Maritime SIGINT Architecture Technical Standards Handbook

Version 1.0

March 1999

Maritime Information Dominance For America

NATIONAL SECURITY AGENCY
CENTRAL SECURITY SERVICE
FORT GEORGE G. MEADE, MARYLAND 20755

23 August 1999

MEMORANDUM FOR DISTRIBUTION

SUBJECT: Maritime SIGINT Architecture (MSA) Technical Standards Handbook, Version 1.0 - INFORMATION MEMORANDUM

We are pleased to issue the inaugural version of the MSA Technical Standards Handbook (MSH). This document represents a significant collaborative effort on the part of the maritime SIGINT community. Its tenets are critical to achieving Department of Defense objectives of interoperability, connectivity to National systems and modernization for tactical SIGINT systems.

Chaired by the Naval Security Group Command, a working group of representatives from key maritime organizations selects the technical standards and protocols necessary to develop and improve interoperability between maritime SIGINT systems. The working group also ensures MSH standards are coordinated among the key maritime stakeholders, and are fully consistent with the Joint Technical Architecture, the Joint Airborne SIGINT Architecture Standards Handbook, the Unified Cryptologic Architecture Technical Architecture, and the Department of the Navy's Information Technology Standards Guidance. The working group includes representatives from U.S. Navy, U.S. Marine Corps, U.S. Special Operations Command, U.S. Coast Guard and NSA's Tactical SIGINT Program Office.

In its next iteration, the MSH will constitute the Technical View of the recently established Maritime Cryptologic Architecture (MCA). Additionally, the group developing Version 2.0 will be chartered as the MCA Technical View Working Group and its representation will include 2nd Party Allies. The MHS is a living document and will be updated periodically as technologies emerge and mature. Comments may be forwarded to the MCA Technical View Working Group through any of the points of contact listed at the end of Chapter 1.

Encl:
MSA Technical Standards Handbook - Version 1.0

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Executive Summary

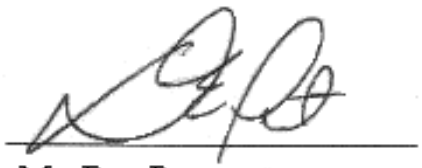
The Maritime SIGINT Architecture Technical Standards Handbook (MSH) provides essential information for acquisition managers, engineers and other individuals responsible for acquiring, developing or modernizing tactical Maritime SIGINT Systems (MSS). Collaboratively developed by elements of the U.S. Navy, U.S. Marine Corps, U.S. Special Operations Command, and the National Security Agency, it is the first effort by the maritime partners to establish cohesive standards for their tactical SIGINT systems.

Consistent with the Joint Technical Architecture and the Unified Cryptologic Architecture (UCA), the MSH bridges the standards gap between the tactical maritime Services and the national SIGINT community. It provides a technical foundation for the interoperability and seamless flow of information between tactical and national SIGINT systems, as well as among tactical SIGINT systems and their host Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) systems. It constitutes both the *cryptologic* subset of the Naval C4ISR Technical Architecture and the *maritime* component of the UCA Technical Architecture. Moreover, it is the technical complement of the Maritime Cryptologic Architecture's (MCA) Operational View and, in its next iteration, will become the MCA's Technical View.

The MSH contains common standards and specifications which will reduce development costs, facilitate the leveraging of SIGINT functionality across maritime programs, and increase interoperability between them. More specifically, it:

- Identifies and mandates minimum standards and technical guidelines for MSS
- Determines essential data formats and protocols
- Selects and defines standards to migrate MSS to an open systems environment
- Incorporates new and emerging standards to keep pace with technology

Use of the MSH by acquisition managers and system developers will greatly facilitate attainment of Department of Defense objectives for *interoperability*, *connectivity* and *modernization* among tactical SIGINT systems.



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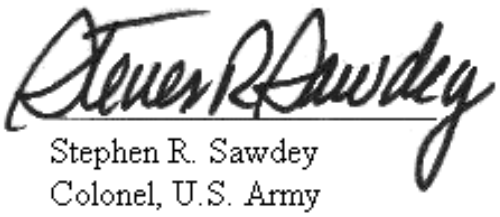

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1 INTRODUCTION

The Maritime SIGINT Architecture Technical Standards Handbook (MSH) is the first attempt by U.S. maritime cryptologic partners to establish a cohesive set of standards for their tactical SIGINT systems.[1] It formalizes and expands the maritime cryptologic community's efforts to achieve interoperability between and among tactical and national SIGINT systems, and constitutes the initial step toward community compliance with the Department of Defense's (DoD) *C4ISR Architecture Framework*. Collaboratively developed by elements of the U.S. Navy, U.S. Marine Corps, U.S. Special Operations Command (USSOCOM), and the National Security Agency (NSA)[2], the MSH bridges the cryptologic standards gap between the tactical maritime services and the national SIGINT community. It complies with DoD's *Joint Technical Architecture* (JTA) and Navy's *C4ISR Technical Architecture*, serving both the cryptologic subset of naval C4ISR technical architectures and the maritime component of the Unified Cryptologic Architecture's (UCA) Technical Architecture. The MSH is the technical complement of the *Maritime Cryptologic Architecture Operational View* (MCA OV) and, in its next iteration, will become the Technical View (TV) of the MCA. As the MCA's TV, it will be regularly revised and published with continued Service, agency and industry participation. Additionally, future versions will incorporate technical standards applicable to maritime Information Operations (IO).

1.1 Purpose

The purpose of the MSH is to provide a technical foundation for the interoperability and seamless flow of information between tactical and national SIGINT systems, as well as among the various tactical maritime SIGINT systems (MSS)[3] and their host Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) systems. Navy, Marine Corps and USSOCOM SIGINT systems are developed for a variety of tactical platforms (e.g., surface, subsurface, aircraft, team-portable, man-portable, etc). As a consequence, MSS are configured with different antenna forms, physical dimensions, numbers of workstations, information management processes, and associated communications suites. Nevertheless, their cryptologic ***mission*** functions (i.e., searching the radio frequency spectrum, detecting, processing, analyzing, and geolocating signals of interest (SOI), correlating similar and dissimilar information, and applying the derived information to the tactical situation) are essentially the same. Therefore,

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[1] For the purposes of the MSH, the terms "SIGINT" and "cryptology" are essentially the same. "SIGINT" is intelligence information comprising Communications Intelligence (COMINT), Electronics Intelligence (ELINT) and Foreign Instrumentation Signals Intelligence (FISINT). The term "cryptology" refers to the SIGINT functions of the maritime Services and incorporates Information Security or INFOSEC functions.

[2] The MSH was developed by the 1997 Maritime SIGINT Architecture (MSA) Study Group which included representatives from the Chief of Naval Operations (OPNAV), NSA's Tactical SIGINT Programs Office (TSPO), Commandant of the Marine Corps (CMC), Space and Naval Warfare Systems Command (SPAWARSYSCOM), Naval Sea Systems Command (NAVSEASYSCOM), Naval Air Systems Command (NAVAIRSYSCOM), Marine Corps Systems Command (MARCORSYSCOM), USSOCOM and Naval Security Group Command (NAVSECGRUCOM).

[3] An MSS is defined as SIGINT collection and processing elements, operator elements, intra-system protocols, and associated internal and external interfaces. It also includes mechanical, electrical, and software interfaces that support the SIGINT system.

achieving functional commonality and interoperability among these systems, despite disparities in their physical configurations, is the primary objective of the MSH.

To facilitate interoperability across tactical SIGINT systems, the MSH shares common objectives with other SIGINT technical standards handbooks (e.g., the Joint Airborne SIGINT Architecture (JASA) and the Ground SIGINT Standards Handbook (GSH)) and DoD C4ISR architectures. Specifically, it promotes the:

- Identification and mandating of minimum standards and technical guidelines for the development and acquisition of MSS
- Determination of essential data formats and protocols to permit interoperability among components both internal and external to a given tactical platform
- Selection and definition of standards required for the migration of MSS to an interoperable open systems environment (OSE)
- Incorporation of new and emerging standards to keep pace with global information and communications technologies
- Enabling of multi-platform SIGINT operations, such as precision geolocation, through the use of similar or dissimilar platforms and sensors

In support of these objectives, MSH standards were chosen based on the following criteria:

- Interoperability/Interchangeability: Standards should support implementation of an open architecture, promote interoperability among MSH-compliant systems and, at the product interchange level, facilitate interoperability with non-MSH systems
- Maturity: Standards should be technically mature and relatively stable
- Implementability: Standards should be technically implementable and have reasonable market support for hardware, software, and development tools
- Public availability: Standards should not be sole source proprietary standards
- Consistent with authoritative sources: Standards must be consistent with public law, regulation, policy, and authoritative guidance documents

The MSH uniquely supports the maritime cryptologic community by:

- Documenting, under a single cover, the complete listing of applicable specifications and standards as selected by MSS developers from the alternatives allowed by overarching standards documents (i.e., JTA). It adds to those standards by including mutually agreed

upon specifications or standards when specific areas of concern are not addressed by overarching standards documents.

