OR 680/SYST 798 SENIOR RESEARCH PROJECT
PROGNOS – SYSTEM REQUIREMENTS DOCUMENT

Integration Strategy for PROGNOS

Knowledge Exchange Module Interfaces

(ISP-KEMI)

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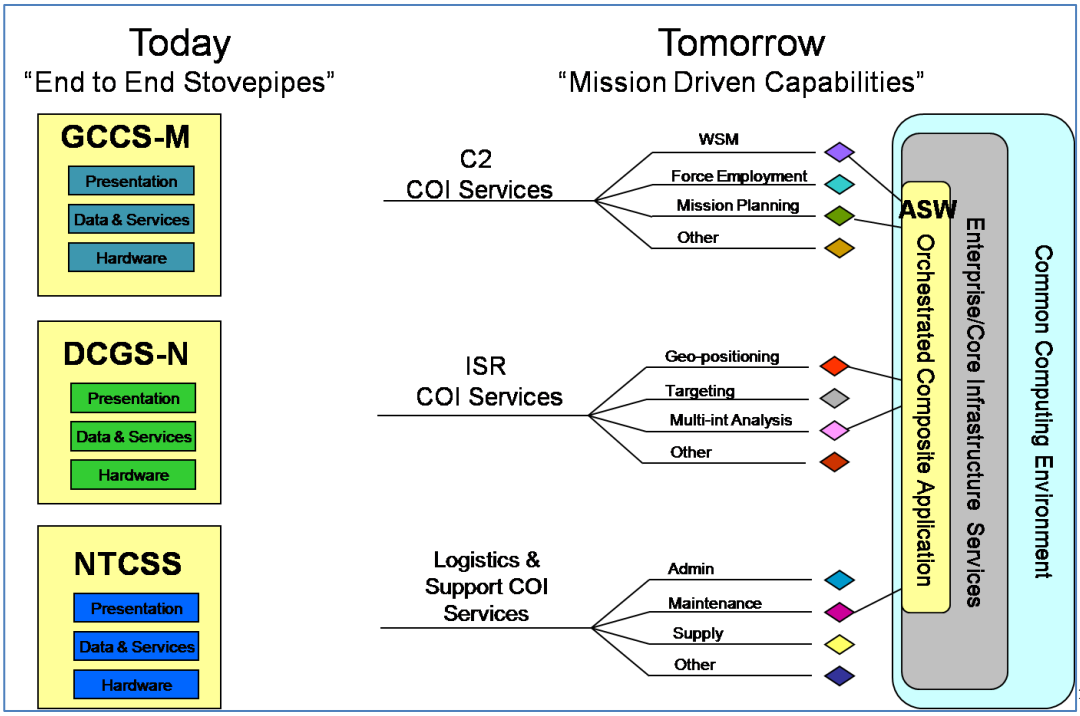
1 INTRODUCTION

Today we are living in an era called the "Information Age", an era where information is a necessity for countries and serves as a measure of political power. Information is also a status symbol and provides recognition and placement in society. The demand for increasing information has given rise to technological advancement, resulting in the development of more and more complex systems to meet this demand. The Department of Defense and the United States Navy have taken advantage of the information age and have developed systems for each unique warfighter functional area to include Command and Control (C2); Intelligence, Surveillance, and Reconnaissance (ISR); and Logistics. The systems and the sensors connected to these systems generate a vast amount of information that is overwhelming the warfighter and the warfighter is having major challenges in converting the vast amount of data into knowledge and actionable intelligence. The systems were acquired and planned in a disjointed fashion resulting in "stovepipe" systems, custom designed for a specific purpose. The systems serve their defined purpose; however, since they were developed in a divergent fashion, sharing data between these systems is a significant technical challenge due to incompatible message formats and protocols. To improve operational efficiency and accelerate the decision cycle, the Navy must bridge the stovepipes and improve data and information interoperability. Compounding this challenge and contributing to the "fog of war" is the vast amount of data that must be processed to convert data to information and eventually to knowledge. FORCEnet and the network operational constructs from the other services such as Constellation C2 (Air Force) and LandWarNet (Army), need to bridge the "stovepipes" and convert the vast amount of data available to any combatant commander to actionable intelligence and enhanced situation awareness. To solve the interoperability issues, a system is needed to solve incompatibility among different systems' protocols, messages format, and security levels. The PROGNOS Knowledge Exchange Module will provide the bridge between the incompatible protocols and message formats. The PROGNOS system, as a whole, will use a probabilistic ontology based on UCore to deterministically analyze the vast amounts of data to create the vital knowledge and actionable intelligence. Figure 1 illustrates the U.S. Navy plans for transitioning the systems of today to a web centric common operating environment.



[1]

Figure 1 – Problem we are facing today

1.1 Purpose

The purpose of this System Requirements Document (SRD) is to provide a detail list of system requirements for the PROGNOS Knowledge Exchange Module interfaces including the originating requirements which came from the sponsor. In addition, the system requirements document will include Composite, Functional, Constraint, System-wide, and Performance Requirements.

1.2 Scope

The scope of this document is to define what are the Originating, Functional, Constraint, System-wide, and Performance Requirements that were gathered and derived by the PROGNOS team.

1.3 Overview

PROGNOS, a system for Predictive Naval Situation Awareness currently being developed at George Mason University's C4I Center, is a project to improve situation awareness for the U.S. Navy and to "enable predictive analysis with principled hypothesis management"[2]. "PROGNOS will integrate four state-of-the-art enabling technologies into a distributed system architecture that represents domain knowledge as a modular collection of probabilistic ontologies, combine these "knowledge nuggets" dynamically into complex situation models, and apply theoretically sound, computationally efficient hypothesis management and inference to combine evidence and background knowledge to reason about the current situation. PROGNOS will also interoperate with other FORCEnet systems by interacting

[1] Miller, Chris, "PEO C4I Overview and Way Ahead for AFCEA NOVA", 5 April 2007, slide 13.
[2] George Mason University C4I Center / SEOR Department, "Probabilistic Ontologies for Net-Centric Operations Systems", June 2009, slide 8.

via semantically enabled services."[3] Figure 2 below illustrates the system context diagram that depicts the modules and components of the two mentioned systems, FORCENet and PROGNOS, and their interface via some sort of hand shake between the PROGNOS Knowledge Exchange Module and FORCENet, circled in red.

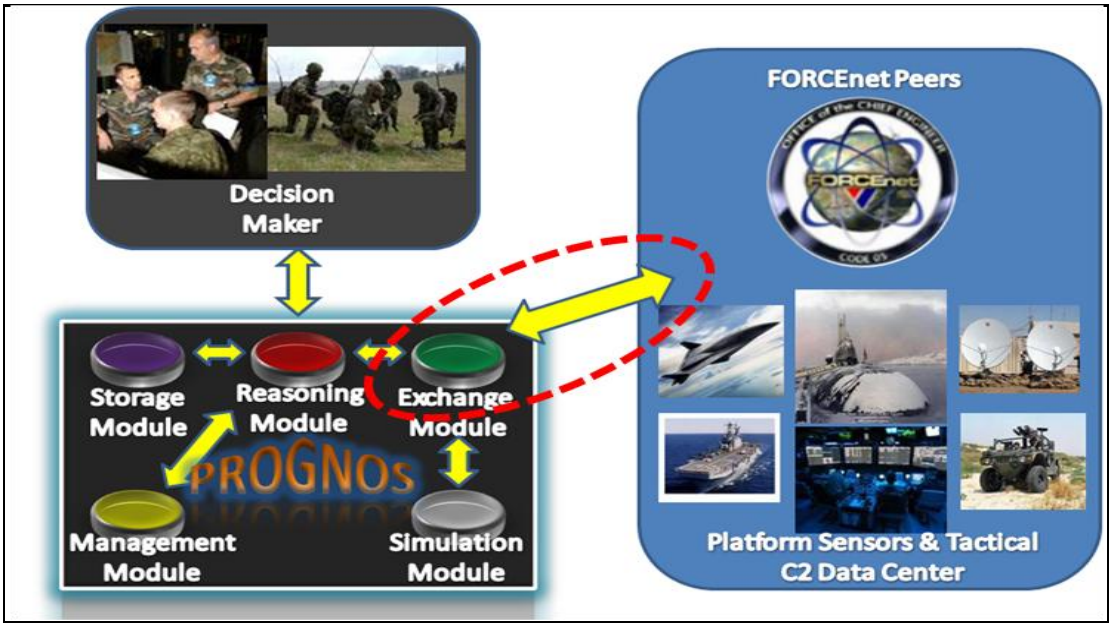


Figure 2 - System Context Diagram

Below in Figure 3 illustrates the required interfaces PROGNOS will need to interface with.

