepts within a domain and the relationships between those concepts.**
  - **Used to reason about the properties of the domain**
  - **Used to describe the domain**
    - **A domain is conceptualized by using**
      - **Classes (or sets)**
      - **Attributes (or properties)**
      - **Relationships (or relations among class members)**



- **Enables Semantic interoperability among disparate systems**
  - **Linguistic Level of Information Exchange**



- ***Semantic***: Understanding of meaning of message.
- ***Syntatic***: Common rules governing composition and transmitting of message

  - **Integrate heterogeneous databases**
  - **Specify interfaces to independent, knowledge-based services**

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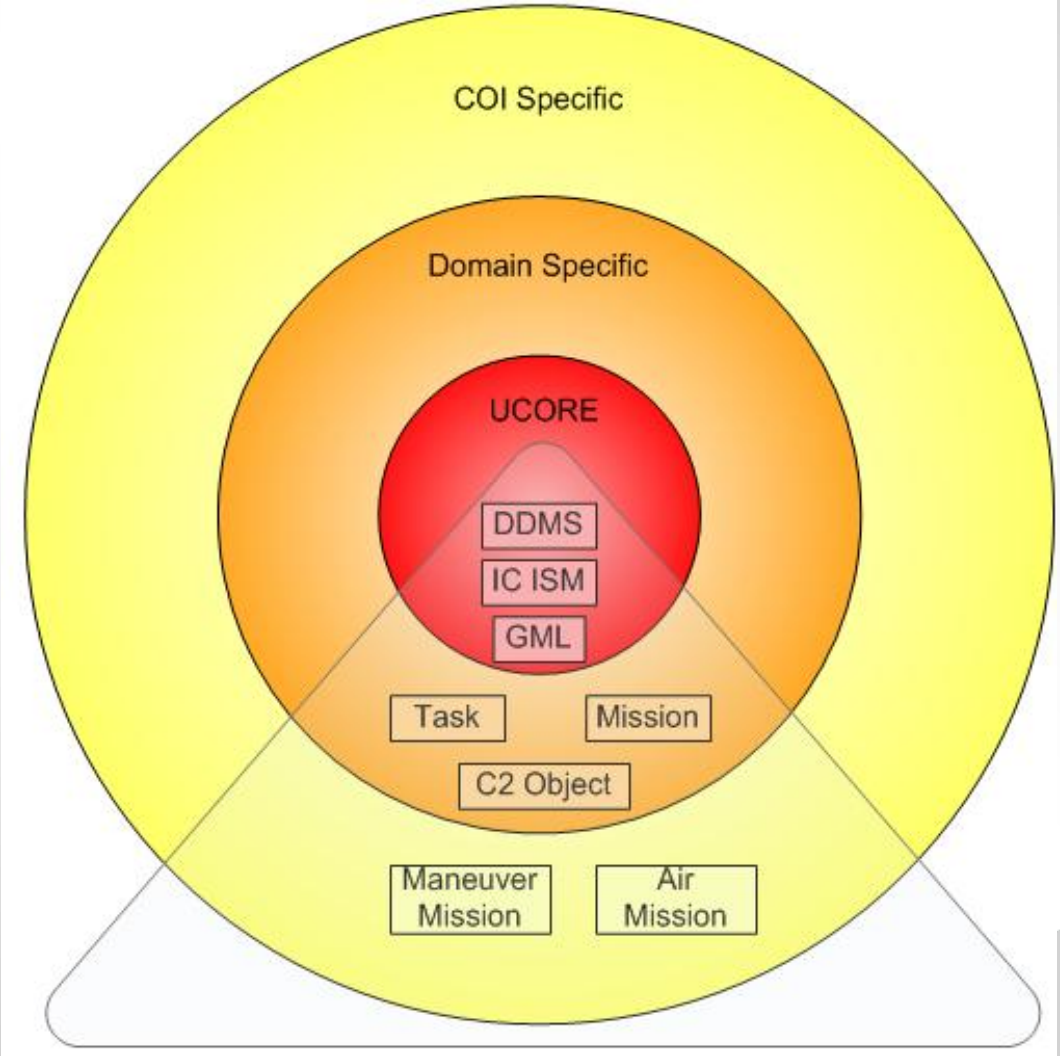
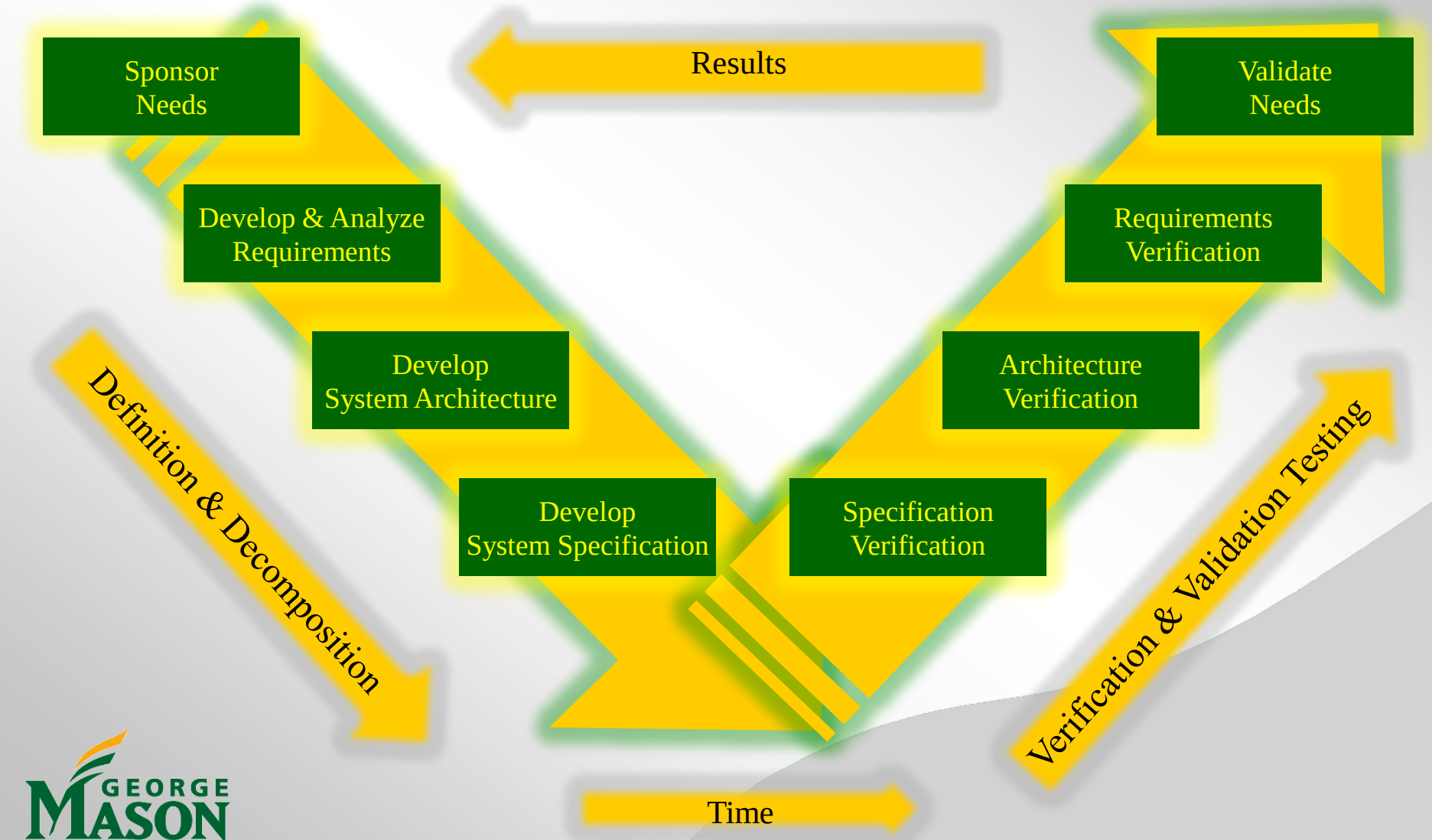
DoD Web Semantic Layered Approach