- Representing MSS standardization decisions to other standards and architecture development forums

1.2 Scope, Applicability and Compliance

Version 1.0 of the MSH relies heavily on the lessons learned and work accomplished by JASA. It is based primarily on JASA Standards Handbook (JSH), the DoD *C4ISR Architecture Framework*, the JTA, the UCA TA, and the *Defense Information Infrastructure (DII) Common Operating Environment (COE)*. Ultimately intended as an extension of the JTA, the MSH tailors JTA information processing standards to meet the needs of MSS developers. It likewise draws from the UCA as well as the Navy *C4ISR TA*. For example, the MSH expands upon the JTA to address additional real-time information processing standards and guidance. The MSH also extends beyond information technology to include areas and services the JTA does not address. These include maritime SIGINT unique standards for front end processing (initial data capture) and physical services (size, weight, power, and environmental conditions).

1.2.1 Scope

Version 1.0 of the MSH focuses on existing and emerging MSS. It includes standards for hardware, software, networks, storage devices, recording media, backplanes, chassis, circuit cards, and electrical and mechanical interfaces used by tactical maritime systems. It also includes data formats for preprocessed and processed data.

The MSH consists of eight chapters and four appendices as follows:

- Chapter One, “Overview”
- Chapter Two, “MSA Reference Model,” introduces major areas and services in the Maritime SIGINT Architecture (MSA) Reference Model (MRM)
- Chapter Three, “Front End Processing,” mandates standards for precision time and navigation data, signal collection, digitization, distribution, and special preprocessing
- Chapter Four, “Information Processing,” mandates standards for information processing
- Chapter Five, “Human Computer Interface,” mandates style guides to provide a common “look and feel” for MSS operators
- Chapter Six, “Information Transfer Services,” mandates information transfer standards and profiles essential for interoperability and connectivity

- Chapter Seven, “Security Services,” mandates standards to minimize risk associated with sharing and disseminating information

- Chapter Eight, “Physical Services,” mandates standards for integrating SIGINT sensors in a maritime environment

Appendices include:

- Appendix A -- Acronym List
- Appendix B -- Glossary
- Appendix C -- Standards
- Appendix D -- MSA Functional Reference Model Description

1.2.2 Applicability

MSH standards pertain to the tactical SIGINT systems developed by the U.S. Navy, U.S. Marine Corps and USSOCOM. Specifically, the standards shall be used for major modifications to existing MSS and for the development of future MSS. Where an emerging standard not yet covered by the MSH is appropriate, the developing SYSCOM shall submit the standard to the MSA Integrated Process Team (IPT) for review. In instances where an MSS standard is governed by multiple tactical SIGINT domain standards handbooks,[4] the most restrictive standard shall apply. Moreover, the use of MSH standards not identified in other tactical SIGINT domain standards handbooks are additive and not intended to conflict with the body of tactical SIGINT standards. Conflicts between tactical SIGINT domain (air, ground, maritime) handbooks shall be resolved by TSPO's Tactical Standards Working Group (TSWG).

1.2.3 Key Considerations and Intended Users

This handbook provides guidance and information to acquisition managers, engineers and other commands and individuals responsible for managing and developing MSS. The standards and specifications listed herein provide a common set of requirements which, if used properly, will reduce development costs, facilitate the leveraging of functionality across maritime cryptologic programs, and increase interoperability/connectivity between them. The MSH should be used as a governing authority by program offices and procurement managers when selecting standards as

[4] Tactical SIGINT domains include the air, ground and maritime components of the UCA. To facilitate the standardization of tactical SIGINT systems within and across the domains, separate standards handbooks have been cooperatively developed. The JASA Standards Handbook (JSH) was developed initially by NSA and the former Defense Airborne Reconnaissance Office (DARO) and is now in version 3.0. The JSH includes standards applicable to U.S. Air Force, U.S. Navy, U.S. Army, U.S. Marine Corps, and U.S. Special Operations Forces (SOF) airborne SIGINT operations. The MSH encompasses primarily Navy, Marine Corps and SOF applications and serves as the maritime complement to the JSH. The Ground SIGINT Standards Handbook (GSH) incorporates Army, Marine Corps and SOF SIGINT applications. To promote interoperability and consistency across the tactical SIGINT domains, handbook developers carefully collaborated with one another. NSA's TSPO is formally charged with governing interoperability across U.S. tactical SIGINT systems and verifies each domain handbook's standards for compliance prior to publication.

part of an MSS acquisition or upgrade. The standards selected should promote commonality, minimize expenditures, maximize use of existing functionality and facilitate the insertion of new technology. Other key considerations when using this handbook include:

First, the mandatory standards in the MSH shall be implemented by systems that have a NEED for the corresponding services. Conversely, those systems that do not require certain services need not apply the corresponding standards. That is, if a resource interface is going to be implemented, it shall be implemented in accordance with the associated standard. If a resource is covered by more than one standard, the appropriate standard should be selected based on system requirements. Mandates are indicated by use of the word "shall."

Second, certain standards are recommended rather than mandated. This is particularly true in areas where there is not a clear case for a single standard. In these instances, "acceptable" standards are given, with the "preferred" one identified. If it does not make sense to use the preferred standard, the rationale/justification for using an alternative should be documented and reported to the MSA IPT (see paragraph 1.2.2). A standard is recommended in the sense that if a resource interface is going to be implemented, it should be implemented in accordance with the associated standard. Recommendations are indicated by use of the word "should."

Third, the MSH is a "forward-looking" document. It guides the acquisition and development of new and emerging maritime SIGINT functionality and provides a standards baseline toward which existing systems will move. It is NOT a catalog of all information technology standards currently used within MSSs. It represents those standards that should be used now and in the future. If legacy standards are needed to interface to existing systems, they can be implemented in addition to the standard.

Fourth, any other standards considered for use (outside of those identified in the MSH) must be additive, complementary, and not in conflict with MSH mandated standards, the JTA, or the UCA TA.

Finally, many standards define a generic implementation profile, with tailored specifications needed to provide a single implementation to meet domain or system-specific requirements. In those cases, a commercial standard may be further defined by a standard profile, such as Federal Information Processing Standards (FIPS) Pub 127-2, to ensure proper operation. In some cases, Interface Control Documents (ICDs) will need to be developed.

1.2.4 Compliance

NSA’s TSPO shall verify standards compliance for systems being upgraded, migrated, or developed for integration into the MSA. This area will be addressed more completely in future updates to the MSH.

1.3 C4ISR Architectures -- Background and Foundation

1.3.1 The Technology Challenge

The pace at which new technology is produced by global industry is frequently characterized as evolutionary and explosive. As a consequence, the sophistication and availability of information and communications technology have expanded dramatically around the world, resulting in increasingly complex and agile information environments. In executing the national military objectives of *Forward Presence* and *Full Spectrum Dominance*, maritime forces routinely operate within foreign information infrastructures that present both unique challenges and opportunities. For the cryptologic elements of the U.S. maritime community, the challenges include:

- **Contributing to dominant battlespace knowledge**. Maritime cryptologists must be capable of exploiting and manipulating littoral information environments to contribute to the tactical commander's knowledge of the battlespace.

- **Pacing technology (modernization)**. Maritime cryptologists must have the flexibility to rapidly incorporate emerging technology (i.e., hardware, software and techniques) in order to match threat capabilities and deliver time-sensitive, actionable combat information to tactical commanders. Of critical importance, MSS developers and integrators must respond to these challenges with increasingly limited resources.

- **Achieving interoperability and connectivity**. Contributing to dominant battlespace knowledge and delivering time-sensitive, actionable combat information requires a fully integrated, networked battlespace information infrastructure (BII). The BII necessitates maximum interoperability and connectivity between C4ISR systems (including MSS) through common operating environments (COE) and shared data environments (SHADE). To contribute, maritime commanders must deploy with MSS that are interoperable and compliant with the COE and SHADE.