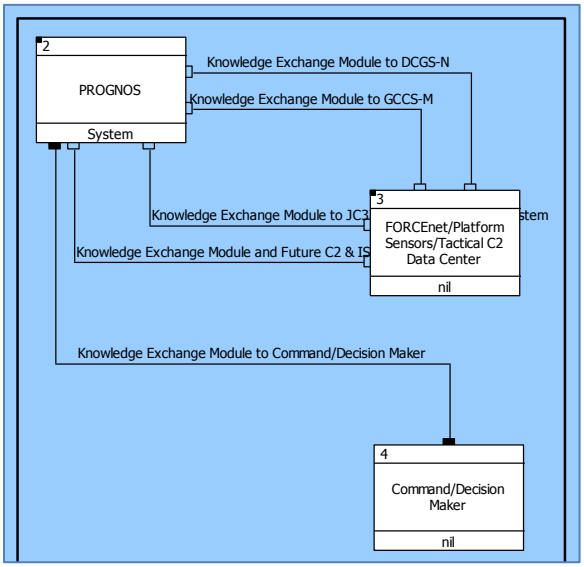


Figure 3 - PROGNOS Context Interface Diagram

[3] Costa, Laskey, and KC Chang. PROGNOS: Applying Probabilistic Ontologies to Distributed Predictive Situation Assessment in Naval Operations, June 2009.

2 System Description

PROGNOS, a system for Predictive Naval Situation Awareness currently being developed at George Mason University's C4I Center, is a project to improve situation awareness for the U.S. Navy and to "enable predictive analysis with principled hypothesis management"[4]. "PROGNOS will integrate four state-of-the-art enabling technologies into a distributed system architecture that represents domain knowledge as a modular collection of probabilistic ontologies, combine these "knowledge nuggets" dynamically into complex situation models, and apply theoretically sound, computationally efficient hypothesis management and inference to combine evidence and background knowledge to reason about the current situation. PROGNOS will also interoperate with other FORCEnet systems by interacting via semantically enabled services."[5] Figure 2 illustrates the data interoperability required between PROGNOS and FORCEnet. Their interface is shown as a handshake from the Knowledge Exchange Module to any systems among the FORCEnet peers.

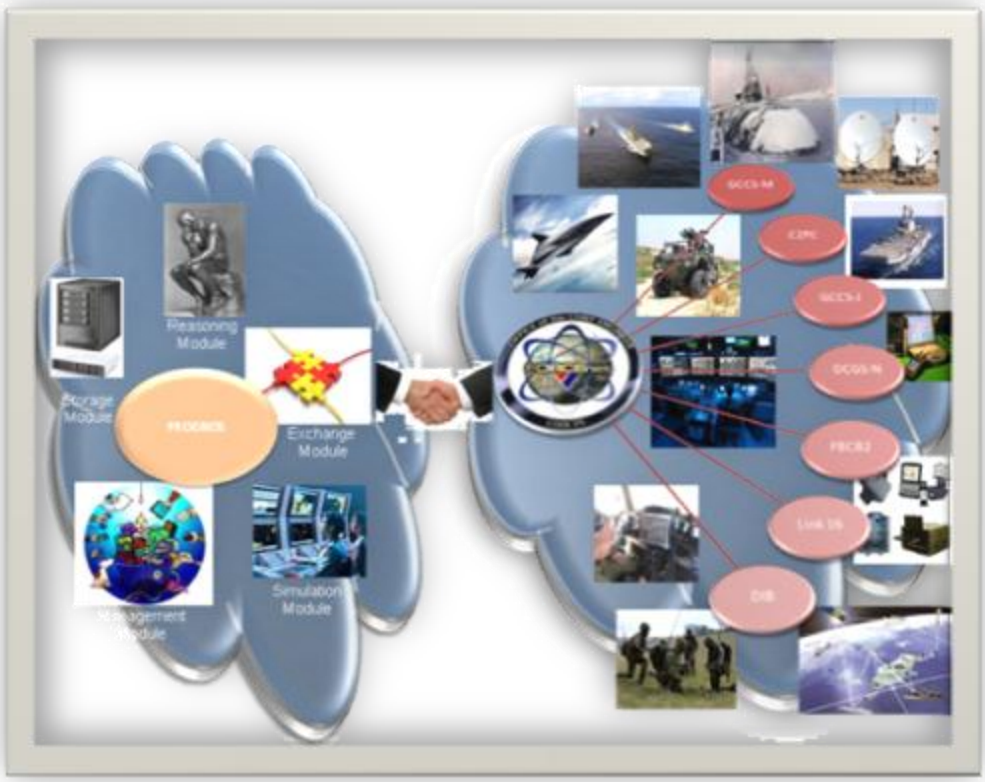


Figure 4- PROGNOS and FORCEnet Integration Diagram

[4] George Mason University C4I Center / SEOR Department, "Probabilistic Ontologies for Net-Centric Operations Systems", June 2009, slide 8.

[5] Costa, Laskey, and KC Chang. "PROGNOS: Applying Probabilistic Ontologies to Distributed Predictive Situation Assessment in Naval Operations", June 2009.

To ensure data interoperability, PROGNOS must understand the messages being sent by FORCEnet systems and vice versa. The Knowledge Exchange Module must translate for the different protocols and message formats and standards used by the different FORCEnet systems. FORCEnet systems use multiple formats to include XML, ontologies, Variable Message Format (VMF), United States Message Text Format (USMTF), and Tactical Data Link (TDL) based systems.

PROGNOS is broken down into five essential modules responsible for different system functionalities and different capabilities.

2.1 Reasoning Module Description

The Reasoning Module is the heart of the PROGNOS System. "It is composed of a Multi-Entity Bayesian Network (MEBN) reasoner that interacts with the other modules and coordinates the execution of Situation-Specific Bayesian Network (SSBN) construction, which includes interleaved hypothesis management and inference…"[6]

2.2 Knowledge Storage Module

The Knowledge Storage Module stores the entities and attributes necessary to implement the PROGNOS probabilistic ontology. "...every track and its respective data are stored within a schema based on and dynamically linked to the PROGNOS system's MPO (Main Probabilistic Ontology)."[7]

2.3 Knowledge Management Module

The Knowledge Management Module is the brains of the PROGNOS System. The Knowledge Manage Module "… is responsible for understanding the situation at hand and defining how to proceed in face of a situation."[8] "The module contains a set of probabilistic ontologies that capture domain knowledge…"[9] The Knowledge Management Module is comprises of two libraries – a Task-Specific Probabilistic Ontology and a Task-Neutral Probabilistic Ontology. The Task-Neutral Probabilistic Ontology contains knowledge applicable to any task. The Task-Specific Probability Ontology contains knowledge specific to a particular task.

2.4 Simulation Module

The Simulation Module supports computerized military exercises, operation simulation, and "what-if" scenario planning. The simulation module "… sends geographical data (coordinates, known or probable) and status (friend, foe, unknown, etc.) of fictitious entities that are going to be used to evaluate the system's response"[10].

[6] Costa, Laskey, Chang. PROGNOS: Applying Probabilistic Ontologies to Distributed Predictive Situation Assessment in Naval Operations, page 6.
[7] Ibid, page 6.
[8] Ibid, page 7.
[9] Ibid, page 7.
[10] Ibid, page 7.