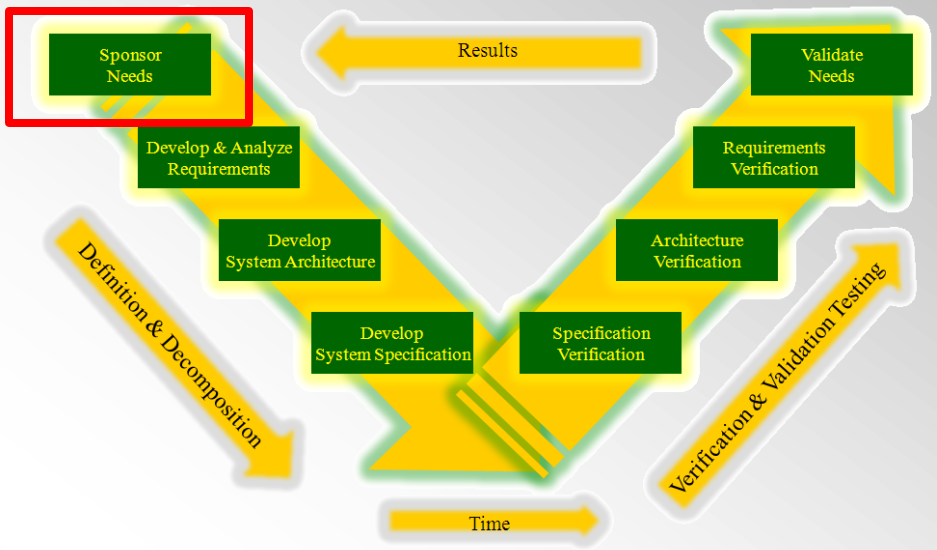


Methodology & Approach

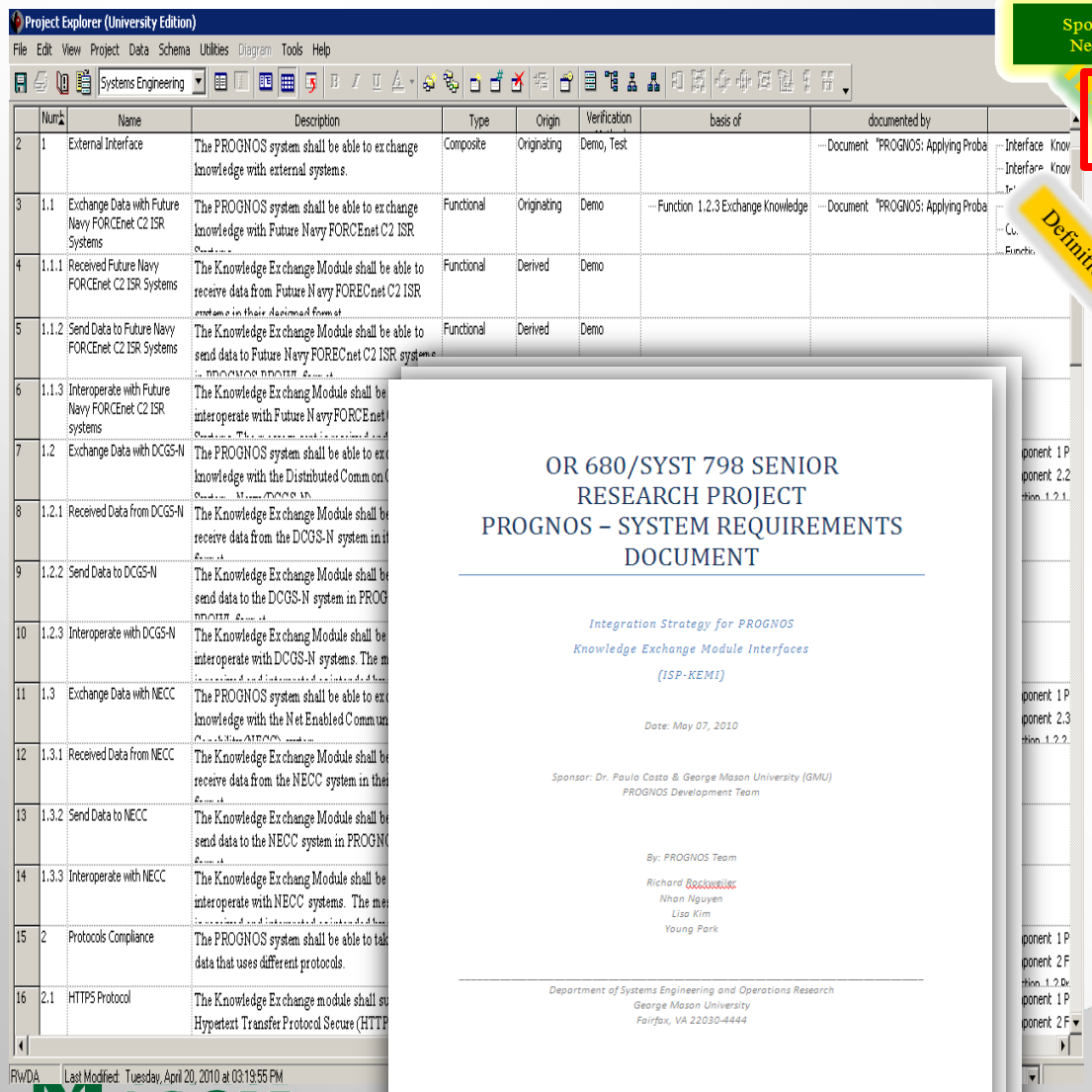


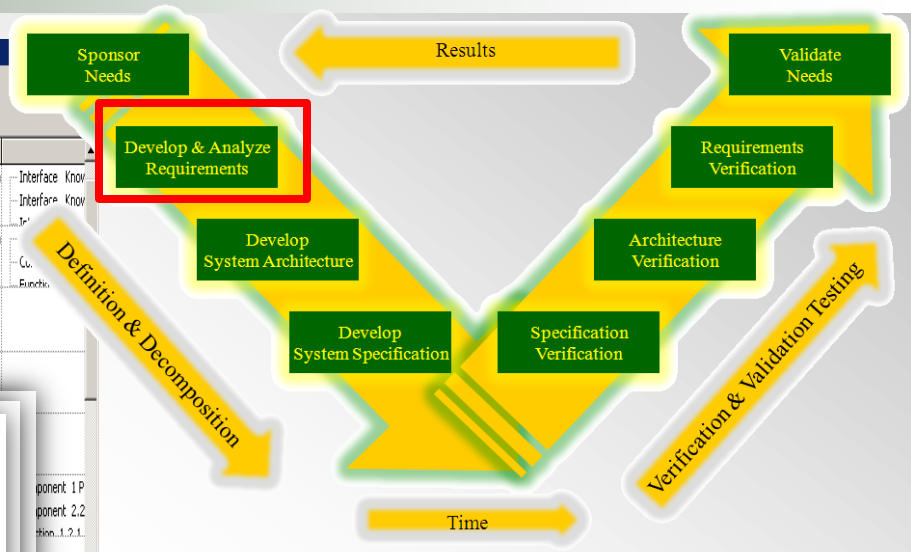
Sponsor Needs

- Define external interfaces to the PROGNOS Knowledge Exchange module
- Provide an integration approach that will ensure successful integration of PROGNOS and FORCEnet



Requirements





Total of 60 requirements

- 13 Originating requirements
- 47 Derived requirements

- 5 Composite requirements
- 37 Constraint requirements
- 15 Functional requirements
- 3 Performance requirements

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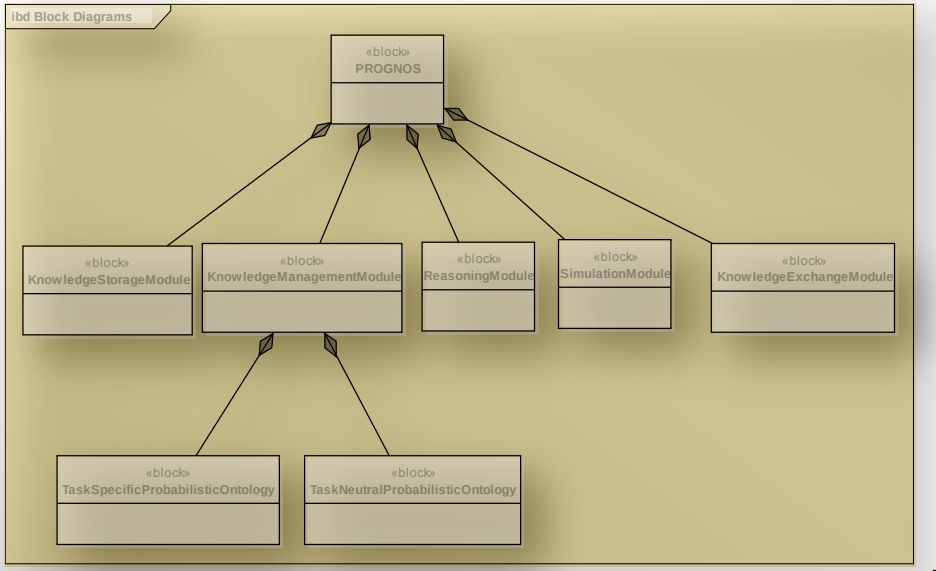
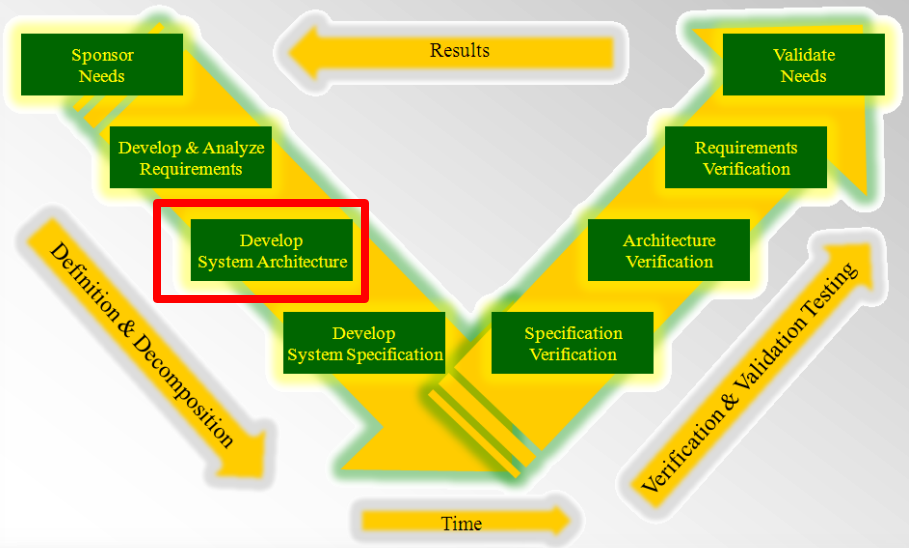
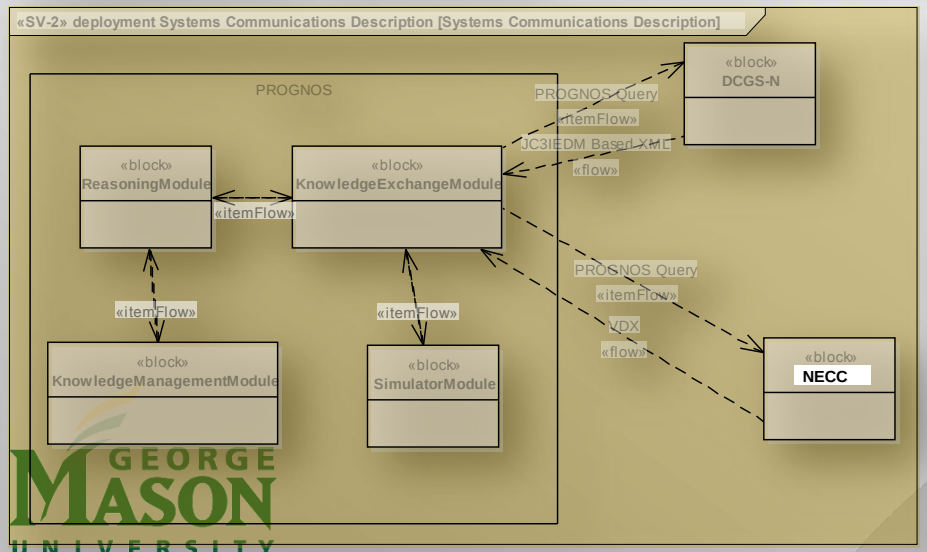
Requirements Traceability