These technology challenges are particularly difficult for the maritime cryptologic community whose SIGINT systems have typically been expensive and “stovepiped.” They have not been readily adaptable or reconfigurable for a rapidly changing SIGINT threat, and not easily made interoperable with other tactical components of the United States Cryptologic System (USCS). These challenges are not limited, however, to SIGINT systems but extend to all C4ISR systems within the DoD. Recognizing the expense of pacing technological change and the need for greater interoperability, the DoD mandated a migration from “stovepiped,” non-interoperable technologies to "open" systems architectures that incorporate commercial solutions. To facilitate this migration, a number of information systems architectures, policies, procedures and standards have been developed and implemented to enable interoperability.

1.3.2 Legislation, Visions and Architectures[5]

The Government Performance and Results Act (GPRA) of 1993 and the Information Technology Management Reform Act (ITMRA) of 1996 (also known as Clinger-Cohen) require DoD organizations to measure the performance of existing and planned information systems. Accordingly, the Assistant Secretary of Defense for Command, Control, Communications and Intelligence (ASD (C3I)) and the Joint Staff (J6) jointly developed the *C4ISR Architecture Framework*, which directs the use of Operational, Systems and Technical Architecture Views as the means to develop, evolve and maintain DoD information systems. Each Commander-in-Chief (CINC), Service and major DoD Agency is creating its own set of C4ISR architecture views. The Joint Staff, ASD (C3I) and the Defense Information Systems Agency (DISA) are collectively organizing and constructing Joint architectures. The JTA, now in its 2.0 version, is a product of this process. Additionally, ASD C3I and J6 hosted a formal working group in November 1998 to create a DoD-wide Joint Operational Architecture.[6]

Development of C4ISR architectures closely follows the emergence of the most recent Joint Staff, Service and Agency operational visions and strategies, such as *Joint Vision 2010, C4I For the Warrior, Forward from the Sea: Anytime, Anywhere, Operational Maneuver From the Sea,* and the *National Cryptologic Strategy for the 21st Century* (*NCS 21*). Corresponding to these higher-level documents, the Services and agencies subsequently developed their own C4ISR strategies which include the Navy's *Copernicus…C4ISR for the 21st Century*; the Marine Corps' *MAGTF C4I*, the Air Force's *Horizon*, the Army's *Enterprise*, and the Intelligence Community's *UCA 2010*. *Copernicus …C4ISR for the 21st Century* outlines the Department of the Navy's (DON) C4ISR strategy for operations ranging from the seabed to the stratosphere. It envisions an organizational infrastructure and C4I architecture that meets the challenges presented by the five catalysts of change expressed by the Chief of Naval Operations:

- Operations in a littoral rather than blue water environment
- Full participation in Joint/Allied/Coalition operations
- Increased involvement in Military Operations Other Than War (MOOTW)
- Rapidly evolving technologies (especially in computers, communications, and weapons)
- Defense downsizing and budget reductions

NCS 21 sets forth NSA's vision of "Information Superiority for America" by ensuring dominant battlespace knowledge for national command authority and subordinate decision makers through the integration of cryptology with joint operations. Its objectives include:

- Integration of the USCS into the planning and conduct of military operations

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[5] An architecture is defined by the Institute of Electrical and Electronic Engineers (IEEE) in IEEE 610.12 as the structure of components, their relationships, and the principles and guidelines governing their design and evolution over time. DoD implemented this definition through an interrelated set of architectural views.

[6] *C4ISR Architecture Framework* V1.0 identified the three aspects of a C4ISR Architecture as separate "architectures." V2.0 of the *Framework* clarified the concept of architectures and changed the name of the three aspects to "views." In spite of V2.0's clarification, the terms "architecture" and "view" are frequently used interchangeably. However, the approved and preferred term when referring to an architecture aspect is "view."

- Satisfaction of the warfighter's intelligence needs at the lowest possible classification
- Provision of information systems security products and services for battlespace security
- Effective participation in joint and combined military operations
- Ensuring national cryptologic systems are interoperable with those of the Services and Allies

The guiding principles and precepts of each Service and Agency C4ISR Architecture, in turn, conform with their C4ISR vision. Within the DON, C4ISR architectures are developed by SPAWARSYSCOM and the Marine Corps Combat Development Command (MCCDC), respectively. The Intelligence Community's UCA was crafted by an organization of cryptologic and intelligence professionals and is maintained by the UCA Office (UCAO) at Fort Meade, Maryland. SPAWARSYSCOM produced the first versions of the Navy's C4ISR Architecture Operational, Systems and Technical Architectures in 1997 and 1998. The UCA's Operational, Systems and Technical Architectures were likewise published in January 1998.

1.3.3 Architecture Purposes and Intended Uses

C4ISR architectures and their associated views provide a framework for evolving, maintaining, and integrating existing and emerging information technology. Simply put, architecture development is the first step in implementing a C4ISR vision. The process of developing C4ISR architectures forces a critical review of existing systems and their functions in order to identify inefficiencies, improve processes, enhance information flows and increase automation. The process also compels platform and program sponsors to ensure the viability of future systems by looking over the horizon at emerging warfighting concepts, operational capabilities, geopolitical threats and technological advances to ensure:

- Operational and systems requirements are refined
- New technologies for insertion and integration are identified
- Resource investment strategies are developed
- Force structure (manpower, skill, training) needs are determined
- Force doctrine and fleet operational plans are revised

As depicted in Figure 1.1, each architecture view (operational, systems and technical) has a unique function and purpose; each presents a different perspective of the overall architecture. As stated by the *C4ISR Architecture Framework*, the principal purpose of an OV is to "describe the tasks, operational elements and information flows required to accomplish or support a warfighting function." The Systems View (SV) "describes the systems and interconnections providing or supporting warfighting functions." And, last, the TV provides "the minimal set of rules governing the arrangement, interaction, and interdependence of the parts or elements, whose purpose is to ensure that a conformant system satisfies a specified set of requirements." Using the simple analogy of a house, the OV represents the overall concept or vision of the structure, the SV serves as the blueprint, and the TV sets forth the building codes.

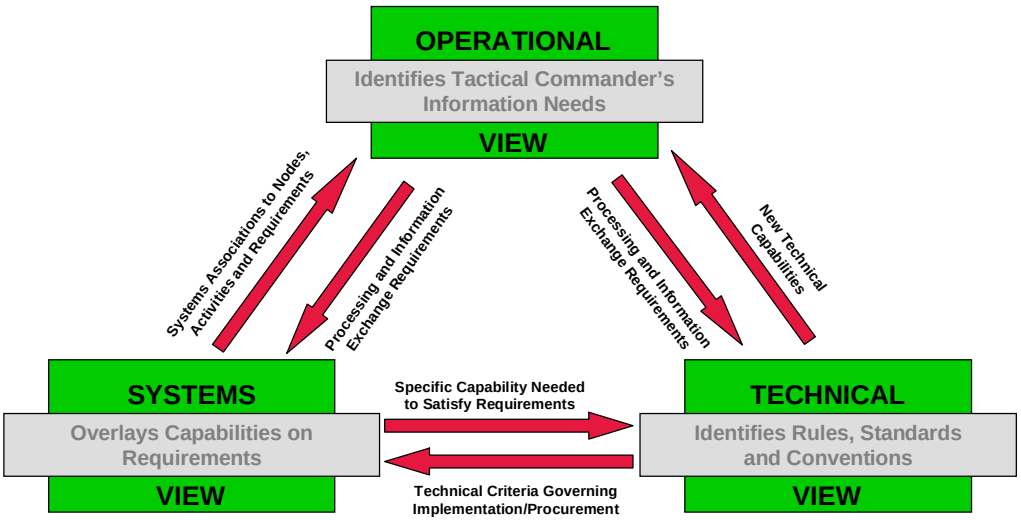

Figure 1-1: C4ISR Achitecture and Corresponding Views

Collectively, the three views provide C4ISR system designers a master plan that satisfies operational requirements and ensures the corresponding systems are developed using validated fleet priorities. They assure that affordability, supportability, timely introduction of new technology, use of off-the-shelf hardware and software, and similar criteria are considered. In the aggregate, the three views provide:

- A roadmap for systems evolution and technology insertion
- Direction to the systems commands for system development and acquisition
- Guidance to the acquisition community for system and product procurement
- A framework for achieving global network integration and interoperability
- A structure for connectivity to Joint, Allied and Coalition partners, irrespective of geographic location
- A process for improving information integrity

In the case of maritime SIGINT, the MCA provides the overarching C4ISR architecture. The MCA OV serves as its formal concept of operations and the MSH (as the MCA TV) delivers its technical "building codes." Together, the MCA OV and the MSH provide the basis for generating the MCA SV. The SV will determine how the OV's required information processes and connectivities are achieved, as well as how system design guidance, technical design principles, and TV constraints are addressed. As illustrated in Figure 1-2, the operational, systems and technical views, when combined and coordinated, will influence MSS interoperability as well as future investment, acquisition, force structure and training strategies for maritime cryptology.

