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1. Introduction

1.1 Purpose

This document establishes the functional, performance, physical, and interface requirements for the Hydra-C4 Comms Module. The Hydra-C4 is a ruggedized, high-throughput communications module designed for secure data transmission in demanding naval environments. This specification serves as the primary technical baseline for the system's design, development, test, and acceptance.

1.2 Scope

This specification applies to the Hydra-C4 Comms Module, herein referred to as "the system." It covers the system's performance characteristics, physical attributes, environmental tolerances, and external interfaces. All development activities for the system shall be conducted in accordance with the engineering lifecycle defined in **SS-ENG-PLAN-001: Engineering Management Plan**.

1.3 System Overview

The Hydra-C4 is a line-replaceable unit (LRU) designed for integration into shipboard combat systems. It provides robust, multi-waveform communication capabilities, enabling secure voice and data networking between naval assets. The system is designed for high reliability and maintainability in a maritime operational context. It functions as the core processing and transmission component for secure tactical communications, interfacing with shipboard power, cooling, and antenna systems.

2. Applicable Documents

The following documents form a part of this specification to the extent specified herein. In the event of a conflict between the documents referenced here and the content of this specification, the content of this specification shall take precedence.

- **SS-ENG-PLAN-001:** Engineering Management Plan
- **SS-SEC-POL-001:** Defence Security Policy
- **SS-TEST-PLAN-001:** Test & Evaluation Master Plan (TEMP)
- **SS-HYD-GUIDE-001:** Shipboard Integration Guide

3. Requirements

3.1 Functional Requirements

3.1.1 Data Throughput

The system shall provide a configurable data throughput rate, supporting continuous operations at a minimum of 100 Mbps. The system shall be capable of burst throughput rates up to 250 Mbps for periods not to exceed 60 seconds.

3.1.2 Waveform Support

The system shall support, at a minimum, the following waveforms:

- Wideband HF
- VHF/UHF Line-of-Sight (LOS)
- SATCOM (Ku-Band)

3.1.3 Data Encryption

All data transmitted and received by the system shall be encrypted. The system shall implement, at a minimum, the Advanced Encryption Standard with a 256-bit key length (AES-256). The encryption module shall be designed for future upgrades to support emerging cryptographic standards as mandated by the **SS-SEC-POL-001**.

3.1.4 Tactical Data Link (TDL) Processing

The system shall be capable of processing and routing Tactical Data Link (TDL) messages. It shall support, at a minimum:

- **Link 16 (J-Series) Messages:** The system shall parse and validate J-series messages for routing to specified command and control nodes.
- **Variable Message Format (VMF):** The system shall support the transmission and reception of VMF messages.

3.1.5 Network Routing and Management

The system shall provide dynamic network routing capabilities.

- **Routing Protocols:** The system shall support standard routing protocols, including Open Shortest Path First (OSPF) and Border Gateway Protocol (BGP).
- **Quality of Service (QoS):** The system shall implement Differentiated Services (DiffServ) for QoS, allowing for the prioritization of traffic based on message precedence (e.g., voice, TDLs, data).
- **Network Monitoring:** The system shall support Simple Network Management Protocol (SNMP) v3 for monitoring network status and performance.

3.1.6 Secure Voice Communications

The system shall provide secure Voice over IP (VoIP) functionality.

- **VoIP Protocols:** The system shall support Session Initiation Protocol (SIP) for call setup and teardown.
- **Voice Encryption:** All VoIP traffic shall be secured using the Secure Real-time Transport Protocol (SRTP).

3.1.7 System Management

The system shall provide a secure management interface for configuration, status monitoring, and fault diagnosis. The management interface shall be accessible via Ethernet and require two-factor authentication for all administrative access.

3.1.8 Data and Event Logging

The system shall log all critical system events, including security events, system faults, and network status changes. Logs shall be timestamped in accordance with the system time source. All security-relevant events, as defined in **SS-SEC-POL-001**, shall be logged to a secure, non-volatile memory partition.