2.5 Knowledge Exchange Module

The Knowledge Exchange Module external system interfaces include FORCEnet and other platform's sensors and tactical C2 systems. It provides the translation for any systems that do not follow the PROGNOS message standards or protocols. Figure 3 illustrates the Knowledge Exchange Module as the translator block in the middle between PROGNOS and the five categorized systems. The FORCEnet systems and its peers will fall under one of these five types of systems -- ontology based systems, XML based systems, VMF based systems, USMTF based systems and TDL based systems.

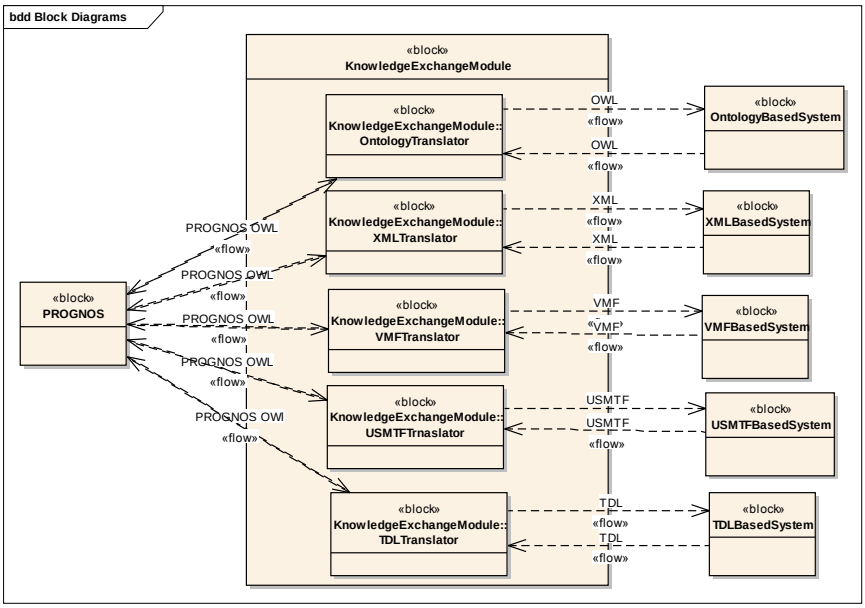


Figure 5 – PROGNOS block diagram

2.5.1.1 Ontology Based System

Future ontology systems may send messages via a XML, RDF, and OWL formatted messages. Using a Web Ontology Language (OWL) based communications assumes some common ontological structure between OWL and some other ISR or C2 system. Lower layer transport mechanisms will be IP/TCP/HTTPS/SOAP. As will be part of our assumption is that the Net Enabled Command and Capability system will be implemented and transition to an ontology based system.

2.5.1.2 Extensible Markup Language (XML) based system

An XML based system would be any system that uses XML formatting as a means of transporting data from one system to the other. Messages will be formatted in accordance with DDMS and Community of Interests (COIs) defined in the DoD Metadata Registry. Lower layer transport mechanisms will be IP/TCP/HTTPS/SOAP. We are assuming, based on DoD documentation, that Distributed Command and Ground System – Navy (DCGS-N) and NECC will be XML communication based systems.

2.5.1.3 Variable Message Format (VMF) based system

To support connectivity with Army and Marine Corp ground force Blue Force Tracking systems, PROGNOS will need to interact with VMF based systems. VMF is a binary encoded format defined by

MIL-STD-6017. VMF is used by Force Battle Command Brigade and Below (FBCB2) and Advanced Field Artillery Tactical Data System (AFATDS) among other systems.

2.5.1.4 United States Message Text Format (USMTF) based system

Formal reports and guidance in DoD are published in the USMTF format. USMTF is a text format defined by MIL-STD-6040. To receive intelligence analysis reports, PROGNOS must support USMTF.

2.5.1.5 Tactical Data Link (TDL) based system

TDL refers to a series of standards primarily used by aircraft for Position Location Information tracking and sometimes communication. The most common one currently in use is Link-16/TADIL-J. TADIL-J is used for aircraft tracking; however, it can support more than aircraft tracking to include Position, Location Information (PLI) reporting and voice communications.

3 System Requirements

3.1 External Interface

Requirement Statement:
The PROGNOS system shall be able to exchange knowledge with external systems.

Source Document(s):
"PROGNOS: Applying Probabilistic Ontologies to Distributed Predictive Situation Assessment in Naval Operations" presentation

Refined By Subordinate Requirements:
1.1 Exchange Data with Future Navy FORCEnet C2 and ISR Systems
1.2 Exchange Data with DCGS-N
1.3 Exchange Data with NECC

Verification Method: Demo, Test
The scenario walkthrough and simulation demo will provide verification for KEM interface with external systems.

3.1.1 Exchange Data with Future Navy FORCEnet C2 and ISR Systems

Requirement Statement:
The PROGNOS system shall be able to exchange knowledge with Future Navy FORCEnet C2 and ISR Systems.

Source Document(s):
"PROGNOS: Applying Probabilistic Ontologies to Distributed Predictive Situation Assessment in Naval Operations" presentation

Refines Higher-Level Requirement:
1 External Interface

Refined By Subordinate Requirements:
1.1.1 Received Future Navy FORCEnet C2 and ISR Systems
1.1.2 Send Data to Future Navy FORCEnet C2 and ISR Systems
1.1.3 Interoperate with Future Navy FORCEnet C2 and ISR systems

Verification Method: Demo

The scenario walkthrough and simulation demo will provide verification for KEM interface with external systems.

3.1.1.1 Received Future Navy FORCEnet C2 and ISR Systems

Requirement Statement:
The Knowledge Exchange Module shall be able to receive data from Future Navy FORECnet C2 and ISR systems in their designed format.

Source Document(s):

Refines Higher-Level Requirement:
1.1 Exchange Data with Future Navy FORCEnet C2 and ISR Systems

Refined By Subordinate Requirements:

Verification Method: Demo
The scenario walkthrough and simulation demo will provide verification for received data from future Navy FORCEnet C2 and ISR systems.

3.1.1.2 Send Data to Future Navy FORCEnet C2 and ISR Systems

Requirement Statement:
The Knowledge Exchange Module shall be able to send data to Future Navy FORECnet C2 and ISR systems in PROGNOS PROWL format.

Source Document(s):

Refines Higher-Level Requirement:
1.1 Exchange Data with Future Navy FORCEnet C2 and ISR Systems

Refined By Subordinate Requirements:

Verification Method: Demo
The scenario walkthrough and simulation demo will provide verification for send data to future Navy FORCEnet C2 and ISR systems.

3.1.1.3 Interoperate with Future Navy FORCEnet C2 and ISR systems

Requirement Statement:
The Knowledge Exchang Module shall be able to interoperate with Future Navy FORCEnet C2 and ISR Systems. The message sent is received and interpreted as intended by sender.

Source Document(s):

Refines Higher-Level Requirement:
1.1 Exchange Data with Future Navy FORCEnet C2 and ISR Systems

Refined By Subordinate Requirements:

Verification Method: Demo
The scenario walkthrough and simulation demo will provide verification for KEM to understand data from future Navy C2 and ISR systems.

3.1.2 Exchange Data with DCGS-N

Requirement Statement:
The PROGNOS system shall be able to exchange knowledge with the Distributed Common Ground System - Navy (DCGS-N).

Refines Higher-Level Requirement:
1 External Interface

Refined By Subordinate Requirements:
1.2.1 Received Data from DCGS-N
1.2.2 Send Data to DCGS-N
1.2.3 Interoperate with DCGS-N

Verification Method: Demo
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.

3.1.2.1 Received Data from DCGS-N

Requirement Statement:
The Knowledge Exchange Module shall be able to receive data from the DCGS-N system in its designed format.