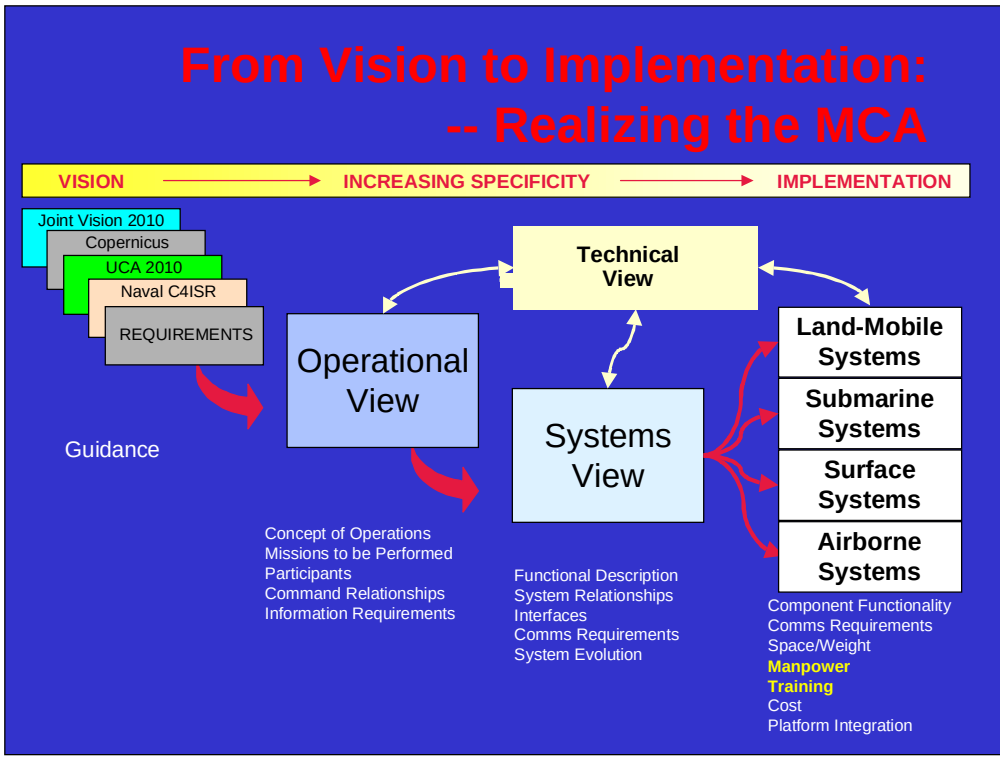

Figure 1-2: The MCA's Influence

1.3.4 Technical Architecture Relationships

As indicated previously, the MSH bridges the standards gap between the tactical maritime Services and the USCS. As a result, it is closely related to and interdependent with the C4ISR architecture TV products and development efforts of a number of organizations. The following paragraphs describe these relationships and interdependencies.

1.3.4.1 JTA

The JTA is the DoD-level technical architecture mandated for all C4I applications, including MSS. It establishes the foundation for interoperability among tactical, strategic, and sustaining base systems. The JTA provides the "building codes" for a seamless flow of information to tactical forces. It is a living document that will evolve with changes in technology and the marketplace. All C4ISR architecture TVs developed within DoD must be compliant with the JTA. Figure 1-3 illustrates the relationship of the MSH to the JTA and other technical architecture documents.

1.3.4.2 UCA

The USCS' mission is to provide SIGINT services and products to its customers. It does this by collecting, manipulating and exploiting data, generating associated products, and disseminating information to operational commanders and national decision makers. The UCA is an evolving

architecture that will create a Common Information Infrastructure (CII) necessary for the interaction of national and tactical SIGINT sensors and the dissemination of SIGINT-derived information. The UCA CII will provide a seamless web of communications networks, computers, software, databases, applications, data, and security services to meet the needs of the SIGINT community.

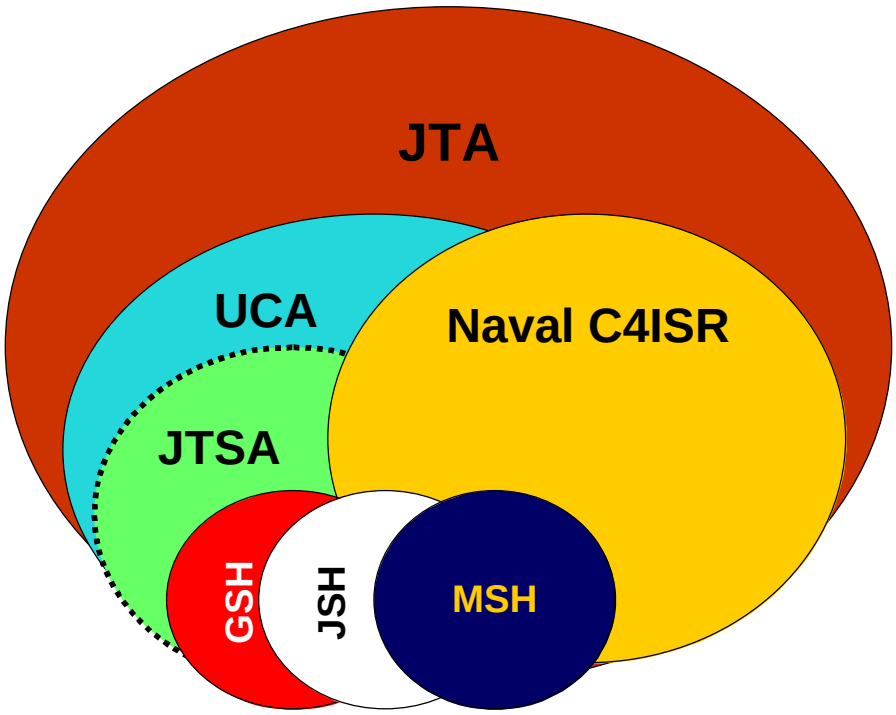

Figure 1-3: Technical Architecture Relationships

The UCA's TA provides the rules and standards for the USCS. It contains the overarching technical guidance for both the Intelligence Community and DoD and aims to transform the community's disparate SIGINT systems into a "single interoperable machine." The UCA TA conforms to the *C4ISR Architecture Framework* and serves as the SIGINT subarchitecture, or domain, under the JTA. It focuses on information technology. As such, it complies with and, in some cases, augments the standards found in the JTA. The UCA TA draws from the *Defense Information Infrastructure (DII) Master Plan* and complies with its COE. Where the UCA TA specifies standards for functionality that are not specified by the JTA and COE, those standards will be submitted by the UCAO for inclusion into the JTA and COE. The UCA TA adheres to the JTA order of preference used to select standards, namely in descending order:

- Standards that are commercially used in the marketplace with validated implementations available in multiple vendors' products
- Publicly held standards
- International or national industry standards and
- Military or government standards

1.3.4.3 Joint Tactical SIGINT Architecture (JTSA)

The JTSA is an unofficial subarchitecture focusing on connectivity and interoperability between tactical SIGINT systems. It is an informal subset of the UCA intended to connect tactical SIGINT sensors, processors, analytical nodes, and tactical intelligence customers. The envisioned "virtual network" of tactical customers will allow data sharing among assets and two-way remoting capability. There is close and continuing cooperation between the MSH and JTSA efforts. The JTSA is a product of NSA's TSPO. As depicted in Figure 1-3, the MSH serves as the maritime component of the JTSA, compliant with and complementing the JTA, the UCA, and both the ground and air tactical SIGINT domains.

1.3.4.4 DON C4ISR Architectures

As indicated above, SPAWARSYSCOM and the MCCDC develop and promulgate C4ISR Architectures for DON. The *Navy C4ISR TA* V2.0 was published in September 1998 and provides standards applicable to the Navy C4ISR domain of Theater Air Defense (TAD) and the Naval Strike, Amphibious, Undersea and Mine Warfare mission areas. Fully compliant with the JTA, it was developed by SPAWAR (051) through the Naval Architectures Working Group (NAWG) and with guidance from the Copernicus Requirements Working Group (CRWG). To ensure compatibility and interoperability with Navy C4ISR systems, standards contained in the MSH shall complement and comply with the *Navy C4ISR TA*. Where/if the TA makes no provision for cryptology or IO, the MSH and its successor documents will forward unique standards to the NAWG for consideration and incorporation in future versions of the C4ISR TA. The MSH's relationship to Navy C4ISR is illustrated in Figure 1-3.