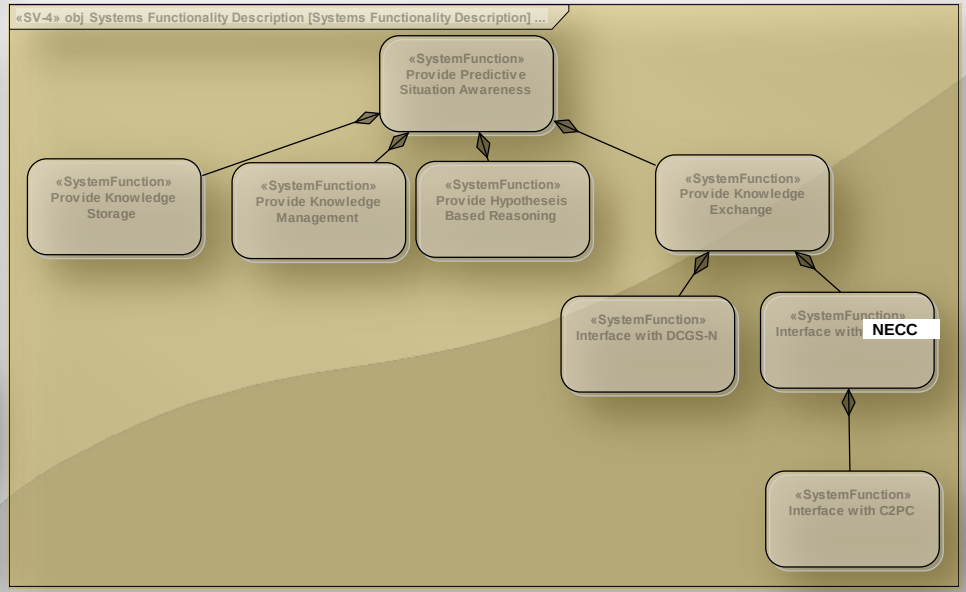
#	Name	Description	Origin	Type	Verification Method	documented by	refined by
1	External Interface	The PROGNOS system shall be able to exchange knowledge with external systems, FORCEnet.	Originating	Functional	Demo, Test. The scenario walkthrough and simulation demo will provide verification for KEM interface with external systems.	"PROGNOS: Applying Probabilistic Ontologies to Distributed Predictive Situation Assessment in Naval Operations" presentation	1.1 Exchange Data with Future Navy FORCEnet C2 ISR Systems 1.2 Exchange Data with DCGS-N 1.3 Exchange Data with NECC
1.2	Exchange Data with DCGS-N	The PROGNOS system shall be able to exchange knowledge with the Distributed Common Ground System - Navy (DCGS-N).	Derived	Functional	Simulation Demo. This demo will include simulated PROGNOS query that will be translated into XML and sent to DCGS-N. DCGS-N after receiving query request will provide response in XML that will be translated back into PROGNOS OWL Language.		1.2.1 Received Data from DCGS-N 1.2.2 Send Data to DCGS-N 1.2.3 Interoperate with DCGS-N
1.2.1	Received Data from DCGS-N	The Knowledge Exchange Module shall be able to receive data from the DCGS-N system	Derived	Functional	Simulation Demo. The Demo will show that PROGNOS received transmitted XML DCGS-N data		
1.2.2	Send Data to DCGS-N	The Knowledge Exchange Module shall be able to send data to the DCGS-N system in PROGNOS PROWL format.	Derived	Functional	Simulation Demo. The demo show that PROGNOS was able to generate a query in PR-OWL which is then translated into XML and sent to DCGS-N. DDCGS-N acknowledge query received.		
1.2.3	Interoperate with DCGS-N	The Knowledge Exchang Module shall be able to interoperate with DCGS-N systems. The message sent is received and interpreted as intended by sender.	Derived	Functional	Simulation Demo. The demo will show that not only that PROGNOS Knowledge Exchange Module can send and receive data from DCGS-N but it can interpret the data as intended by the sender, DCGS-N.		
3.1	XML	The Knowledge Exchange module shall enable data input with the Extensible Markup Language (XML) IAW W3C's XML 1.0	Originating	Constraint	Simulation Demo. The DCGS-N simulated data will be XML based IAW W3C XML 1.0 Specification.	"PROBABILISTIC ONTOLOGIES: THE NEXT STEP FOR NET-	3.1.1 Web Services Addressing 3.1.2 Xpath

System Architecture









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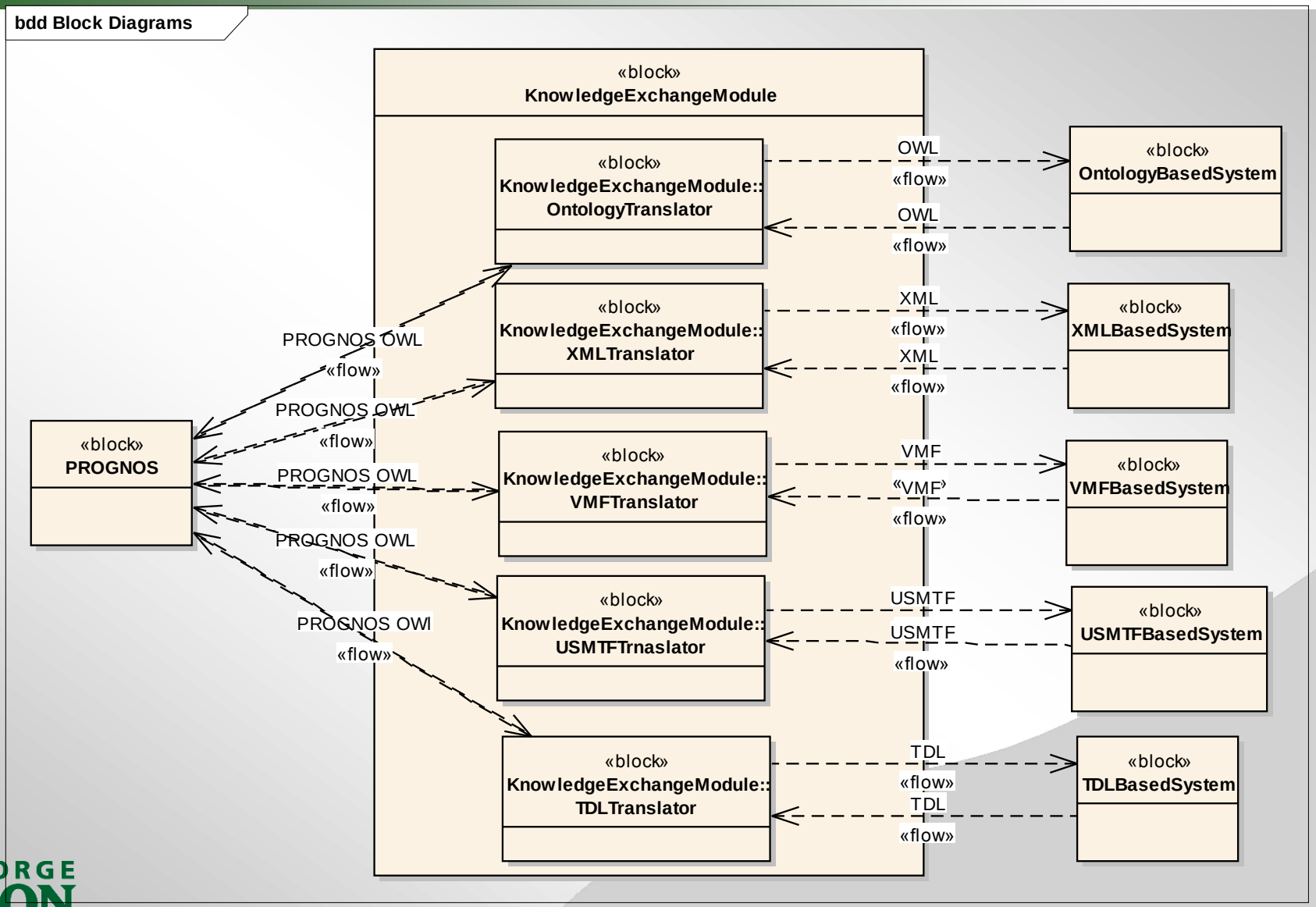
Knowledge Exchange Message Translation



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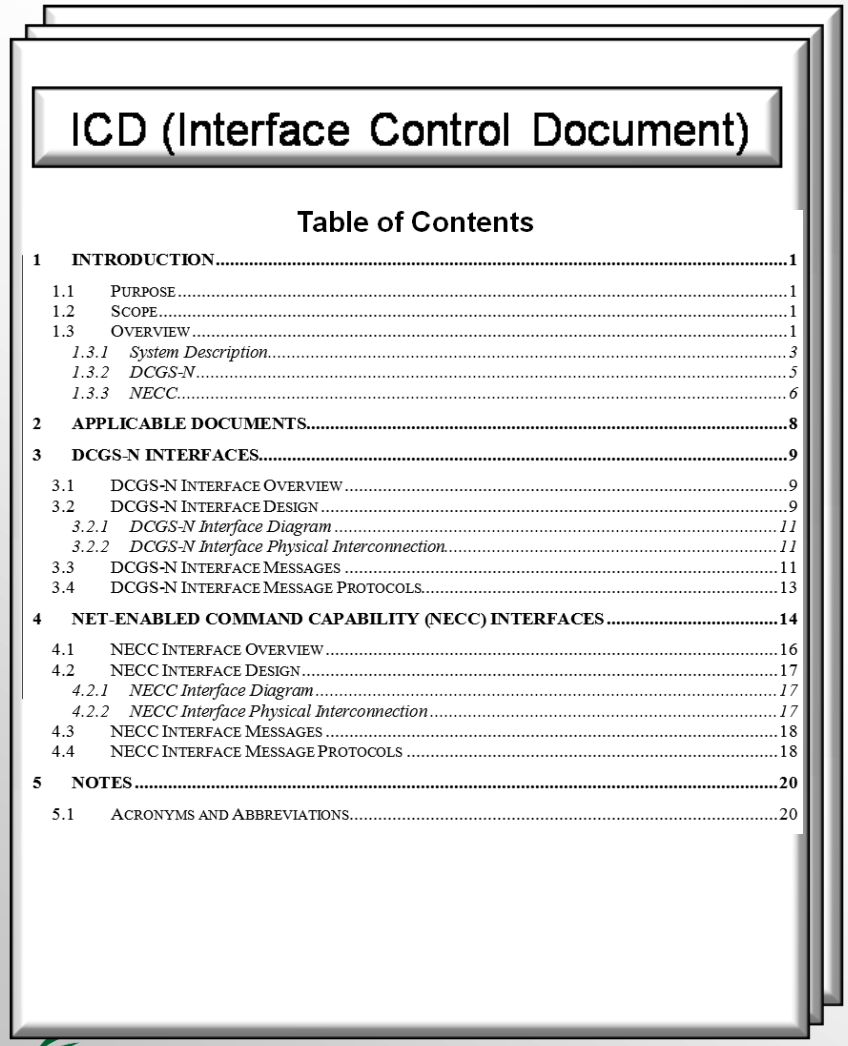
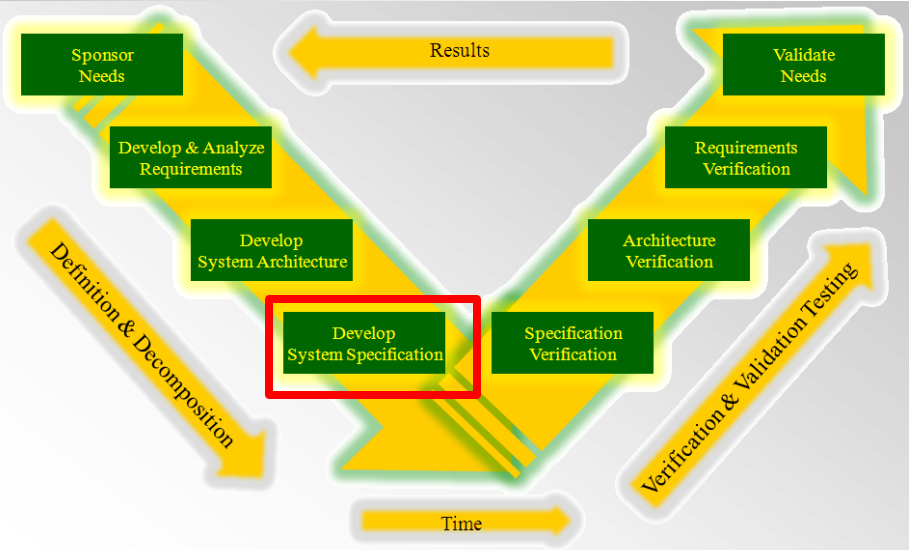
System Interface Control Document