Source Document(s):

Refines Higher-Level Requirement:
1.2 Exchange Data with DCGS-N

Refined By Subordinate Requirements:

Verification Method: Demo
Simulation Demo. The Demo will show that PROGNOS received transmitted XML DCGS-N data and had translated into PR-OWL.

3.1.2.2 Send Data to DCGS-N

Requirement Statement:
The Knowledge Exchange Module shall be able to sent data to the DCGS-N system in PROGNOS PROWL format.

Source Document(s):

Refines Higher-Level Requirement:
1.2 Exchange Data with DCGS-N

Refined By Subordinate Requirements:

Verification Method: Demo
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 acknowledges query received.

3.1.2.3 Interoperate with DCGS-N

Requirement Statement:
The Knowledge Exchang Module shall be able to interoperate with DCGS-N systems. The message sent is received and interpreted as intended by sender.

Source Document(s):

Refines Higher-Level Requirement:
1.2 Exchange Data with DCGS-N

Refined By Subordinate Requirements:

Verification Method: Demo

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.

3.1.3 Exchange Data with NECC

Requirement Statement:

The PROGNOS system shall be able to exchange knowledge with the Net Enabled Command Capability (NECC) system.

Refines Higher-Level Requirement:

1 External Interface

Refined By Subordinate Requirements:

1.3.1 Received Data from NECC
1.3.2 Send Data to NECC
1.3.3 Interoperate with NECC

Verification Method: Demo

The scenario walkthrough and simulation demo will provide verification for KEM interface with NECC systems.

3.1.3.1 Received Data from NECC

Requirement Statement:

The Knowledge Exchange Module shall be able to receive data from the NECC system in their designed format.

Source Document(s):

Refines Higher-Level Requirement:

1.3 Exchange Data with NECC

Refined By Subordinate Requirements:

Verification Method: Demo

The scenario walkthrough and simulation demo will provide verification for received data from future NECC systems.

3.1.3.2 Send Data to NECC

Requirement Statement:

The Knowledge Exchange Module shall be able to send data to the NECC system in PROGNOS PROWL format.

Source Document(s):

Refines Higher-Level Requirement:

1.3 Exchange Data with NECC

Refined By Subordinate Requirements:

Verification Method: Demo

The scenario walkthrough and simulation demo will provide verification for sent data from NECC systems.

3.1.3.3 Interoperate with NECC

Requirement Statement:
The Knowledge Exchange Module shall be able to interoperate with NECC systems. The message sent is received and interpreted as intended by sender.

Source Document(s):

Refines Higher-Level Requirement:
1.3 Exchange Data with NECC

Refined By Subordinate Requirements:

Verification Method: Demo
The simulation demo will provide verification that KEM understands data from NECC systems.

3.2 Protocols Compliance

Requirement Statement:
The PROGNOS system shall be able to take in system data that uses different protocols.

Source Document(s):
"PROGNOS: Applying Probabilistic Ontologies to Distributed Predictive Situation Assessment in Naval Operations" presentation

Refined By Subordinate Requirements:
2.1 HTTPS Protocol
2.2 SOAP Protocol
2.3 Web Map Services (WMS)
2.4 Styled Layer Descriptor

Verification Method: Test
The verification for this will occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with different external systems protocols.

3.2.1 HTTPS Protocol

Requirement Statement:
The Knowledge Exchange module shall support the Hypertext Transfer Protocol Secure (HTTPS) IAW IETF RFC 2818 and RFC 5246.

Source Document(s):
"PROBABILISTIC ONTOLOGIES: THE NEXT STEP FOR NET-CENTRIC OPERATIONS" paper
The SSL Protocol Version 3.0

Refines Higher-Level Requirement:
2 Protocols Compliance

Verification Method: Test
The verification for this will occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use HTTPS protocol.

3.2.2 SOAP Protocol

Requirement Statement:
The Knowledge Exchange Module shall support Simple Object Access Protocol (SOAP) IAW W3C's SOAP version 1.2 dated 27 April 2007.

Source Document(s):
"PROBABILISTIC ONTOLOGIES: THE NEXT STEP FOR NET-CENTRIC OPERATIONS" paper
Soap Version 1.2

Refines Higher-Level Requirement:
2 Protocols Compliance

Refined By Subordinate Requirements:
2.2.1 Web Services Transfer
2.2.2 Web Services Enumeration

Verification Method: Test
The verification for this will occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use SOAP protocol.

3.2.2.1 Web Services Transfer

Requirement Statement:
The Knowledge Exchange module shall support Web Services Transfer (WS-Transfer) IAW the W3C's W3C Member Submission dated 27 September 2006.

Source Document(s):
DISA "Net-Enabled Command Capability (NECC)

Refines Higher-Level Requirement:
2.2 SOAP Protocol

Refined By Subordinate Requirements:

Verification Method: Test
The verification for this will occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use Web Services Transfer in accordance with World Wide Web Consortium (W3C).

3.2.2.2 Web Services Enumeration

Requirement Statement:
The Knowledge Exchange Module shall support Web Services Enumeration (WS-Enumeration) IAW the W3C's W3C Member Submission dated 15 March 2006.

Source Document(s):
DISA "Net-Enabled Command Capability (NECC)

Refines Higher-Level Requirement:
2.2 SOAP Protocol

Refined By Subordinate Requirements:

Verification Method: Test

The verification for this will occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use Web Services Enumeration in accordance with World Wide Web Consortium (W3C).

3.2.3 Web Map Services (WMS)

Requirement Statement:
The Knowledge Exchange module shall support Web Map Service (WMS) IAW the OpenGIS Web Map Service (WMS) Implementation Specification version 1.1.1.

Source Document(s):
DISA "Net-Enabled Command Capability (NECC)

Refines Higher-Level Requirement:
2 Protocols Compliance

Refined By Subordinate Requirements:

Verification Method: Test
The verification for this will occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use Web Map Services in accordance with OpenGIS Web Map Service (WMS) Implementation Specification version 1.1.1.

3.2.4 Styled Layer Descriptor

Requirement Statement:
The Knowledge Exchange module shall support Styled Layer Descriptor (SLD) IAW the OpenGIS Styled Layer Descriptor Profile of the Web Map Service Implementation Specification version 1.0.

Source Document(s):
DISA "Net-Enabled Command Capability (NECC)

Refines Higher-Level Requirement:
2 Protocols Compliance

Refined By Subordinate Requirements:

Verification Method: Test
The verification for this will occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use styled layer descriptor in accordance with the OpenGIS Styled Layer Descriptor Profile of the Web Map Service Implementation Specification version 1.0.

3.3 Message Standards

Requirement Statement:
The PROGNOS system shall be able to take in system data that uses different messages standards.

Source Document(s):
"PROGNOS: Applying Probabilistic Ontologies to Distributed Predictive Situation Assessment in Naval Operations" presentation

Refined By Subordinate Requirements:

3.1 XML
3.2 JC3IEDM
3.3 OWL
3.4 C2PC VDX
3.5 USMTF
3.6 JVMF
3.7 TADL-J
3.8 WSDL
3.9 XHTML
3.10 HTML
3.11 Web Services Notification
3.12 GML
3.13 Web Feature Service (WFS)
3.14 RDF Site Summary (RSS)

Verification Method: Demo, Test

The scenario walk through will point out some of the required messages standards for PROGNOS KEM, and the simulation will demonstrate the feasibility of the data exchange. To incorporate the other standards, other scenarios may be implemented to include different standards. A walkthrough and simulation can also accomplished these other standards.

3.3.1 XML Data Message Format

Requirement Statement:

The Knowledge Exchange module shall enable data input with the Extensible Markup Language (XML) IAW W3C's XML 1.0 Specification.

Source Document(s):

"PROBABILISTIC ONTOLOGIES: THE NEXT STEP FOR NET-CENTRIC OPERATIONS" paper

Refines Higher-Level Requirement:

3 Message Standards

Refined By Subordinate Requirements:

3.1.1 Web Services Addressing
3.1.2 Xpath

Verification Method: Demo

The scenario walkthrough and Simulation Demo verify the need for this message standard. The DCGS-N simulated data will be XML based IAW W3C XML 1.0 Specification.