1.4 Document Configuration Management

Industry and government are strongly encouraged to forward comments or questions concerning the MSH in writing to the following points of contact:

- Commander, Naval Security Group Command:
  LCDR Mark Neighbors (N35), (240) 373-3184; email: mdneigh@spawar.navy.mil
  LT Bill Lintz (N9), (240) 373-3784, email: lintz@niwa.navy.mil
- Commander, Space and Naval Warfare Systems Command (SPAWAR):
  Mr. Ralph Skiano (PMW 163-1), (619) 524-7890; email: skianor@spawar.navy.mil
- Commander, U.S. Naval Sea Systems Command (NAVSEA):
  Mr. Paul Gross, (PMS 401), (703) 602-3143 ext 122; email: gross_paul@hq.navsea.navy.mil
- Commander, U.S. Naval Air Systems Command (NAVAIR):
  Ms. Melinda Strosnider, (PMA 290E), (301) 757-5686; email: strosnidermw.ntrprs@navair.navy.mil
- Commander, U.S. Marine Corps Systems Command (MARCORSYSCOM):
  MAJ Bill Lang (C4I IC), (703) 784-4541 ext 8036; email: langw@quantico.usmc.mil

- U.S. Special Operations Command (USSOCOM):
  LCDR James A. Poole (SOAL-PMI), (813) 828-2989; email: poolej@socom.mil
- Space and Naval Warfare Systems Center, (SPAWARSYSCEN) San Diego:
  Mr. Lenny Coppenrath, (7221), (619) 553-5649; email: coppenl@spawar.navy.mil

2 MSA REFERENCE MODEL

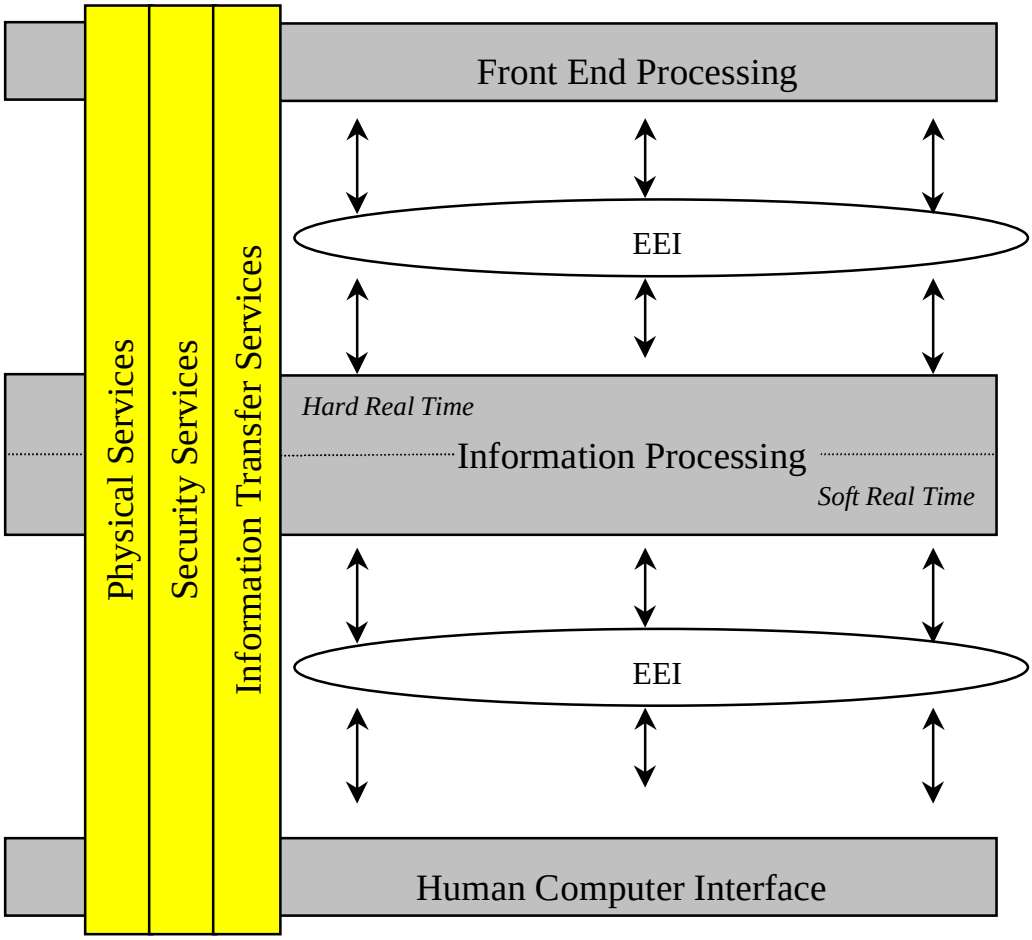

Figure 2-1: MSA Reference Model

2.1 Introduction

The MSA Reference Model (MRM) is derived from the DoD Technical Reference Model (TRM) and the MSA Functional Reference Model (FRM) (See Appendix D). The DoD TRM is a general model representing the information processing entities (application software entity and application platform entity) and interfaces (application platform interfaces and external environment interfaces). The MSA FRM is a functional block diagram representing the components and major hardware interface nodes of the MSA. It is primarily a hardware system model. The MRM overlays the DoD TRM onto the FRM to provide a software reference model related to the hardware model.

The MRM (See Figure 2-1) identifies three major areas: Front End Processing, Information Processing, and the Human Computer Interface. Within the maritime SIGINT community, Front End Processing is platform-specific (e.g., surface, subsurface, air, ground-mobile). Information Processing maps directly to the DoD TRM although some extensions are required. The Human Computer Interface is represented as an external environment entity on the DoD TRM.

The MRM also identifies three cross area services (cross area services affect one or more major areas): Information Transfer Services, Security Services, and Physical Services. Information Transfer Services and Security Services map to the DoD TRM and MSA FRM. Physical Services are maritime SIGINT unique at this time.

The MRM identifies an External Environment Interface (EEI) that provides an interface between Information Processing (represented as the application platform in the DoD TRM) and Front End Processing and the Human Computer Interface (represented as the external environment in the DoD TRM).

2.2 Front End Processing

Front End Processing identifies the standards necessary for data capture (RF), special preprocessing, digitization, wideband recording and distribution. It also identifies the standards necessary to deliver precision time and navigation data from the platform to the SIGINT sensor. It includes the RF and IF distribution, low band and high band tuners, digitizers, recorders, and processors for data capture and interface to the navigation system and atomic clock reference for precision time and navigation data. Front End Processing is represented as Front End Processing and Navigation and Timing in the MSA FRM and is represented as the external environment in the DoD TRM. It also includes embedded information processing which has extreme real-time/high bandwidth requirements. (See Chapter 3.)

2.3 Information Processing

Information Processing identifies the standards necessary for software and data interoperability, modularity and reuse. It includes software engineering services, user interface services, data management services, data interchange services, graphics services, communications services and operating system services. Information Processing maps directly to the DoD TRM. Information Processing also includes maritime SIGINT specific data formats and may include real-time operating systems not currently addressed in the JTA. (See Chapter 4.)

2.4 Human Computer Interface

The Human Computer Interface (HCI) identifies the standards and guidelines to provide the operator an interface with a common “look and feel”. A standard HCI with a common “look and feel” increases operator effectiveness and reduces operator training. (See Chapter 5.)

2.5 Information Transfer Services

Information Transfer Services are cross-area services with the identified standards, protocols, and interfaces necessary for seamless communications and data transfer. These services provide the interoperability and connectivity within and among maritime SIGINT platforms. These services include digital network services, data link interfaces and Reach Back, Reach Forward and Reach Between interfaces. The MSA FRM represents Information Transfer Services as the Data Flow Network, Command, Control, and Information (C2I) network, multimedia networks, the data link/bridge and the reporting blocks. (See Chapter 6.)

2.6 Security Services

Security Services are cross-area services with the identified standards necessary to provide a seamless flow of information while protecting SIGINT-derived information. These services include multilevel trust, encrypted storage and data link encryption as well as authentication access control, etc. The TRM represents the Security Services as Information Systems Security. The MSA FRM only explicitly identifies Multi-Level Guards (MLG) and encrypted storage for system security, although the other aspects addressed by the TRM are assumed. (See Chapter 7.)