ICD (Interface Control Document)

Table of Contents



- Interface Control Document (ICD) is a critical document for systems engineering
- ICD describes the systems that the KEM must interface with
- ICD defines the interfaces that KEM must support to interface with external systems

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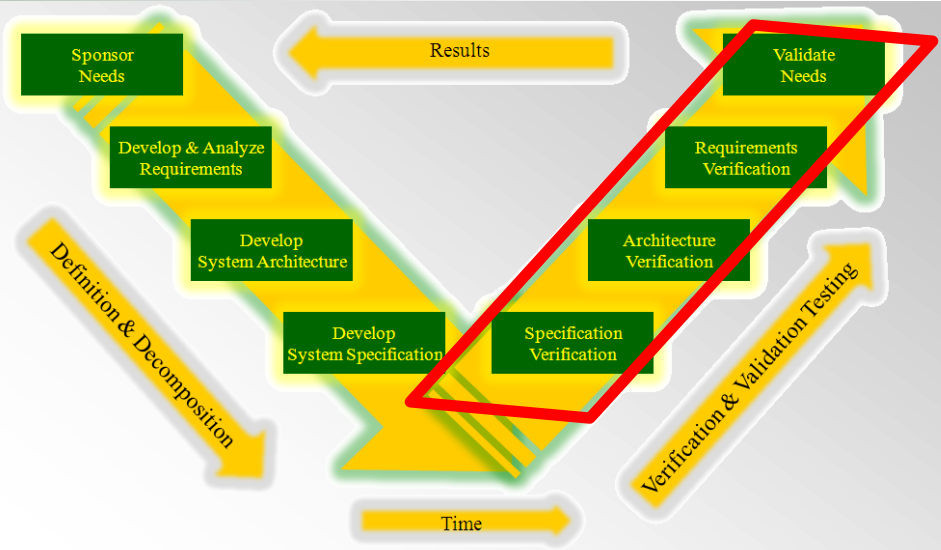
Verification and Validation

Two approaches

- Scenario
  - Demonstrate a detailed walkthrough of the scenario
  - Provides partial requirements & architecture verification and validation



- Simulation
  - Demonstrate Knowledge Exchange Module system interchange with another external XML based system
  - Message exchange between PROGNOS Knowledge Exchange module and DCGS-N provides verification and validation of some system requirements
  - Interface verification provided via verbatim instantiation of the DCGS system

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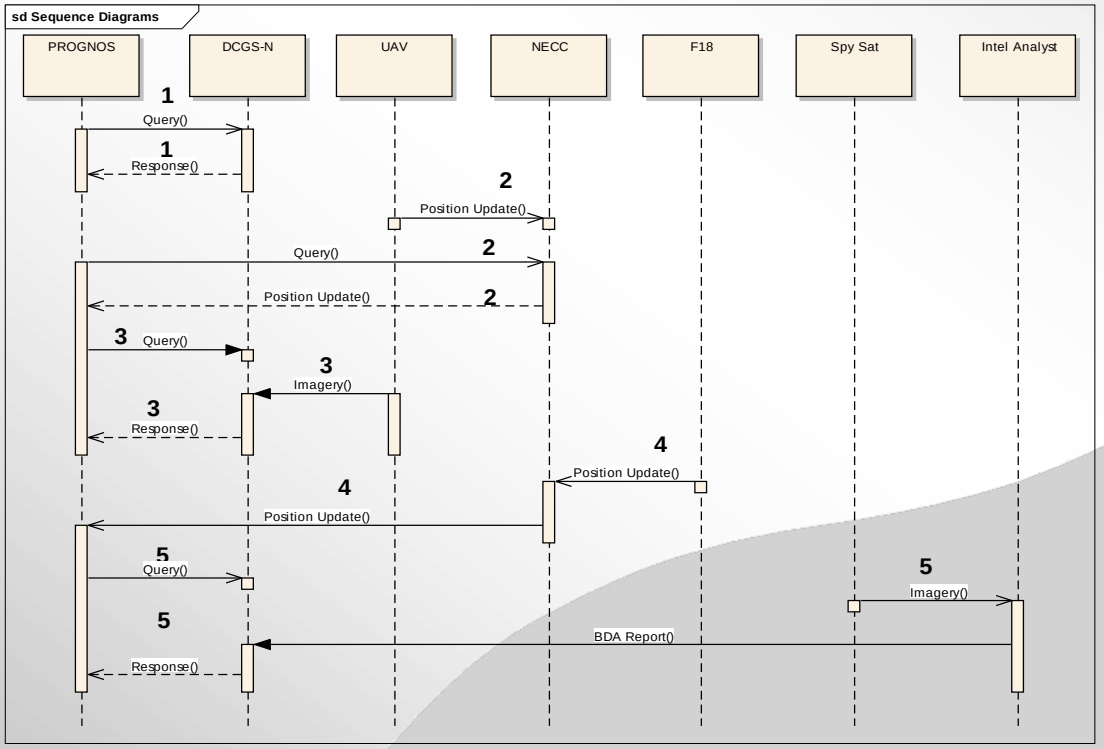
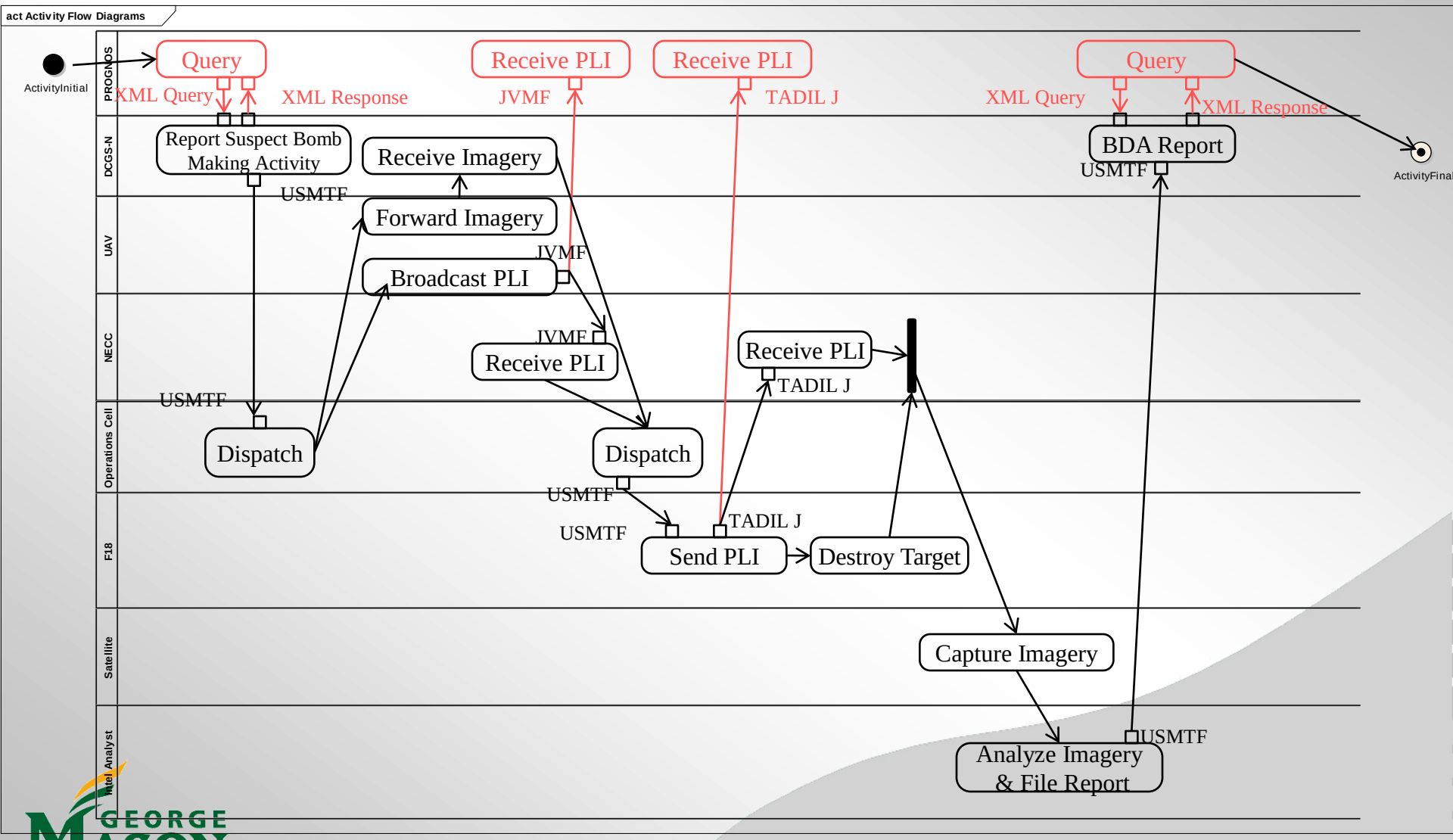
KEM Scenario

1. Human Intelligence (HUMINT) report received about possible Weapons of Mass Destruction (WMD) in Oman. Information received via DCGS-N and originates from CIA. Anticipate message format being a XML formatted message IAW a schema defined in the DoD Meta-Data Registry.
2. UAV dispatched to confirm. UAV is tracked via NECC or alternatively tracked via Link-16.
3. UAV arrives to loiter and detects excessive radiation activity. UAV video via DCGS-N.
4. F18 fighter aircrafts dispatched to bomb facility. F18s tracked via NECC (Link 16 feed).
5. BDA received via satellite and received on DCGS-N. BDA assessed by intel analyst and report filed.
6. Mission complete.