3.3.1.1 Web Services Addressing

Requirement Statement:

The Knowledge Exchange module shall support Web Services Addressing (WS-Addressing) IAW the W3C's W3C Member Submission dated 10 August 2004.

Source Document(s):

DISA "Net-Enabled Command Capability (NECC)

Refines Higher-Level Requirement:

3.1 XML Data Message Format

Refined By Subordinate Requirements:

Verification Method: Demo, Test

The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use Web Services Addressing in accordance with the W3C's W3C Member Submission dated 10 August 2004. However, it can also be verified by using a scenario walkthrough with systems that use Web Services Addressing as a message standard in accordance with World Wide Web Consortium (W3C).

3.3.1.2 Xpath

Requirement Statement:

The Knowledge Exchange module shall support XML Path Language (XPath) IAW the W3C's W3C XML Path Language (XPath) Version 1.0 dated 15 March 2006.

Source Document(s):

DISA "Net-Enabled Command Capability (NECC)

Refines Higher-Level Requirement:

3.1 XML Data Message Format

Refined By Subordinate Requirements:

Verification Method: Demo, Test

The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use Xpath in accordance with the W3C's W3C XML Path Language (XPath) Version 1.0 dated 15 March 2006. However, it can also be verified by using a scenario walkthrough with systems that use Xpath as a message standard.

3.3.2 JC3IEDM

Requirement Statement:

The Knowledge Exchange module shall enable data input with the Joint C3 Information Exchange Data Module (JC3IEDM) IAW NATO STANAG 5525.

Source Document(s):

"PROGNOS: Applying Probabilistic Ontologies to Distributed Predictive Situation Assessment in Naval Operations" presentation

Refines Higher-Level Requirement:

3 Message Standards

Refined By Subordinate Requirements:

Verification Method: Demo, Test

The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use JC3IEDM message standard in accordance with the NATO STANAG 5525. However, it can also be verified by using a scenario walkthrough with systems that use JC3IEDM as a message standard.

3.3.3 OWL Data Message Format

Requirement Statement:

The Knowledge Exchange module shall enable data input with the Web Ontology Language (OWL) IAW the W3C's OWL 2 Web Ontology Language Document Overview dated 27 October 2009.

Source Document(s):
Probabilistic Ontologies for Net-Centric Operations Systems briefing to ONR

Refines Higher-Level Requirement:
3 Message Standards

Verification Method: Demo, Test
The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use OWL data message standard in accordance with W3C's OWL 2 Web Ontology Language Document Overview dated 27 October 2009. However, it can also be verified by using a scenario walkthrough with systems that use OWL as a message standard.

3.3.4 C2PC VDX

Requirement Statement:
The PROGNOS system shall be able to take in system data messages that are in Command and Control Personal Computer (C2PC) Variable Data Exchange (VDX) format.

Source Document(s):
Scenario/Operation Concept

Refines Higher-Level Requirement:
3 Message Standards

Verification Method: Demo, Test
The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use C2PC VDX data message. However, it can also be verified by using a scenario walkthrough with systems that use C2PC VDX as a message standard.

3.3.5 USMTF Data Message Format

Requirement Statement:
The PROGNOS system shall be able to take in system data messages that are in United States Message Text Form (USMTF) format.

Source Document(s):
Scenario/Operation Concept

Refines Higher-Level Requirement:
3 Message Standards

Verification Method: Demo, Test
The scenario walkthrough demonstrate verification of the need for USMTF data message format for PROGNOS interface.

3.3.6 VMF

Requirement Statement:

The PROGNOS system shall be able to take in system data messages that are in Variable Message Format (VMF) format.

Source Document(s):
Scenario/Operation Concept

Refines Higher-Level Requirement:
3 Message Standards

Verification Method: Demo, Test
The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use VMF data message. However, it can also be verified by using a scenario walkthrough and simulation with systems that use VMF as a message standard to show feasibility of data exchange with PROGNOS KEM.

3.3.7 TADL-J

Requirement Statement:
The PROGNOS system shall be able to take in system data messages that are in Tactical Data Link J Series (TADL-J) format.

Source Document(s):
Scenario/Operation Concept

Refines Higher-Level Requirement:
3 Message Standards

Verification Method: Demo, Test
The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use C2PC VDX data message. However, it can also be verified by using a scenario walkthrough and simulation with systems that use OWL as a message standard to show feasibility of data exchange with PROGNOS KEM.

3.3.8 WSDL

Requirement Statement:
The Knowledge Exchange module shall support the Web Services Description Language (WSDL) IAW W3C's WSDL 1.1 Specification.

Source Document(s):
"PROBABILISTIC ONTOLOGIES: THE NEXT STEP FOR NET-CENTRIC OPERATIONS" paper

Refines Higher-Level Requirement:
3 Message Standards

Verification Method: Demo, Test
The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use WSDL data message in accordance with W3C's WSDL 1.1 Specification. However, it can also be verified by using a scenario walkthrough and simulation with systems that use WSDL as a message standard to show feasibility of data exchange with PROGNOS KEM.

3.3.9 XHMTL

Requirement Statement:
The Knowledge Exchange module shall enable data input with the XHTML IAW the W3C's XHTML1.1 - Module-based XHTML dated 31 May 2001.

Source Document(s):
DISA "Net-Enabled Command Capability (NECC)

Refines Higher-Level Requirement:
3 Message Standards

Verification Method: Demo, Test
The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use XHTML data message in accordance with the W3C's XHTML1.1 - Module-based XHTML dated 31 May 2001. However, it can also be verified by using a scenario walkthrough and simulation with systems that use XHTML as a message standard to show feasibility of data exchange with PROGNOS KEM.

3.3.10 HMTL

Requirement Statement:
The Knowledge Exchange module shall enable data input with the Hypertext Markup Language (HTML) IAW the W3C's HTML 4.01 Specification dated 24 December 1999.

Source Document(s):
DISA "Net-Enabled Command Capability (NECC)

Refines Higher-Level Requirement:
3 Message Standards

Verification Method: Test
The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use HTML data message in accordance with the W3C's HTML 4.01 Specification dated 24 December 1999. However, it can also be verified by using a scenario walkthrough and simulation with systems that use HTML as a message standard to show feasibility of data exchange with PROGNOS KEM.

3.3.11 Web Services Notification

Requirement Statement:
The Knowledge Exchange module shall support Web Services Notification (WS-Notification) IAW the OASIS WSBase-Notification version 1.3.

Source Document(s):
DISA "Net-Enabled Command Capability (NECC)

Refines Higher-Level Requirement:
3 Message Standards

Verification Method: Demo, Test

The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use Web Services Notification data message in accordance with the OASIS WSBase-Notification version 1.3. However, it can also be verified by using a scenario walkthrough and simulation with systems that use Web Services Notification to exchange data message to show feasibility of data exchange with PROGNOS KEM.

3.3.12 GML

Requirement Statement:

The Knowledge Exchange module shall support Geography Markup Language (GML) IAW the OpenGIS Geography Markup Language Encoding Specification version 3.1.1 dated 7 February 2004.

Source Document(s):

DISA "Net-Enabled Command Capability (NECC)

Refines Higher-Level Requirement:

3 Message Standards

Verification Method: Demo, Test

The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use GML data message in accordance with the OpenGIS Geography Markup Language Encoding Specification version 3.1.1 dated 7 February 2004. However, it can also be verified by using a scenario walkthrough and simulation with systems that use GML data message standard to show feasibility of data exchange with PROGNOS KEM.

3.3.13 Web Feature Service (WFS)

Requirement Statement:

The Knowledge Exchange module shall support Web Feature Service (WFS) IAW the OpenGIS Web Map Service (WMS) Implementation Specification version 1.1.