2.7 Physical Services

Physical Services are cross-area services with the identified standards necessary to integrate SIGINT sensors into a maritime environment. These services address environmental conditions and size, weight and power (SWAP) considerations unique to maritime SIGINT. These services include chassis, backplanes, circuit cards, power quality and environmental standards. Physical Services as defined here are unique to maritime SIGINT and do not map to the DoD TRM or the MSA FRM. (See Chapter 8.)

3 FRONT END PROCESSING

3.1 Introduction

This chapter identifies standards necessary for data capture and distribution. It also identifies the standards necessary to deliver precision time and navigation data from the platform to the SIGINT sensor.

3.2 Mandates

3.2.1 Time, Frequency, Navigation, and Geodesy (TFNG)

Time, Frequency, Navigation and Geodesy (TFNG) standards and specifications ensure accurate information for precise geolocation and time tagging applications. The TFNG standards and specifications were jointly selected with the Airborne-Overhead Interoperability Task Force (AOITF) to ensure compatible cross platform geolocation capability.

The MSA TFNG model (Figure 3-1) is a notional model for the purpose of providing a common frame of reference. All analysis associated with the model does not take into account atmospheric effect uncertainties. In addition, the following apply:

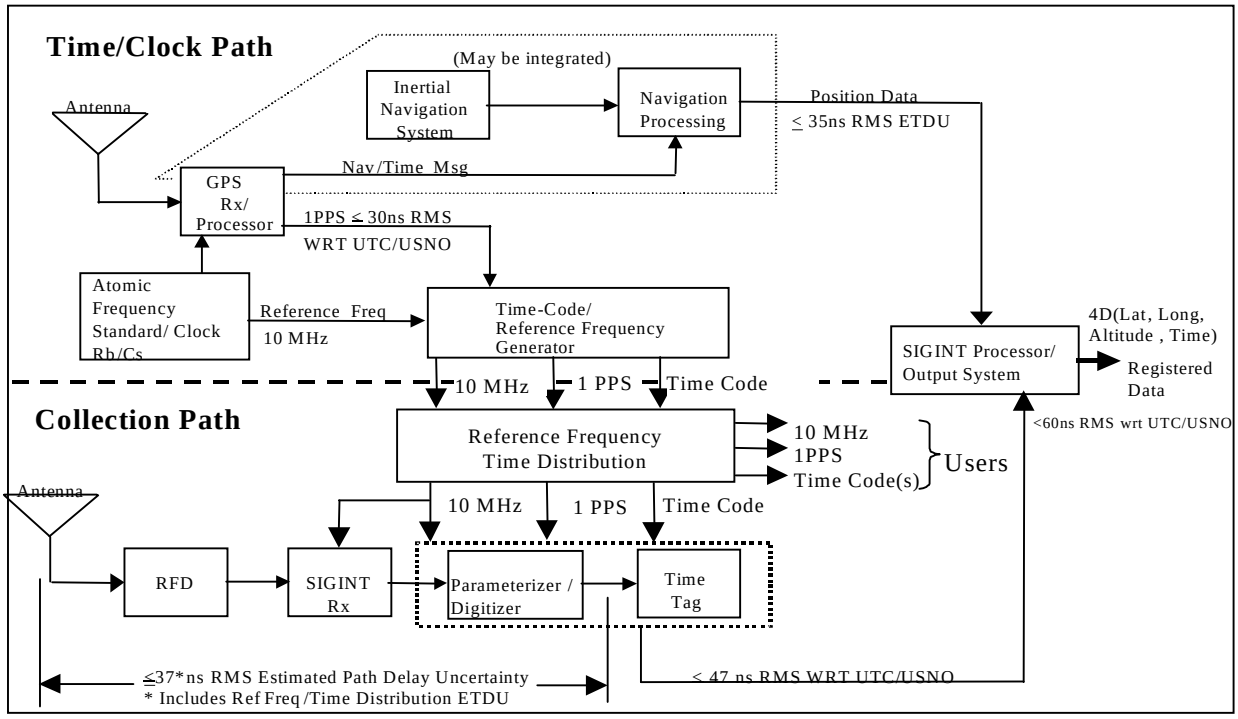

Figure 3-1: MSA TFNG Model

- Specifications shall be met over the operating environment of the host platform
- The accuracies and resolutions shall be made available and maintained at the input point(s) to the SIGINT sensor
- The specified resolutions and accuracies shall be independent of the rate the information is provided to the sensor
- For all related SIGINT data, the navigation and time data will be translated from the platform's reference point(s) to the navigation and time when the signal arrived at the collector antenna

Table 3-1 provides the maximum allowable Time of Arrival (TOA) and Frequency of Arrival (FOA) uncertainty values to achieve cross-system collection requirements. Collection system TOA and FOA uncertainties shall comply with Table 3-1.

Table 3-1: Major Elements of the Collection System Error Budget

Collection System (Collection Antenna to time tag)	TOA Uncertainty	FOA Uncertainty
Path Delay and Processing	$\leq$ 37 ns RMS	N/A
Synchronization (WRT UTC/USNO)	$\leq$ 30 ns RMS	N/A
Total Path Time Delay Uncertainty (Root Sum of Squares (RSS) of above)	$\leq$ 47 ns RMS	N/A
Navigation Uncertainty	$\leq$ 35 ns RMS	N/A
Frequency Stability	N/A	$\leq 3 \times 10^{-11}$ (@1second)
Frequency Determination	N/A	$\leq 5 \times 10^{-11}$ (@1second)
RSS	$\leq$ 60 ns (Note 1)	$\leq 6 \times 10^{-11}$
Note 1: RSS of total path time delay and navigation uncertainties		

3.2.1.1 Timing and Time Tagging

Time tagging refers to the capability to determine the time of arrival of a signal to the specified accuracy in an analog or digital sample or pulse descriptor word format. A time tag for a continuous data stream should be generated initially and at a minimum of every one second thereafter. A time tag is a link between data and metadata. There is a hierarchy of time registration methods required in the collection system depending on the application. The timing data shall be available in real time and referenced to Universal Coordinated Time (UTC), United States Naval Observatory (USNO) and shall comply with Table 3-2.

To support analog recording activities such as wide band recording, time data shall be available in Inter-Range Instrumentation Group (IRIG) B format as defined in IRIG Document 104-70. In addition the following standard shall be used:

-- ICD GPS 151

Table 3-2: Time, Time Tag, and Time-Code

PARAMETER	FORM/ FORMAT	ACCURACY	RESOLUTION	RATE	COMMENTS
Time Event Pulse (TEP)	Event-Pulse	≤ 30 ns (RMS)WRT UTC (USNO)	≤ 2 ns Note 2	1 PPS	TTL Pulse, on-time @ 1v, 20 µs PW
GPS Time of Week, Time of Day	GPS Word - 09, See GPS ICD 151	Note 1	1 ns	1 Hz	—
Time-code	Note 3	10 ms	1 ms	100 PPS	See IRIG Document 104-70
Time Tag	Note 1	≤ 30 ns	≤ 5 ns	Note 1	—

Note 1: See GPS ICD 151
Note 2: 1 PPS pulse rise-time ≤ 4 ns
Note 3: IRIG B

3.2.1.2 Navigation

Navigation data from the platform needs to provide position, attitude, and velocity information tied to precision time. Accuracy of the navigation information assumes that position and velocity are continuously obtained using Precise Positioning Service (PPS) GPS in conjunction with inertial or other navigation systems.

Table 3-3: Navigation

	ACCURACY	RESOLUTION	RATE	RANGE	OTHER
Position	≤ 16 Meters SEP (≤ 10 Meters CEP)	≤ 1 meter	5-50 Hz	Note 1	Note 2
Velocity					
Horizontal	≤ 0.01 m/s RMS each axis	≤ 0.005 m/s	5-50 Hz	Note 1	
Vertical	≤ 0.1 m/s RMS	≤ 0.02 m/s	5-50 Hz	Note 1	
Heading	≤ 0.05 Degrees	≤ 0.01 Degrees	5-50 Hz	Note 1	Note 3
Acceleration	≤ 0.1 m/s^2 RMS	≤ 0.05 m/s^2	5-50 Hz	Note 4	
Angular Rate	≤ 0.05 $Degrees/s^2$ RMS	≤ 0.016 $Degrees/s^2$	5-50 Hz	Note 4	Note 5
Attitude (Pitch, Roll, Yaw)	≤ 0.05 Degrees RMS	≤ 0.005 Degrees	5-50 Hz	Note 4	Note 6

Note 1: See ICD GPS 151
Note 2: FOM, time of solution, estimated error
Note 3: Jitter ≤ 0.02 Degrees
Note 4: See SNU 84-1, Rev. D.
Note 5: Jitter ≤ 0.016 Degrees/Second
Note 6: Jitter ≤ 0.005 Degrees

The navigation data performance standards in Table 3-3 have been demonstrated operationally and can be improved by using differential GPS (DGPS) techniques, Wide Area GPS Enhancement (WAGE), and other GPS accuracy improvements.