3.1.9 Time Synchronisation

The system shall be capable of synchronizing its internal time reference to an external source via the Network Time Protocol (NTP) v4 or Precision Time Protocol (PTP).

3.1.10 Built-In Test (BIT)

The system shall incorporate a comprehensive Built-In Test (BIT) capability.

- **Power-on BIT (PBIT):** Shall execute automatically upon system power-up and verify the health of all critical internal components. PBIT shall complete within 90 seconds.
- **Continuous BIT (CBIT):** Shall run continuously during operation to monitor system health without disrupting traffic.
- **Initiated BIT (IBIT):** Shall provide a non-disruptive, operator-initiated test suite to perform a full system health check.

3.2 Performance Requirements

3.2.1 Reliability

The system shall have a demonstrated Mean Time Between Failure (MTBF) of no less than 15,000 operating hours.

3.2.2 Maintainability

The system shall have a Mean Time To Repair (MTTR) of no more than 30 minutes.

This shall be achieved by a single technician of average skill, using standard tools, at the LRU level.

3.2.3 System Boot Time

The system shall be fully operational and ready to transmit within 120 seconds from the application of primary power.

3.3 Physical Requirements

3.3.1 Dimensions

The system shall be housed in a standard 19-inch rack-mountable chassis. The dimensions of the chassis shall not exceed:

- **Height:** 8.75 inches (5U)
- **Width:** 17.75 inches
- **Depth:** 22.0 inches (from front mounting flange to rearmost connector)

3.3.2 Weight

The total weight of the system shall not exceed 25 kilograms.

3.3.3 Power

- **Power Consumption:** The system shall consume no more than 450 Watts under maximum operational load. In standby mode, power consumption shall not exceed 50 Watts.
- **Input Voltage:** The system shall operate from a standard shipboard power source of 115 VAC, 60 Hz.

3.3.4 Cooling

The system shall be forced-air cooled. All thermal exhaust shall be directed from the front to the rear of the chassis. The system's thermal design must ensure all components remain within their specified operating temperature limits under all conditions defined in Section 3.4.

3.4 Environmental Requirements

The system shall be capable of meeting all performance requirements specified herein under the following environmental conditions.

3.4.1 Operating Temperature

The system shall operate within a temperature range of -10°C to +55°C.

3.4.2 Storage Temperature

The system shall be capable of being stored within a temperature range of -40°C to +71°C without degradation.

3.4.3 Shock and Vibration

The system shall withstand the shock and vibration profiles typical of a naval surface combatant environment, as specified in MIL-STD-810G, Method 516.6 (Shock) and Method 514.6 (Vibration).

3.4.4 Humidity

The system shall operate in a high-humidity environment, with relative humidity up to 95% (non-condensing).

3.5 Interface Requirements

3.5.1 RF Interfaces

The system shall provide N-type female connectors for all RF inputs and outputs.

3.5.2 Data Interfaces

The system shall provide the following data interfaces:

- 4x 1000BASE-T Gigabit Ethernet ports (RJ45 connectors) for network connectivity.
- 1x 10/100BASE-T Ethernet port (RJ45 connector) for the management interface.

3.5.3 Power Interface

The system shall utilize a standard MIL-DTL-38999 series connector for the primary power input.

4. Verification

All requirements specified in this document shall be formally verified. The verification methods shall be defined in the product-specific test documentation, which shall be developed in accordance with the **SS-TEST-PLAN-001: Test & Evaluation Master Plan (TEMP)**. A cross-reference matrix mapping each requirement in this document to a verification case in the test plan shall be created and maintained.

5. Document Control

This document is a controlled document and is subject to the configuration management processes defined in **SS-CM-PLAN-001: Configuration Management**

Plan. Any changes to this specification must be approved by the Configuration Control Board (CCB).