Source Document(s):

DISA "Net-Enabled Command Capability (NECC)

Refines Higher-Level Requirement:

3 Message Standards

Verification Method: Demo, Test

The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use WFS data message in accordance with the OpenGIS Web Map Service (WMS) Implementation Specification version 1.1. However, it can also be verified by using a scenario walkthrough and simulation with systems that use WFS data message standard to show feasibility of data exchange with PROGNOS KEM.

3.3.14 RDF Site Summary (RSS)

Requirement Statement:

The Knowledge Exchange module shall support RDF Site Summary (RSS) version 1.0.

Source Document(s):
DISA "Net-Enabled Command Capability (NECC)

Refines Higher-Level Requirement:
3 Message Standards

Verification Method: Test
The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use RSS. However, it can also be verified by using a scenario walkthrough and simulation with systems that use RSS data message standard to show feasibility of data exchange with PROGNOS KEM.

3.4 Message Conversion Speed

Requirement Statement:
The PROGNOS system shall be able to convert messages from external system format to the PROGNOS format within 2 seconds (Threshold) / less than 1 second (Objective).

Source Document(s):

Verification Method: Test, Analysis
This verification can be done via analysis once you gathered all the performance characteristics from the KEM to the external systems. You can also conduct a real time test to measure the message conversion speed from one type to the other.

3.5 Operating System Compatibility

Requirement Statement:
The Knowledge Exchange Module shall be able to run on various operating systems.

Source Document(s):

Refines Higher-Level Requirement:

Refined By Subordinate Requirements:
7.1 Microsoft Operating System
7.2 Linux Operating System

Verification Method: Demo
The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout operations compatibility using a designated OS.

3.5.1 Microsoft Operating System

Requirement Statement:
The Knowledge Exchange module shall run on a Windows 7 operating system.

Source Document(s):

Refines Higher-Level Requirement:
7 Operating System Compatibility

Verification Method: Demo
The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout operations compatibility using a Microsoft OS.

3.5.2 Linux Operating System

Requirement Statement:
The Knowledge Exchange module shall run on a Windows 7 operating system.

Source Document(s):

Refines Higher-Level Requirement:
7 Operating System Compatibility

Verification Method: Demo
The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout operations compatibility using a Linux OS.

3.6 System Security

Requirement Statement:
The Knowledge Exchange module shall support PKI certificate authentications for both the client and server.

Source Document(s):
DODI 8552.01

Refines Higher-Level Requirement:

Refined By Subordinate Requirements:
8.1 Accept and Provide PKCS#7,12 Key Format
8.2 PKI X.509 Certificates

Verification Method: Demo
The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout data exchanges using PKI certificate authentications.

3.6.1 Accept and Provide PKCS#7,12 Key Format

Requirement Statement:
The Knowledge Exchange module shall be able to accept and provide PKCS#7,12 public key format.

Source Document(s):
DODI 8552.01

Refines Higher-Level Requirement:
8 System Security

Verification Method: Demo
The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed.

3.6.2 PKI X.509 Certificates

Requirement Statement:
The Knowledge Exchange module shall be able to use X.509 PKI certificates.

Source Document(s):
DODI 8552.01

Refines Higher-Level Requirement:
8 System Security

Refined By Subordinate Requirements:
8.2.1 PKI X.509 Accept and Provide Certificates
8.2.2 PKI X.509 Revocation Checking via CRL
8.2.3 PKI X.509 Revocation Checking via CRL stored via LDAP directory
8.2.4 PKI X.509 Revocation Checking via OCSP Protocol

Verification Method: Demo
The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout data exchanges using PKI X.509 certificate.

3.6.2.1 PKI X.509 Accept and Provide Certificates

Requirement Statement:
The Knowledge Exchange module shall be able to accept and provide X509v3 certificates to perform DoD PKI in accordance to DoD8250.2 and DoD 5200.40.

Source Document(s):
DODI 8552.01
DODI 8552.02
DOD 5200.40

Refines Higher-Level Requirement:
8.2 PKI X.509 Certificates

Verification Method: Demo
The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed.

3.6.2.2 PKI X.509 Revocation Checking via CRL

Requirement Statement:
The Knowledge Exchange module shall support revocation checking of X.509 certificates via local CRL.

Source Document(s):
DODI 8552.01

Refines Higher-Level Requirement:
8.2 PKI X.509 Certificates

Verification Method: Demo
The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed.

3.6.2.3 11.2.3 PKI X.509 Revocation Checking via CRL stored via LDAP directory

Requirement Statement:

The Knowledge Exchange module shall support revocation checking of X.509 certificates via CRL stored in an LDAP accessible directory.

Source Document(s):
DODI 8552.01

Refines Higher-Level Requirement:
8.2 PKI X.509 Certificates

Verification Method: Demo
The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed.

3.6.2.4 PKI X.509 Revocation Checking via OCSP Protocol

Requirement Statement:
The Knowledge Exchange module shall support revocation checking of X.509 certificates via OCSP protocol.

Source Document(s):
DODI 8552.01

Refines Higher-Level Requirement:
8.2 PKI X.509 Certificates

Verification Method: Demo
The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed.

3.7 Reliability

Requirement Statement:
The PROGNOS system shall have a reliability of 99%.

Refined By Lower-Level Requirements:
9.1 MTBF
9.2 MTTR

Verification Method: Demo
The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout exhaustive testing of single point failure and endurance testing to make sure PROGNOS system does not crash.

3.7.1 MTBF

Requirement Statement:
The PROGNOS system Mean Time Before Failure shall be not less than 10k hours.

Refines Higher-Level Requirement:
9 Reliability

Verification Method: Demo

The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout testing of measured time between failures.

3.7.2 MTTR

Requirement Statement:

The PROGNOS system Mean Time To Repair shall be not longer than 0.25 hours.

Refines Higher-Level Requirement:

12 Reliability

Verification Method: Demo

The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout testing of measured time when a failure occur and when it is back up and operational.

4 APPENDIX A – REQUIREMENTS TRACEABILITY MATRIX

#	Name	Description	Origin	Type	Verification Method	documented by
1	External Interface	The PROGNOS system shall be able to exchange knowledge with external systems.	Originating	Composite	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 and ISR Systems	The PROGNOS system shall be able to exchange knowledge with Future Navy FORCEnet C2 and ISR Systems.	Originating	Functional	Demo. 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
1.1.1	Received Future Navy FORCEnet C2 and ISR Systems	The Knowledge Exchange Module shall be able to receive data from Future Navy FORECnet C2 and ISR systems in their designed format.	Derived	Functional	Demo. The scenario walkthrough and simulation demo will provide verification for received data from future Navy FORCEnet C2 and ISR systems.	
1.1.2	Send Data to Future Navy FORCEnet C2 and ISR Systems	The Knowledge Exchange Module shall be able to send data to Future Navy FORECnet C2 and ISR systems in PROGNOS PROWL format.	Derived	Functional	Demo. The scenario walkthrough and simulation demo will provide verification for send data to future Navy FORCEnet C2 and ISR systems.	
1.1.3	Interoperate with Future Navy FORCEnet C2 and ISR systems	The Knowledge Exchang Module shall be able to interoperate with Future Navy FORCEnet C2 and ISR Systems. The message sent is received and interpreted as intended by sender.	Derived	Functional	Demo. The scenario walkthrough and simulation demo will provide verification for KEM to understand data from future Navy C2 and ISR systems.	
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	

#	Name	Description	Origin	Type	Verification Method	documented by
					XML that will be translated back into PROGNOS OWL Language.	
1.2.1	Received Data from DCGS-N	The Knowledge Exchange Module shall be able to receive data from the DCGS-N system in its designed format.	Derived	Functional	Simulation Demo. The Demo will show that PROGNOS received transmitted XML DCGS-N data and had translated into PR-OWL.	
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.	
1.3	Exchange Data with NECC	The PROGNOS system shall be able to exchange knowledge with the Net Enabled Command Capability (NECC) system.	Derived	Functional	Demo. The scenario walkthrough and simulation demo will provide verification for KEM interface with NECC systems.	
1.3.1	Received Data from NECC	The Knowledge Exchange Module shall be able to receive data from the NECC system in their designed format.	Derived	Functional	Demo. The scenario walkthrough and simulation demo will provide verification for received data from future NECC systems.	
1.3.2	Send Data to NECC	The Knowledge Exchange Module shall be able to send data to the NECC system in PROGNOS PROWL format.	Derived	Functional	Demo. The scenario walkthrough and simulation demo will provide verification for sent data from NECC systems.	