Navigation data shall be available in real time referenced to World Geodetic System 84 (WGS-84) and shall comply with Table 3-3.

3.2.1.3 Reference Frequency

The reference frequency provides signals needed for inter- and intra-platform operations. The reference frequency provides a stable RF signal synchronized with the GPS system, which is monitored continuously and steered to the USNO Master Clock frequency. The information provided in Tables 3-4 and 3-5 is based on projected performance of currently available COTS frequency standards in a typical operating environment. This data shall be available in real time and referenced to USNO Master Clock to the specified accuracies and stabilities per Table 3-4 and Table 3-5.

Table 3-4: Frequency Reference

Frequency	10 MHz Sine wave
Accuracy	
Short Term	1 X 10^{-11} RMS @ 1 seconds
Long Term	5 X 10^{-12} RMS @ 1000 seconds
Amplitude	1 VRMS (+ 13 dBm ± 1 dB) into 50 ohms
Coherence	2 ns Sine wave to 1 PPS
Phase Noise	See Table 3-5

Table 3-5: SSB Phase Noise dBc/Hz on 10 MHz Reference Frequency

Offset Hz	Phase Noise (dBc/Hz)
10^0	≤ -85
10^1	≤ -100
10^2	≤ -130
10^3	≤ -140
10^4	≤ -145

3.2.2 Frequency Interfaces

3.2.2.1 RF Control

The interfaces between the antennas, preamplifiers, and RF distribution are unique for each installation. These interfaces must be designed to provide the necessary input signal to the system

tuners and receivers to optimize system signal performance characteristics (e.g., input signal to noise ratio, second and third intercept points, etc.).

ICDs should be developed and maintained for each platform detailing the specifics of the RF and antenna interfaces. Additional standards required supporting SIGINT collection may be identified later. The RF input, output and connecting coaxial cable impedance shall be 50 ohms (nominal).

The following are acceptable standards to be utilized in MSS:

- IEEE 488.1, IEEE Standard Digital Interface for Programmable Instrumentation
- IEEE-488.2, IEEE Standard Codes, Formats, Protocols, and Common Commands
- RS-232

The following is preferred:

- VXI 1155/1993, Standard VMEbus extensions

Universal Serial Bus should be considered for future use.

3.2.2.2 IF Interfaces

To allow interoperability and interchangeability of tuners, digitizers, and processors, it is necessary to define a common set of intermediate frequencies down-converted from the many widely used industry standards. This will standardize information transfer in the analog domain just as down selections in LANs help standardize information transfer in the digital domain.

It is not intended to preclude the use of other internal IFs, but rather to facilitate modularity, scalability, and interoperability. Additionally, certain advanced specialized signals such as ultra-wideband Electronic Intelligence (ELINT) may require different center frequencies and/or bandwidths due to performance requirements. These should be handled as waivers. Bandwidth shall be defined as the minimum 3 dB bandwidth available at output nodes and maximum 3 dB bandwidth useable by an input node. Recommended frequencies and bandwidths for analog IFs are:

- 10 MHz bandwidth at 21.4 MHz
- 100 MHz bandwidth at 160 MHz
- 600 MHz bandwidth at 1 GHz
- The IF input, output and connecting coaxial cable impedance shall be 50 ohms (nominal)

3.2.3 Geolocation

For geolocation, MSS shall use the following acceptable mapping alternatives:

- Defense Mapping Agency (DMA) DTED Level 1
- DMA DTED Level 2 or 3 (where available)

The following Navigational Spheroids also apply (the final two fields permit user defined entries):

Table 3-6: NAVIGATION SPHEROIDS

(0,”ARF - M = ARC 1950”);	(1,”ARS - M = ARC 1960”);
(2,”AUA = AUSTRALIA Geo 66”);	(4,”BOO = Bogota Obsrvtory”);
(5,”CAI = Campo Inchauspe”);	(6,”CAP = Cape”);
(7,”CGE = Carthage”);	(8,”CHI = Catham 71”);
(9,”CHU = Chua Astro”);	(10,”COA = Corrego Alegre”);
(11,”EUR - A = Euro50 – West Euro”);	(12,”EUR - E = Euro50 – Cyprus”);
(13,”EUR - F = Euro50 – Egypt”);	(14,”EUR - H = Euro50 – Iran”);
(15,”EUR - J = Euro50 – Sicily”);	(16,”EUS = Europe 1979”);
(17,”FAH - Oman”);	(18,”GAA = Gandajika Base);
(19,”GEO = Geodetic Dtm 49”);	(20,”HJO = Hjorsey 1955”);
(21,”IND - A = India - Thai/Viet”);	(22,”IND - I = India - B - I - N”);
(23,”IRL = Ireland 1965”);	(24,”KEA = Kertau 1948”);
(25,”LIB = Liberia 1964”);	(26,”LUZ - A = Luzon”);
(27,”MAS = Massawa”);	(28,”MER = Merchich”);
(29,”MIN = Minna”);	(30,”NAH - C = Narhrwan”);
(31,”NAR = North Amer 1983”);	(32,”NAS - C = No Amer-CONUS);
(33,”NAS - D = No Amer-Alaska”);	(34,”NAS - E = No Amer-Canada”);
(35,”NAS - N = No Amer-Cent Am”);	(36,”OEG = Old Egyptian”);
(37,”OGB - M = Ord Surv GrBr”);	(38,”OHA - M = Old Hawaiian”);
(39,”PIT = Pitcairn 1967”);	(40,”QAT = QATAR National”);
(41,”QUO = Qornoq”);	(42,”SAN - M = South America 69”);
(43,”SCK = Schwarzeck”);	(44,”TIL = Timbalai 1948);
(45,”TOY - M = Tokyo”);	(46,”WGD = WGS - 84”);
(47,”WGS = WGS - 72”);	(48,”ZAN = Zandeerij”);
(49,”USER1”);	(50,”USER2 “);

MSSs shall use the following mapping alternative as the preferred source:

- World Geodetic System 84 (WGS-84) to include current supplements

4 INFORMATION PROCESSING

4.1 Introduction

The information SIGINT systems process is perishable and the processing of this information must be done in real time. The following two definitions of real-time are widely accepted and provide a frame of reference for the discussion of real-time information processing:

- *Soft real-time* - timing must be explicitly managed and the value of data diminishes after a deadline expires. This could be the response time to an operator action, time required to make a database query, or any other time-constrained event.
- *Hard real-time* - deadlines are deterministic and must be met. Data is lost or loses its value after a deadline expires. Failing to process the information in a buffer before it is overwritten is an example.

4.2 Mandates

4.2.1 Information Processing (Soft Real-Time)

The purpose of implementing information processing standards is to improve interoperability and reduce the effort required to develop, integrate, and maintain software. The JTA mandates DISA's DII COE as the primary mechanism to implement software standardization. An overview of the DII COE is provided in the following paragraphs. Documents and additional information can be obtained from *the Defense Information Infrastructure Common Operating Environment Home Page* (http://spider.osfl.disa.mil/dii/). The DII COE is a not a system; it is a foundation for building open systems. It encompasses architecture, standards, specifications, software reuse, shareable data, interoperability, and automated integration in a cohesive framework for system development.

The DII COE consists of the following layers:

- *Kernel* – This layer is the minimal set of software elements required on every workstation in the system. It will normally consist of an operating system, basic system administration functions, basic security functions, operator templates, and COE tools for segment installation.

- *Infrastructure Services* – This layer provides low-level tools for data exchange. These include Management services (network, system, and security administration), Communications services, Distributed Computing services, Presentation services, Data Management services, and Workflow and Global Data Management services.