Scenario Activity Flow Diagram



KEM Simulation

- Purpose :
  - Validate KEM interface approach to another XML based system
  - Verify XML requirements
- Measure Points :
  - Demonstrate interoperability (using standards – DDMS, GML, ISR COI)
  - Feasibility
- Limitation :
  - Single query-response
  - Only demonstrates an interface to a XML formatted message system

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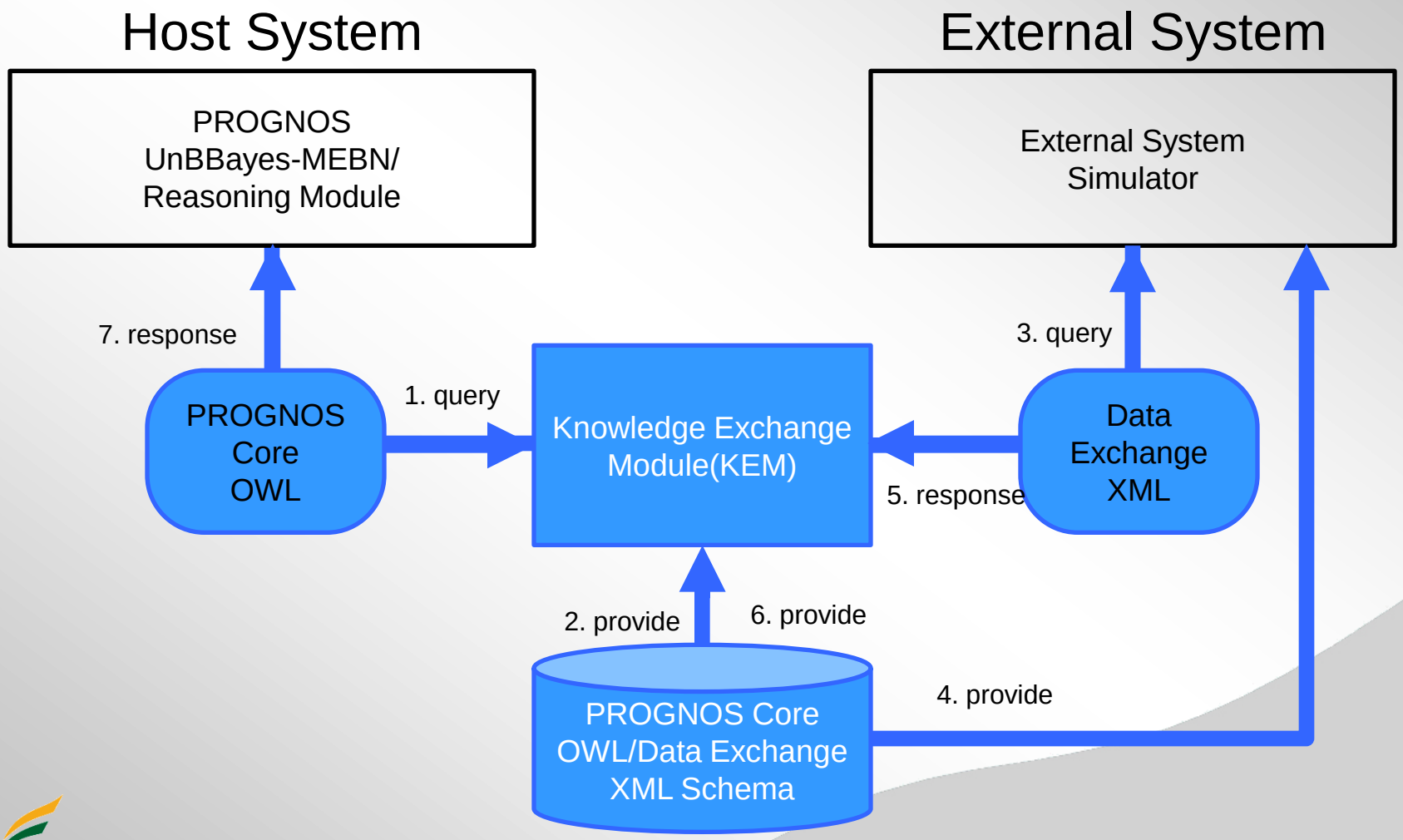
KEM Simulation Process



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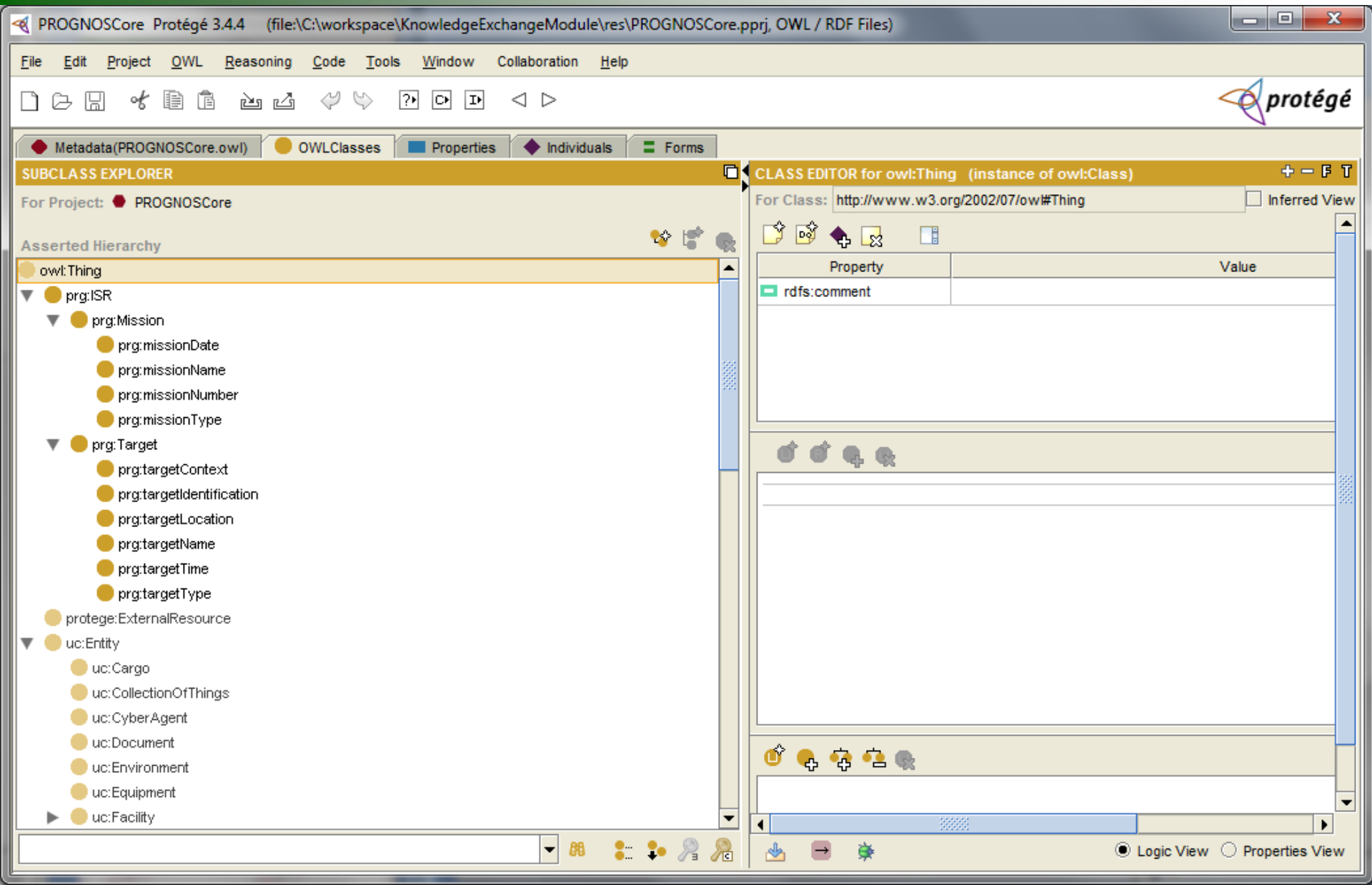
Developed PROGNOS Core OWL