#	Name	Description	Origin	Type	Verification Method	documented by
1.3.3	Interoperate with NECC	The Knowledge Exchang Module shall be able to interoperate with NECC systems. The message sent is received and interpreted as intended by sender.	Derived	Functional	Demo. The simulation demo will provide verification that KEM understands data from NECC systems.	
2	Protocols Compliance	The PROGNOS system shall be able to take in system data that uses different protocols.	Originating	Composite	Test. The verification for this will occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with different external systems protocols.	"PROGNOS: Applying Probabilistic Ontologies to Distributed Predictive Situation Assessment in Naval Operations" presentation
2.1	HTTPS Protocol	The Knowledge Exchange module shall support the Hypertext Transfer Protocol Secure (HTTPS) IAW IETF RFC 2818 and RFC 5246.	Originating	Constraint	Test. The verification for this will occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use HTTPS protocol.	"PROBABILISTIC ONTOLOGIES: THE NEXT STEP FOR NET-CENTRIC OPERATIONS" paper The SSL Protocol Version 3.0
2.2	SOAP Protocol	The Knowledge Exchange Module shall support Simple Object Access Protocol (SOAP) IAW W3C's SOAP version 1.2 dated 27 April 2007.	Originating	Constraint	Test. The verification for this will occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use SOAP protocol.	"PROBABILISTIC ONTOLOGIES: THE NEXT STEP FOR NET-CENTRIC OPERATIONS" paper Soap Version 1.2

#	Name	Description	Origin	Type	Verification Method	documented by
2.2.1	Web Services Transfer	The Knowledge Exchange module shall support Web Services Transfer (WS-Transfer) IAW the W3C's W3C Member Submission dated 27 September 2006.	Derived	Constraint	Test. The verification for this will occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use Web Services Transfer in accordance with World Wide Web Consortium (W3C).	DISA "Net-Enabled Command Capability (NECC)
2.2.2	Web Services Enumeration	The Knowledge Exchange module shall support Web Services Enumeration (WS-Enumeration) IAW the W3C's W3C Member Submission dated 15 March 2006.	Derived	Constraint	Test. The verification for this will occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use Web Services Enumeration in accordance with World Wide Web Consortium (W3C).	DISA "Net-Enabled Command Capability (NECC)
2.3	Web Map Services (WMS)	The Knowledge Exchange module shall support Web Map Service (WMS) IAW the OpenGIS Web Map Service (WMS) Implementation Specification version 1.1.1.	Derived	Constraint	Test. The verification for this will occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use Web Map Services in	DISA "Net-Enabled Command Capability (NECC)

#	Name	Description	Origin	Type	Verification Method	documented by
					accordance with OpenGIS Web Map Service (WMS) Implementation Specification version 1.1.1.	
2.4	Styled Layer Descriptor	The Knowledge Exchange module shall support Styled Layer Descriptor (SLD) IAW the OpenGIS Styled Layer Descriptor Profile of the Web Map Service Implementation Specification version 1.0.	Derived	Constraint	Test. The verification for this will occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use styled layer descriptor in accordance with the OpenGIS Styled Layer Descriptor Profile of the Web Map Service Implementation Specification version 1.0.	DISA "Net-Enabled Command Capability (NECC)
3	Message Standards	The PROGNOS system shall be able to take in system data that uses different messages standards.	Originating	Composite	Test. The scenario walk through will point out some of the required messages standards for PROGNOS KEM, and the simulation will demonstrate the feasibility of the data exchange. To incorporate the other standards, other scenarios may be implemented to include different standards. A walkthrough and simulation can also accomplished these other standards.	"PROGNOS: Applying Probabilistic Ontologies to Distributed Predictive Situation Assessment in Naval Operations" presentation
3.1	XML	The Knowledge Exchange module shall enable data input with the Extensible Markup Language (XML) IAW W3C's XML 1.0 Specification.	Originating	Constraint	Simulation Demo. The DCGS-N simulated date will be XML based IAW W3C XML 1.0 Specification.	"PROBABILISTIC ONTOLOGIES: THE NEXT STEP FOR NET-CENTRIC OPERATIONS" paper

#	Name	Description	Origin	Type	Verification Method	documented by
3.1.1	Web Services Addressing	The Knowledge Exchange module shall support Web Services Addressing (WS-Addressing) IAW the W3C's W3C Member Submission dated 10 August 2004.	Derived	Constraint	Demo, Test. The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use Web Services Addressing in accordance with the W3C's W3C Member Submission dated 10 August 2004. However, it can also be verified by using a scenario walkthrough with systems that use Web Services Addressing as a message standard in accordance with World Wide Web Consortium (W3C).	DISA "Net-Enabled Command Capability (NECC)
3.1.2	Xpath	The Knowledge Exchange module shall support XML Path Language (XPath) IAW the W3C's W3C XML Path Language (XPath) Version 1.0 dated 15 March 2006.	Derived	Constraint	Demo, Test. The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use Xpath in accordance with the W3C's W3C XML Path Language (XPath) Version 1.0 dated 15 March 2006. However, it can also be verified by using a scenario walkthrough with systems that use Xpath as a message	DISA "Net-Enabled Command Capability (NECC)

#	Name	Description	Origin	Type	Verification Method	documented by
					standard.	
3.2	JC3IEDM	The Knowledge Exchange module shall enable data input with the Joint C3 Information Exchange Data Module (JC3IEDM) IAW NATO STANAG 5525.	Derived	Constraint	Demo, Test. The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use JC3IEDM message standard in accordance with the NATO STANAG 5525. However, it can also be verified by using a scenario walkthrough with systems that use JC3IEDM as a message standard.	"PROGNOS: Applying Probabilistic Ontologies to Distributed Predictive Situation Assessment in Naval Operations" presentation
3.3	OWL	The Knowledge Exchange module shall enable data input with the Web Ontology Language (OWL) IAW the W3C's OWL 2 Web Ontology Language Document Overview dated 27 October 2009.	Originating	Constraint	Demo, Test. The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use OWL data message standard in accordance with W3C's OWL 2 Web Ontology Language Document Overview dated 27 October 2009. However, it can also be verified by using a scenario walkthrough with systems that use OWL as a message standard.	Probabilistic Ontologies for Net-Centric Operations Systems briefing to ONR

#	Name	Description	Origin	Type	Verification Method	documented by
3.4	C2PC VDX	The PROGNOS system shall be able to take in system data messages that are in Command and Control Personal Computer (C2PC) VDX format.	Derived	Constraint	Demo, Test. The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use C2PC VDX data message. However, it can also be verified by using a scenario walkthrough with systems that use C2PC VDX as a message standard.	Scenario/Operation Concept
3.5	USMTF	The PROGNOS system shall be able to take in system data messages that are in United States Message Text Form (USMTF) format.	Derived	Constraint	Demo, Test. The scenario walkthrough demonstrate verification of the need for USMTF data message format for PROGNOS interface.	Scenario/Operation Concept
3.6	VMF	The PROGNOS system shall be able to take in system data messages that are in Variable Message Format (VMF) format.	Derived	Constraint	Demo, Test. The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use VMF data message. However, it can also be verified by using a scenario walkthrough and simulation with systems that use VMF as a message standard to show feasibility of data exchange with PROGNOS	Scenario/Operation Concept