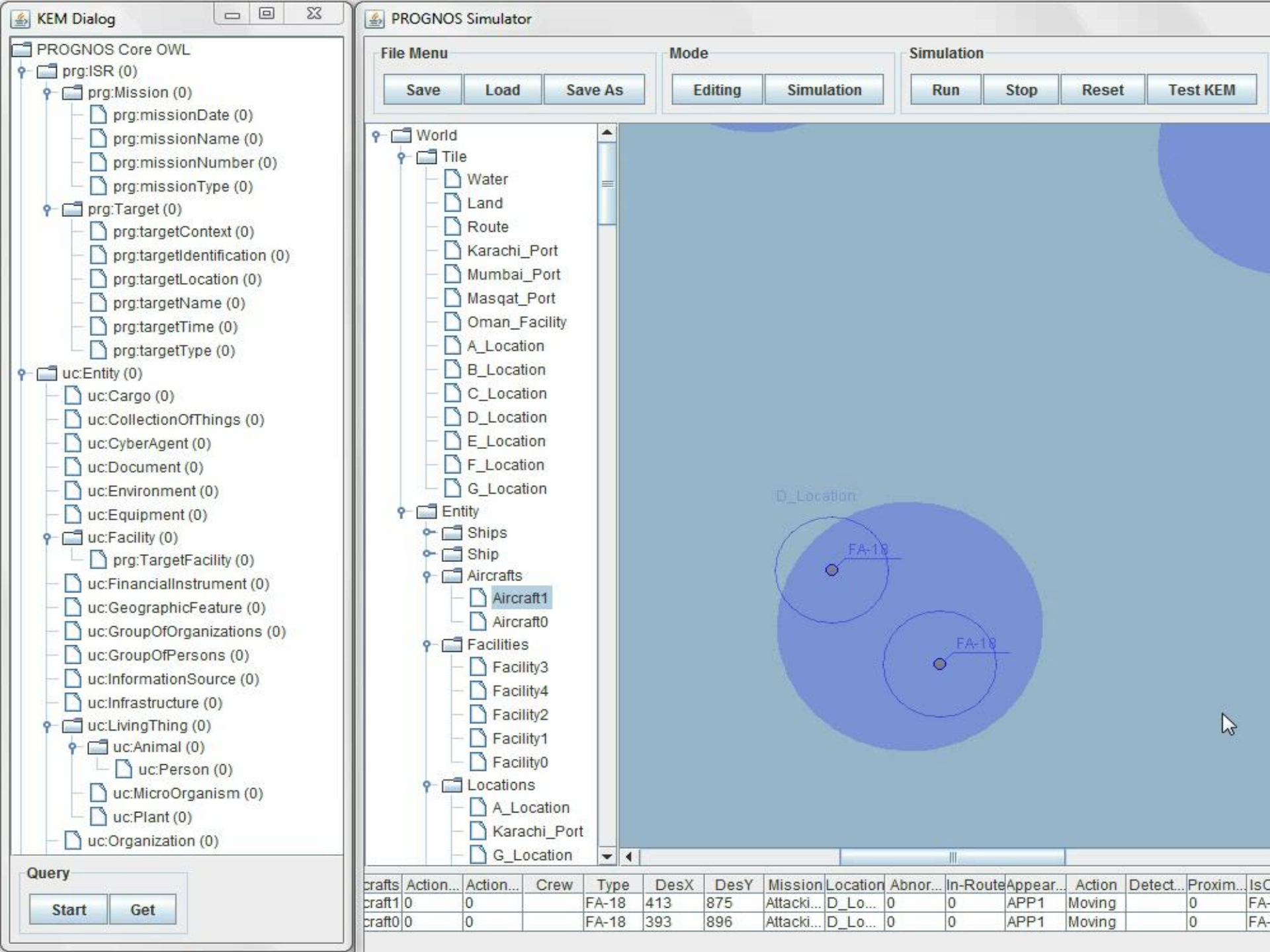
Generated Query-Response XML Message

Query

```
- <eventQuery name="Query to Simulator">
  - <list class="java.util.ArrayList">
    - <QueryItem key="0">
        <value>prg:Target</value>
        <data>null</data>
      </QueryItem>
    - <QueryItem key="1">
        <value>prg:targetContext</value>
        <data>null</data>
      </QueryItem>
    - <QueryItem key="2">
        <value>prg:targetIdentification</value>
        <data>null</data>
      </QueryItem>
    - <QueryItem key="3">
        <value>prg:targetLocation</value>
        <data>null</data>
      </QueryItem>
    - <QueryItem key="4">
        <value>prg:targetName</value>
        <data>null</data>
      </QueryItem>
    - <QueryItem key="5">
        <value>prg:targetTime</value>
        <data>null</data>
      </QueryItem>
    - <QueryItem key="6">
        <value>prg:targetType</value>
        <data>null</data>
      </QueryItem>
    </list>
  </eventQuery>
```

Response

```
- <eventQuery name="response from Simulator">
  - <list class="java.util.ArrayList">
    - <QueryItem key="0">
        <value>prg:Target</value>
        <data>null</data>
      </QueryItem>
    - <QueryItem key="1">
        <value>prg:targetContext</value>
        <data>Attack!</data>
      </QueryItem>
    - <QueryItem key="2">
        <value>prg:targetIdentification</value>
        <data>ID:XD230234</data>
      </QueryItem>
    - <QueryItem key="3">
        <value>prg:targetLocation</value>
        <data>Latitude 35.3, Longitude 11.2</data>
      </QueryItem>
    - <QueryItem key="4">
        <value>prg:targetName</value>
        <data>A Center</data>
      </QueryItem>
    - <QueryItem key="5">
        <value>prg:targetTime</value>
        <data>10:23 AM</data>
      </QueryItem>
    - <QueryItem key="6">
        <value>prg:targetType</value>
        <data>Building</data>
      </QueryItem>
    </list>
  </eventQuery>
```


KEM Dialog
PROGNOS Core OWL
prg:ISR (0)
prg:Mission (0)
prg:missionDate (0)
prg:missionName (0)
prg:missionNumber (0)
prg:missionType (0)
prg:Target (0)
prg:targetContext (0)
prg:targetIdentification (0)
prg:targetLocation (0)
prg:targetName (0)
prg:targetTime (0)
prg:targetType (0)
uc:Entity (0)
uc:Cargo (0)
uc:CollectionOfThings (0)
uc:CyberAgent (0)
uc:Document (0)
uc:Environment (0)
uc:Equipment (0)
uc:Facility (0)
prg:TargetFacility (0)
uc:FinancialInstrument (0)
uc:GeographicFeature (0)
uc:GroupOfOrganizations (0)
uc:GroupOfPersons (0)
uc:InformationSource (0)
uc:Infrastructure (0)
uc:LivingThing (0)
uc:Animal (0)
uc:Person (0)
uc:MicroOrganism (0)
uc:Plant (0)
uc:Organization (0)
Query
Start
Get
PROGNOS Simulator
File Menu
Save
Load
Save As
Mode
Editing
Simulation
Simulation
Run
Stop
Reset
Test KEM
World
Tile
Water
Land
Route
Karachi_Port
Mumbai_Port
Masqat_Port
Oman_Facility
A_Location
B_Location
C_Location
D_Location
E_Location
F_Location
G_Location
Entity
Ships
Ship
Aircrafts
Aircraft1
Aircraft0
Facilities
Facility3
Facility4
Facility2
Facility1
Facility0
Locations
A_Location
Karachi_Port
G_Location
D_Location
FA-18
FA-18
crafts Action... Action... Crew Type DesX DesY Mission Location Abnor... In-Route Appear... Action Detect... Proxim... IsC
craft1 0 0 FA-18 413 875 Attacki... D_Lo... 0 0 APP1 Moving 0 FA-
craft0 0 0 FA-18 393 896 Attacki... D_Lo... 0 0 APP1 Moving 0 FA-

Verification & Validation Results

- Verified XML requirements
- Validated KEM interface approach to another XML based system
- Demonstrated interoperability (using standards – DDMS, GML, ISR COI)
- Demonstrated feasibility

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Future Way Ahead

- GMU-PROGNOS team follow-on work
  - Continue our approach to expand other UCORE to incorporate other DOD COI schemas
  - Define VMF, TDL, and USMTF interfaces
  - Implement SOAP interface
  - Devise interface definition for the Naval Tactical Command Support System (NTCSS) logistics system

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Conclusion

- Met Objectives:
  - Provided an integration approach to integrate PROGNOS with DCGS-N and NECC
  - Defined external interfaces for the PROGNOS Knowledge Exchange Module

- Deliverables:
  - System Architecture
  - Interface Control Document
  - System Requirement Document
  - Simulation
  - Final Report
  - Project Website

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Acknowledgement

- PROGNOS KEM team would like to extend our thanks to Dr. Paulo Costa, and Dr. Kathryn Laskey for their guidance and direction

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QUESTIONS/COMMENTS?

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Requirements

External Interfaces:

- Decision Makers / War Fighters
- Future Navy C2 & ISR systems
- DCGS-N
- NECC

Messaging Formats

- Extensible Markup Language (XML)
- Joint C3 Information Exchange Data Module (JC3IEDM)
- Web Ontology Language (OWL)
- Command and Control Personal Computer (C2PC) VDX
- United States Message Text Form (USMTF)
- Joint Variable Message Format (JVMF)
- Tactical Data Link Series (TDL) series of messages (TADIL-J)

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Requirements

Data Protocols

- Hypertext Transfer Protocol Secure (HTTPS) / Secure Socket Layer (SSL)
- Simple Object Access Protocol (SOAP)

Security Compliance

- Support PKI IAW X.509v3 certificates
- Accept and provide PKCS#7, 12 public key formats
- Support revocation checking of X.509 certificates via local CRL

System Wide Requirements

- Reliability
  - Mean Time Between Failures (MTBF) not less than 10,000 hours
  - Mean Time To Repair (MTTR) shall be 0.25 hours
- Safety
  - PROGNOS shall require redundant operator confirmation for any decision or message that may result in fratricide.
- Human Factors
  - Enable system operators to perform routine equipment tasks under MOPP IV conditions with no more than 15 percent degradation in time.

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Requirements

System Wide Requirements

- System integration into a host platform system (to include, power systems) shall be unobtrusive and shall not degrade either host platform primary mission performance or safety.
- Use of the system shall not degrade the functionality of the host platform.
- The system must survive shock and impulse levels associated with the operation of the host platform and harsh environments.