#	Name	Description	Origin	Type	Verification Method	documented by
					KEM.	
3.7	TADL-J	The PROGNOS system shall be able to take in system data messages that are in Tactical Data Link J Series (TADL-J) format.	Derived	Constraint	Demo, Test. The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use C2PC VDX data message. However, it can also be verified by using a scenario walkthrough and simulation with systems that use OWL as a message standard to show feasibility of data exchange with PROGNOS KEM.	Scenario/Operation Concept
3.8	WSDL	The Knowledge Exchange module shall enable data input with the Web Services Description Language (WSDL) IAW W3C's WSDL 1.1 Specification.	Originating	Constraint	Demo, Test. The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use WSDL data message in accordance with W3C's WSDL 1.1 Specification. However, it can also be verified by using a scenario walkthrough and simulation with systems that use WSDL as a message standard to show feasibility of data exchange with PROGNOS	"PROBABILISTIC ONTOLOGIES: THE NEXT STEP FOR NET-CENTRIC OPERATIONS" paper

#	Name	Description	Origin	Type	Verification Method	documented by
					KEM.	
3.9	XHTML	The Knowledge Exchange module shall enable data input with the XHTML IAW the W3C's XHTML1.1 - Module-based XHTML dated 31 May 2001.	Derived	Constraint	Demo, Test. The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use XHTML data message in accordance with the W3C's XHTML1.1 - Module-based XHTML dated 31 May 2001. However, it can also be verified by using a scenario walkthrough and simulation with systems that use XHTML as a message standard to show feasibility of data exchange with PROGNOS KEM.	DISA "Net-Enabled Command Capability (NECC)
3.10	HTML	The Knowledge Exchange module shall enable data input with the Hypertext Markup Language (HTML) IAW the W3C's HTML 4.01 Specification dated 24 December 1999.	Derived	Constraint	Demo, Test. The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use HTML data message in accordance with the W3C's HTML 4.01 Specification dated 24 December 1999. However, it can also be verified by using a scenario walkthrough and simulation	DISA "Net-Enabled Command Capability (NECC)

#	Name	Description	Origin	Type	Verification Method	documented by
					with systems that use HTML as a message standard to show feasibility of data exchange with PROGNOS KEM.	
3.11	Web Services Notification	The Knowledge Exchange module shall support Web Services Notification (WS-Notification) IAW the OASIS WSBase-Notification version 1.3.	Derived	Constraint	Demo, Test. The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use Web Services Notification data message in accordance with the OASIS WSBase-Notification version 1.3. However, it can also be verified by using a scenario walkthrough and simulation with systems that use Web Services Notification to exchange data message to show feasibility of data exchange with PROGNOS KEM.	DISA "Net-Enabled Command Capability (NECC)
3.12	GML	The Knowledge Exchange module shall support Geography Markup Language (GML) IAW the OpenGIS Geography Markup Language Encoding Specification version 3.1.1 dated 7 February 2004.	Derived	Constraint	Demo, Test. The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use GML data message in accordance with the	DISA "Net-Enabled Command Capability (NECC)

#	Name	Description	Origin	Type	Verification Method	documented by
					OpenGIS Geography Markup Language Encoding Specification version 3.1.1 dated 7 February 2004. However, it can also be verified by using a scenario walkthrough and simulation with systems that use GML data message standard to show feasibility of data exchange with PROGNOS KEM.	
3.13	Web Feature Service (WFS)	The Knowledge Exchange module shall support Web Feature Service (WFS) IAW the OpenGIS Web Map Service (WMS) Implementation Specification version 1.1.	Derived	Constraint	Demo, Test. The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use WFS data message in accordance with the OpenGIS Web Map Service (WMS) Implementation Specification version 1.1. However, it can also be verified by using a scenario walkthrough and simulation with systems that use WFS data message standard to show feasibility of data exchange with PROGNOS KEM.	DISA "Net-Enabled Command Capability (NECC)
3.14	RDF Site Summary (RSS)	The Knowledge Exchange module shall support RDF Site Summary (RSS) version 1.0.	Derived	Constraint	Demo, Test. The verification for this can occur at the implementation stage that is not in our scope and not covered by our Vee model. This requires at least	DISA "Net-Enabled Command Capability (NECC)

#	Name	Description	Origin	Type	Verification Method	documented by
					prototype of PROGNOS KEM is developed. A test plan is needed that will layout the testing of KEM with external systems that use RSS. However, it can also be verified by using a scenario walkthrough and simulation with systems that use RSS data message standard to show feasibility of data exchange with PROGNOS KEM.	
4	Message Conversion Speed	The PROGNOS system shall be able to convert messages from external system format to the PROGNOS format within 2 seconds (Threshold) / less than 1 second (Objective).	Derived	Performance	Test, Analysis. This verification can be done via analysis once you gathered all the performance characteristics from the KEM to the external systems. You can also conduct a real time test to measure the message conversion speed from one type to the other.	
7	Operating System Compatibility	The Knowledge Exchange Module shall be able to support various operating systems.	Originating	Constraint	Demo. The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout operations compatibility using a designated Operating System.	
7.1	Microsoft Operating System	The Knowledge Exchange module shall be able to run on a Windows 7 operating system.	Derived	Constraint	Demo. The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by	

#	Name	Description	Origin	Type	Verification Method	documented by
					our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout operations compatibility using a Microsoft Operating System.	
7.2	Linux Operating System	The Knowledge Exchange module shall run on a Linux 2.6 operating system.	Derived	Constraint	Demo. The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout operations compatibility using a Linux Operating System.	
8	System Security	The Knowledge Exchange module shall support PKI certificate authentications for both the client and server.	Derived	Composite	Demo. The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout data exchanges using PKI certificate authentications.	DODI 8552.01
8.1	Accept and Provide PKCS#7,12 Key Format	The Knowledge Exchange module shall be able to accept and provide PKCS#7,12 public key format.	Derived	Functional	Demo. The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is	DODI 8552.01

#	Name	Description	Origin	Type	Verification Method	documented by
					developed.	
8.2	PKI X.509 Certificates	The Knowledge Exchange module shall be able to use X.509 PKI certificates.	Derived	Constraint	Demo. The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout data exchanges using PKI X.509 certificate.	DODI 8552.01
8.2.1	PKI X.509 Accept and Provide Certificates	The Knowledge Exchange module shall be able to accept and provide X509v3 certificates to perform DoD PKI in accordance to DoD8250.2 and DoD 5200.40	Derived	Functional	Demo. The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed.	DOD 5200.40 DODI 8552.01 DODI 8552.02
8.2.2	PKI X.509 Revocation Checking via CRL	The Knowledge Exchange module shall support revocation checking of X.509 certificates via local CRL.	Derived	Constraint	Demo. The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed.	DODI 8552.01
8.2.3	PKI X.509 Revocation Checking via CRL stored via LDAP directory	The Knowledge Exchange module shall support revocation checking of X.509 certificates via CRL stored in an LDAP accessible directory.	Derived	Constraint	Demo. The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed.	DODI 8552.01

#	Name	Description	Origin	Type	Verification Method	documented by
8.2.4	PKI X.509 Revocation Checking via OCSP Protocol	The Knowledge Exchange module shall support revocation checking of X.509 certificates via OCSP protocol.	Derived	Constraint	Demo. The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed.	DODI 8552.01
9	Reliability	The PROGNOS system shall have a high reliability value of Mean Time Before Failure and fast Mean Time To Repair.	Originating	Composite	Test, Analysis. The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout exhaustive testing of single point failure and endurance testing to make sure PROGNOS system does not crash.	
9.1	MTBF	The PROGNOS system Mean Time Before Failure shall be not less than 10k hours.	Derived	Performance	Test, Analysis. The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout testing of measured time between failures.	
9.2	MTTR	The PROGNOS system Mean Time To Repair shall be not longer than 0.25 hours.	Derived	Performance	Test, Analysis. The verification for this can occur at the implementation and integration stage that is not in our scope and not covered by	

#	Name	Description	Origin	Type	Verification Method	documented by
					our Vee model. This requires at least prototype of PROGNOS KEM is developed. A test plan is needed that will layout testing of measured time when a failure occurs and when it is back up and operational.	