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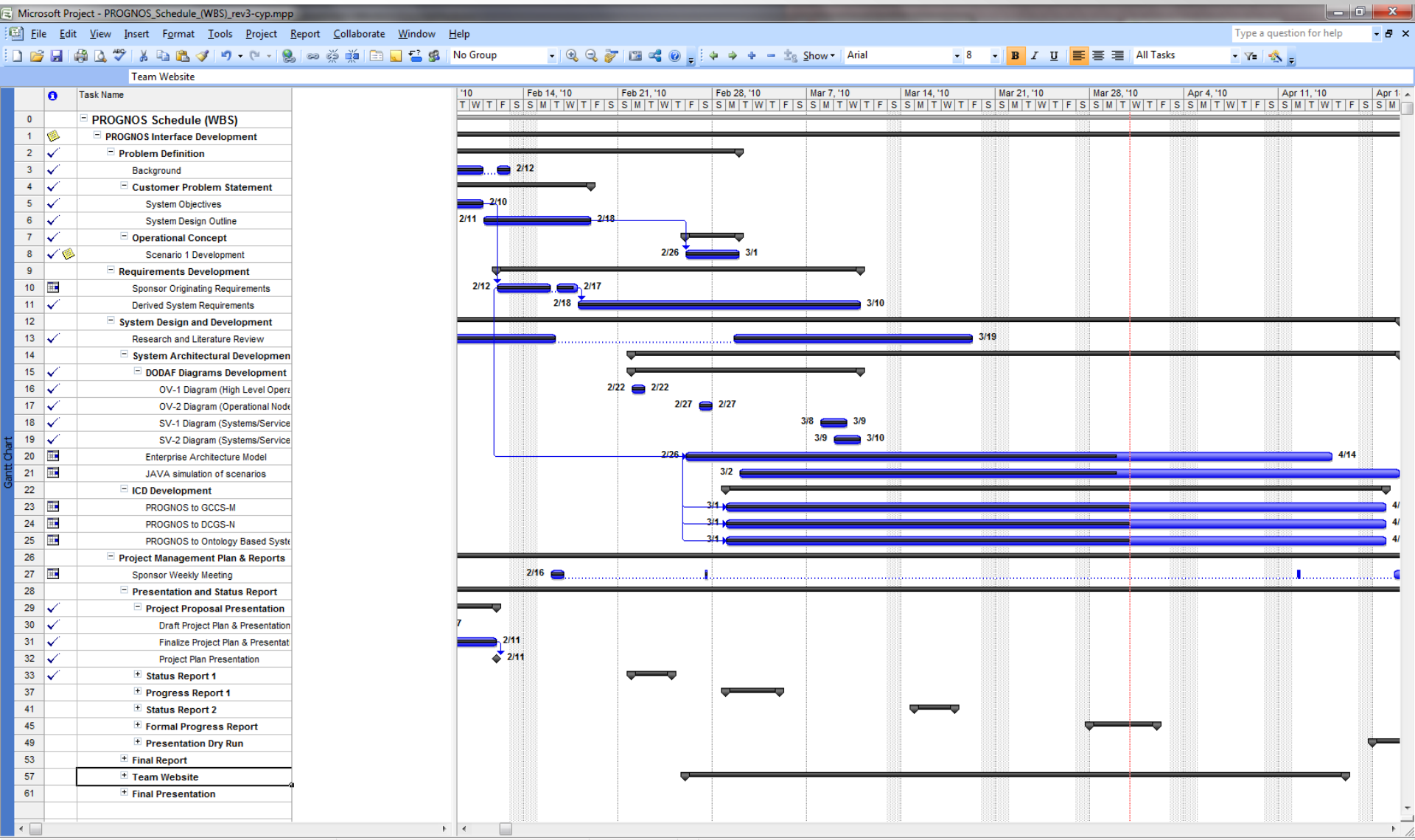
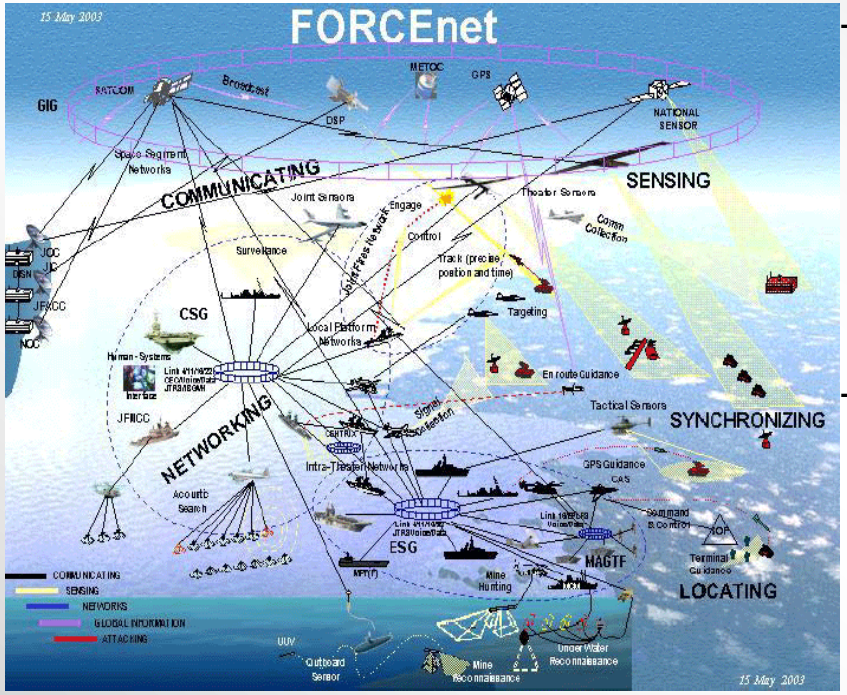
Work Breakdown Structure (WBS)



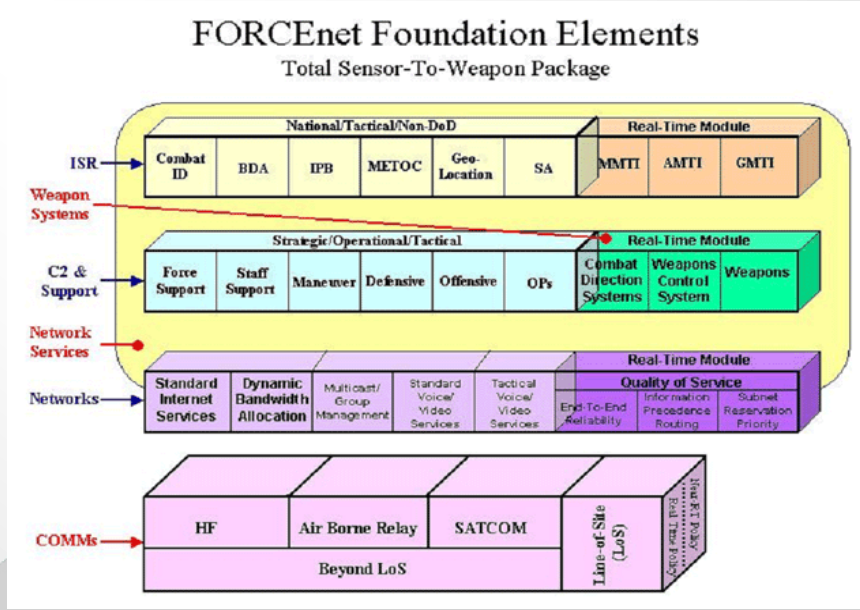
What is FORCEnet?



- The future implementation of Network Centric Warfare in the naval services.
- An enterprise alignment and integration initiative to serve as a change agent and an engine for innovation, potentially touching every naval program.

The operational construct and architectural framework for Naval Warfare in the Information Age, to integrate WARRIORS, sensors, networks, command and control, platforms, and weapons into a networked, distributed combat force, scalable across the spectrum of conflict from seabed to space and sea to land.

The naval command-and-control component for Sea Power 21 and Expeditionary Warfare.



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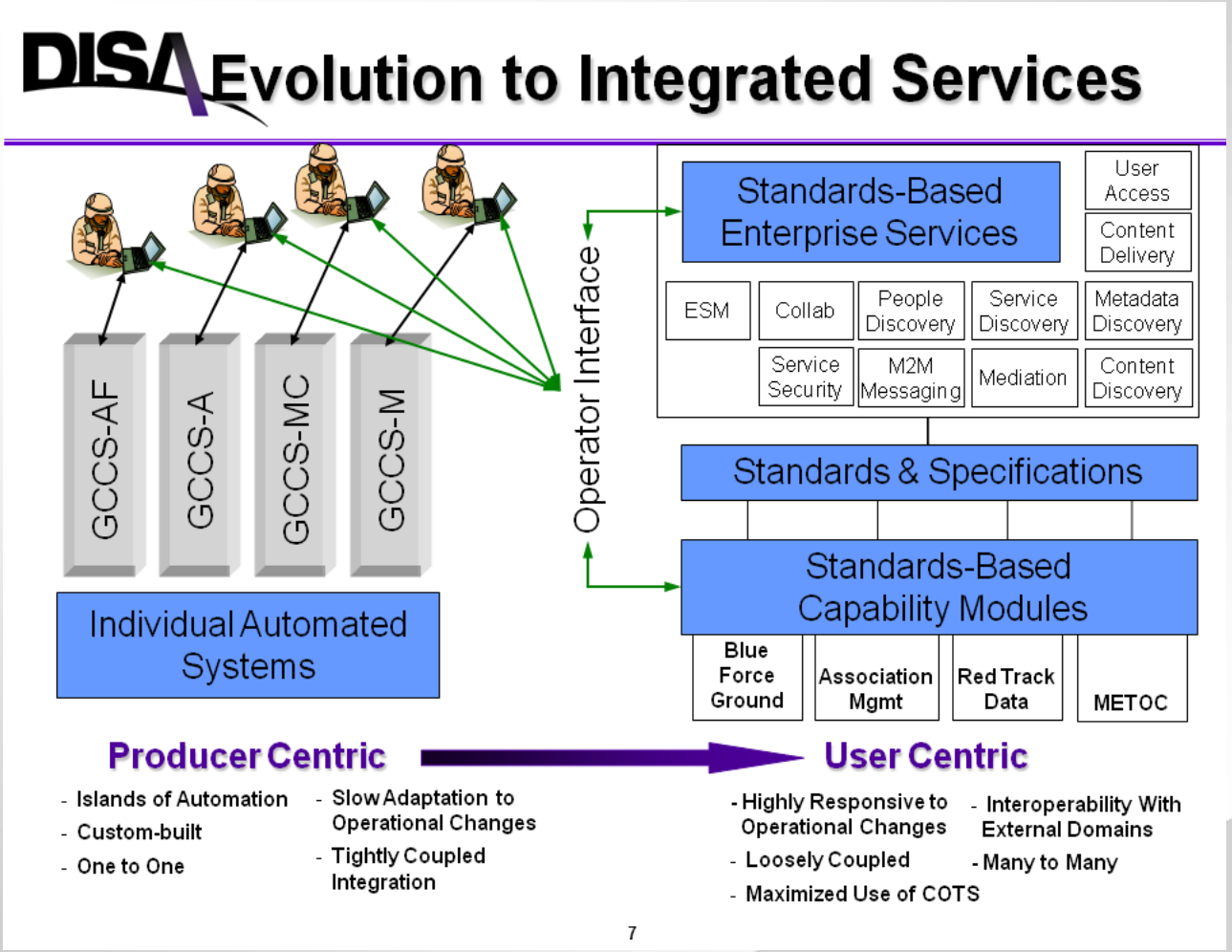
Network-Enabled Command Capability (NECC)



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GCCS FoS to NECC

Unclassified

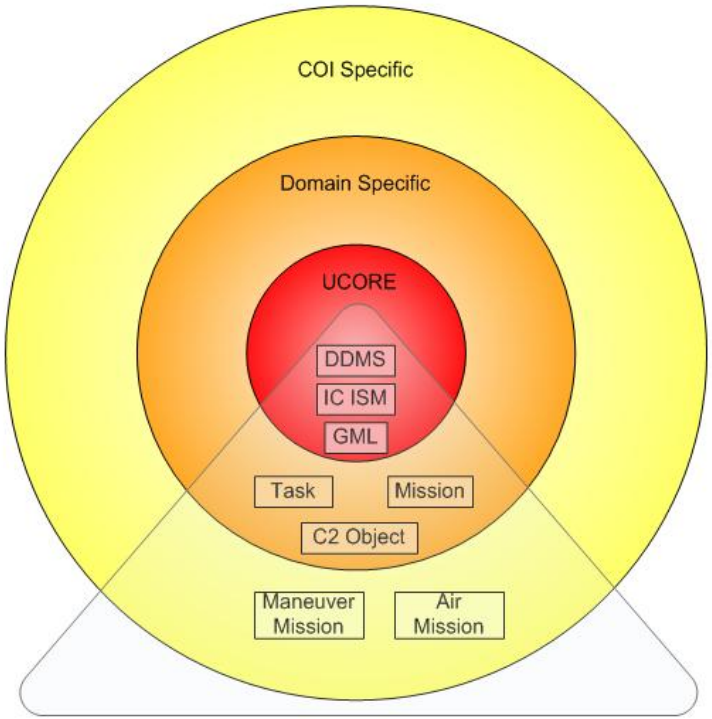
FoS Functionality Transition Plan Background

- NECC achieved a successful Milestone A in February 2006
- The NECC MS A Acquisition Decision Memorandum (ADM) directed DISA to:
  - "…identify the criteria to enable the Military Departments to transfer program management responsibility for GCCS FoS programs to the NECC JPEO"
  - Develop a two part Functionality Transition Plan (FTP)
    1. Method and schedule for identification of GCCS FoS functionality that can migrate to NECC during Increment 1
       - NECC Methodology and Schedule for GCCS Family of Systems (FoS) to NECC Functionality Transition Plan was completed 1 June 2006
       - The "Methodology and Schedule" was a plan for a plan
    2. Crosswalk of NECC CDD capabilities with the GCCS FoS requirements with subsequent refinement based on the content of the new CDD.
       - GCCS FoS to NECC FTP v1.0 was completed 14 Aug 2007, with quarterly updates (Jan 2008, Mar 2008, Jun 2008, etc)

Unclassified

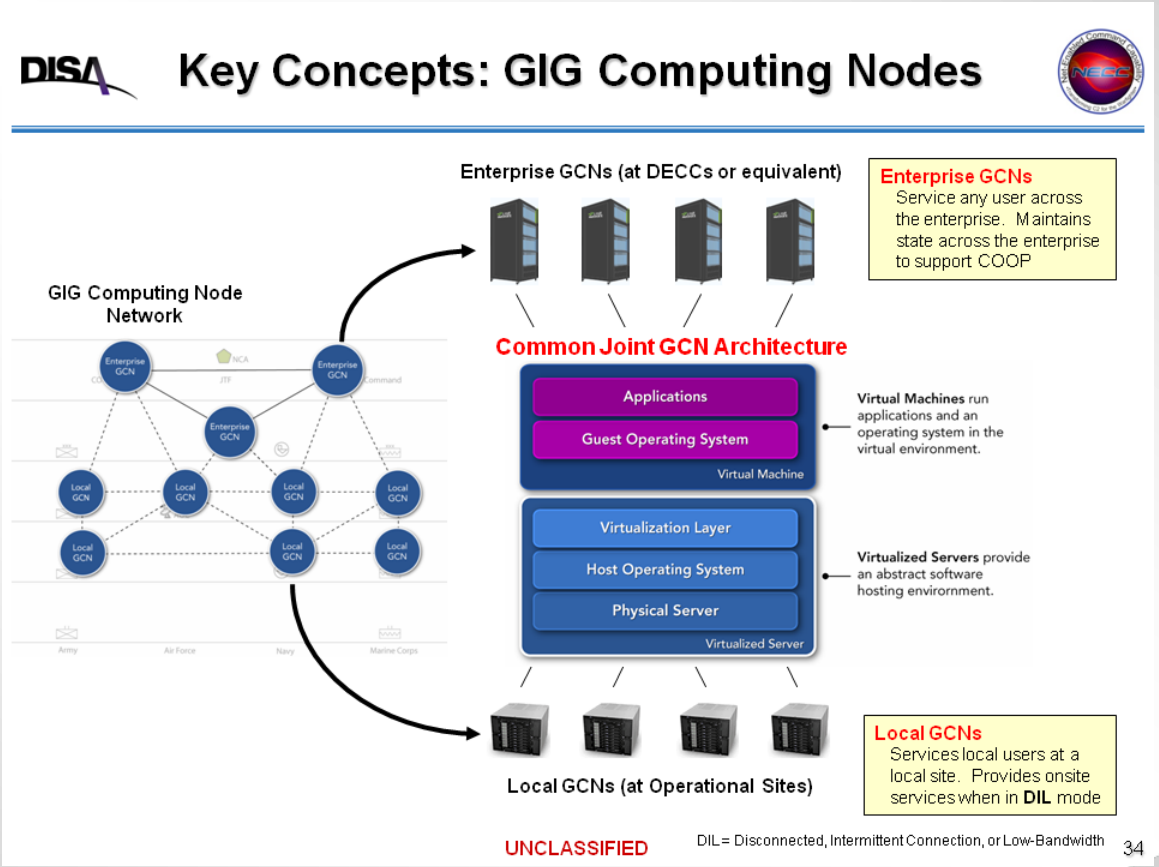
NECC Layered Approach

Layered Data Schemas



UNCLASSIFIED

NECC GIG Computing Node (GCN) Approach



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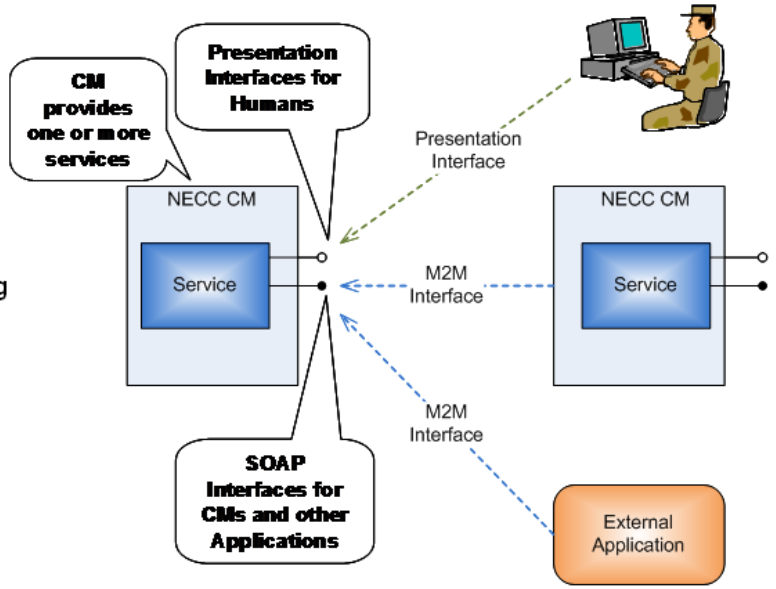
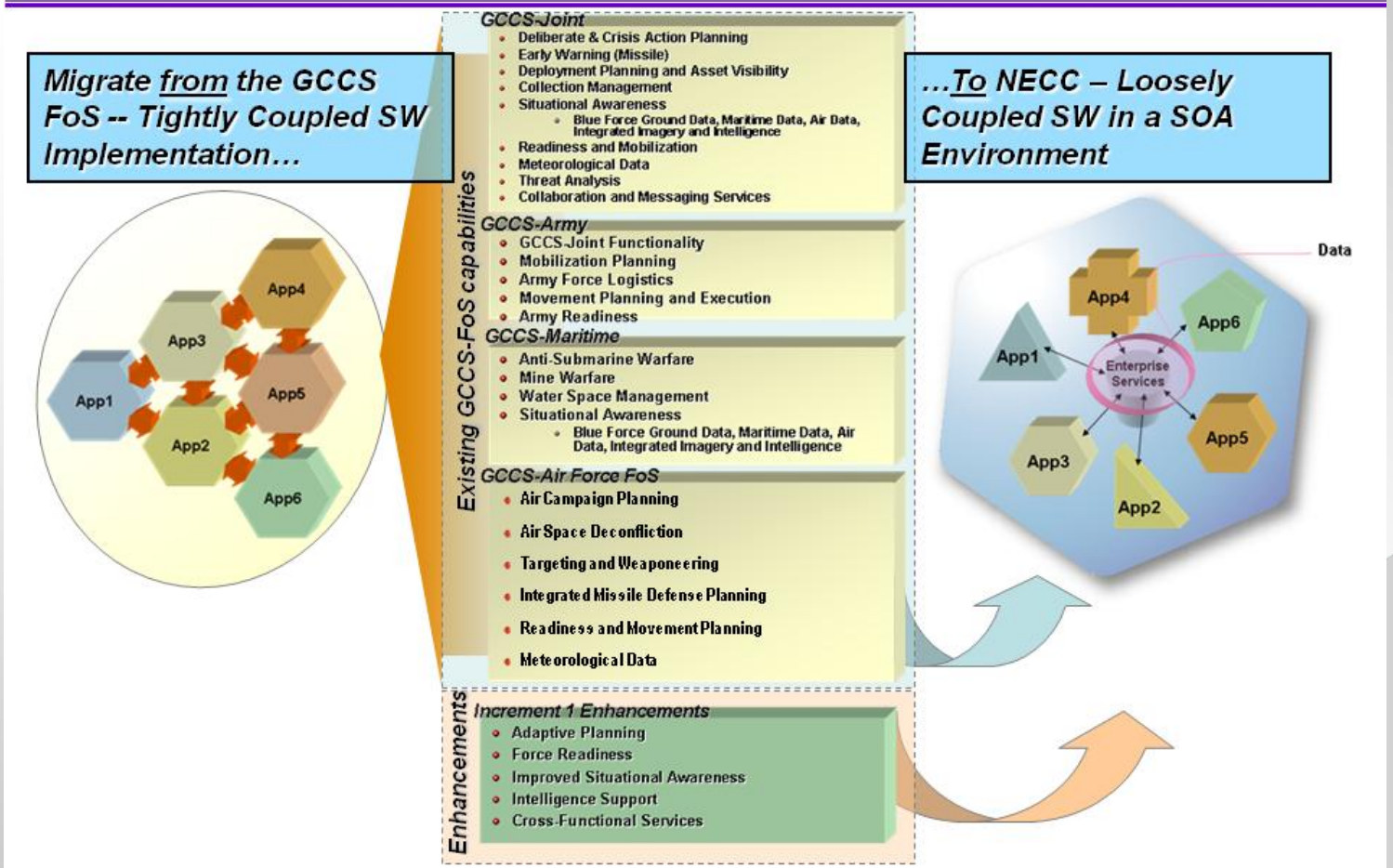
NECC CM

Capability Module (CM)

- A Capability Module is a set of software components that implements a set of logically grouped services
  - service Interface
  - supports C2B and B2B Transactions
- Key Characteristics:
  - primary building block of NECC Architecture
  - distributed across GIG Computing Nodes
  - managed, certified, and deployed as single bundle
  - built-in Scalability/DIL/COOP
- About 60 Increment 1 Capability Modules anticipated



DISA NECC Increment 1 Concept



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