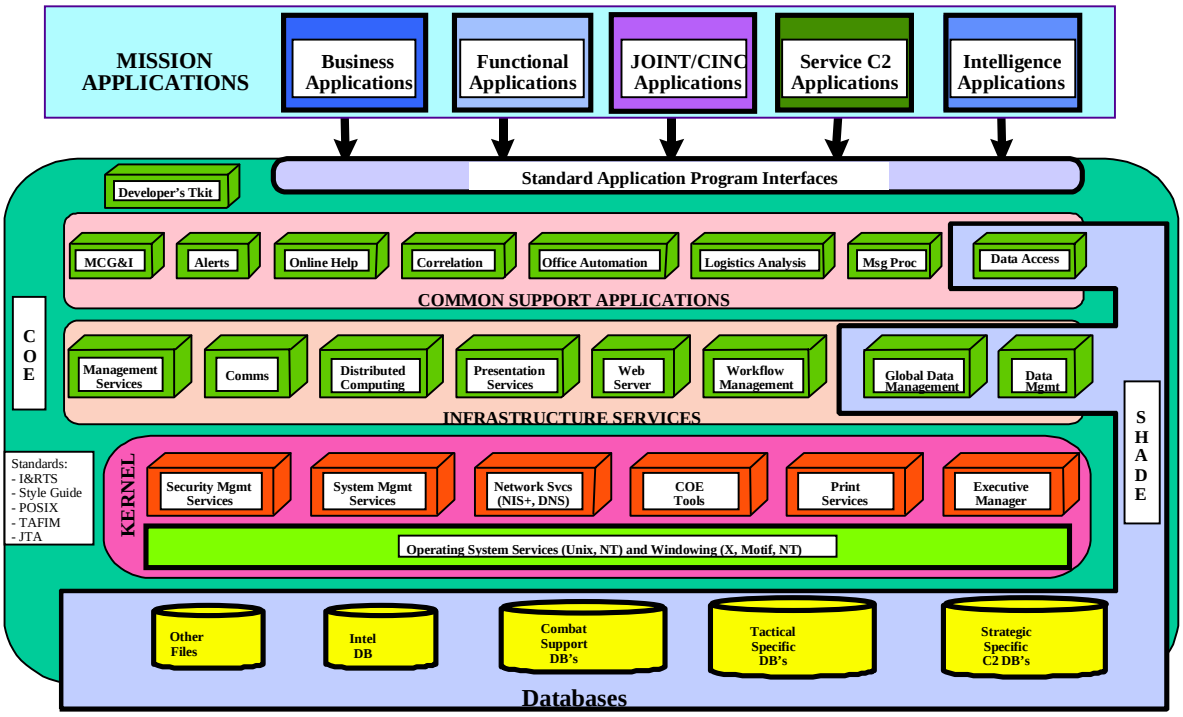

Figure 4-1: Defense Information Infrastructure (DII) Common Operating Environment (COE)

- *Common Support Applications* – This layer is more mission-domain specific. It includes Alert services, Correlation services, Mapping services, Office Automation services, and Data Access services.

- *Standard Application Programming Interfaces* (API) – This layer provides a uniform interface between the software application and the COE services. Standard APIs allow a reusable set of mission applications to be quickly and easily integrated into the COE software infrastructure in a "plug and play" fashion. To ensure system integrity, software applications must access COE services through a standard API.

- *COE Developer Toolkits* – This layer contains libraries of APIs and a collection of tools to assist the software developer in the segmentation process. Segmentation is the engineering process of decomposing system components into segments (functional software modules) and creating the appropriate segment descriptor files.

- *Shared Data Environment* (SHADE) – Provides data storage and data management tools for handling files and databases. See Section 4.2.3.1 for a more detailed discussion.

The COE is designed to allow developers to concentrate their efforts on building mission area applications rather than duplicating system infrastructure services. Common standards support the objective of interoperability. The use and evolution of the COE and the standards it embodies will advance the goal of building systems that are compatible, while minimizing program costs through systematic software reuse. The DII COE is mandated by the JTA. DII COE Integration and Runtime Specifications (I&RTS) Version 3.0, Level 5 is mandated by MSH, but preference is to attain Level 7 compliance. For specific details on compliancy levels, please consult the DII COE Integration and Runtime Specifications Version 3.0.

4.2.1.1 Programming Languages

Software design shall emphasize American National Standards Institute (ANSI) standards for high-level software coding to allow maximum portability of the code. To facilitate software reuse, a standard coding process (e.g., Object Oriented Design) will be utilized to ensure maximum portability. The acceptable options for High Order Languages (HOL) are:

- ANSI/ISO 9899:1992, Programming Languages -- C
- ANSI/ISO/IEC 8652:1995, Ada Reference Manual, Language and Standard Libraries

The preferred option for HOL is:

- C++ (ANSI X3J16/95-0087 (draft))

The preferred future option for HOL:

- The emerging JAVA programming concept is an acceptable method for future use.

4.2.1.2 User Interface Services

User interface services define how users may interact with an application. Depending on the capabilities that users require and the applications, these interfaces may include the following specifications: user interface, graphical client server, object definition management, character-based user interface, and window management. Refer to Chapter 5 for HCI style guidance and standards.

4.2.1.3 Data Management Services

Central to most systems is the management of data that can be defined independently of the processes that create or use it, that can be maintained indefinitely, and that can be shared among many processes. Data management services may include data dictionary/directory, database management system, and transaction processing. The standards identified in the JTA shall apply when the corresponding function is implemented.

4.2.1.4 Data Interchange Services

Data interchange services provide specialized support for the interchange of information between applications and to/from the external environment. These services handle data interchange between applications on the same platform and applications on different (heterogeneous) platforms. These services include document interchange, geospatial data, imagery data, product data, audio data, video data, atmospheric data, oceanographic data, and compression interchange services. The standards contained in the JTA shall apply when the corresponding function is implemented.

4.2.1.4.1 Document Interchange

These services provide the specifications for encoding data and the logical and visual structure of electronic documents. The following standard is acceptable for document interchange:

- ISO 8879: 1986, Standard Generalized Markup Language (SGML), for the production of documents which are intended for long-term storage and electronic dissemination for viewing in multiple formats. SGML formalizes document markup, making the document system and processing independent. It is an architecture-free and application-free language for managing structures and is designed for full multimedia database publishing. SGML is a meta-language, providing the rules for designing and applying a system of markup tags rather than the specific set of tags.

The preferred standard for document interchange is:

- RFC-1866: 1995, Hypertext Mark-up Language (HTML), Internet Version 3.2, Reference Specification, World Wide Web Consortium (W3C), 14 January 1997 - Interchange format used by the WWW for hypertext format and embedded navigational links.

Table 4-2 identifies file formats for the interchange of common document types such as text documents, spreadsheets, and presentation graphics. Some of these formats are controlled by individual vendors, but all of these formats are supported by products from multiple companies. In support of the standards mandated in this section, Table 4-2 identifies conventions for file name extensions for documents of various types. The following file formats are mandated, but not the specific products mentioned:

- All applications acquired or developed for the production of documents shall be capable of generating at least one of the formats listed in Table 4-2 for the appropriate document type.

- With the exception of Briefing Graphics Presentations, all organizations shall at a minimum be capable of reading and printing all of the formats listed below for the appropriate document type.

Table 4-2 - Common Document Interchange Formats

Document Type	Standard/Vendor Format	Recommended File Name Extension	Reference
Plain Text	ASCII Text	.txt	ISO
Compound Document*	Acrobat 2.0	.pdf	Vendor
	HTML 3.2	.htm	W3C
	MS Word 6.0	.doc	Vendor
	Rich Text Format	.rtf	Vendor
	WordPerfect 5.2	.wp5	Vendor
Briefing - Graphic Presentation	Freelance Graphics 2.1	.pre	Vendor
	MS PowerPoint 4.0	.ppt	Vendor
Spreadsheet	Lotus 1-2-3 Release 3.x	.wk3	Vendor
	MS Excel 5.0	.xls	Vendor
Database	Dbase 4.0	.dbf	Vendor
Compression	GZIP file format	.gz	RFC 1952
	Zip file format	.zip	Vendor

Notes: * - Compound documents contain embedded graphics, tables, and formatted text. Object Linking and Embedding (OLE) linking complicates document interchange. Note that some special fonts, formatting, or features supported in the native file format may not convert accurately.

The following standards and specifications are mandated in a Continuous Acquisition and Life Cycle Support (CALS) environment:

- MIL-STD-1840 - Automated Interchange of Technical Information
- MIL-PRF-28001 - Markup Requirements and Generic Style Specification for Exchange of Text and its Presentation

4.2.1.5 Graphics Services

Graphics services provide functions required for creating and manipulating pictures. These services include raster graphics, vector graphics, and device interfaces. The following standards are acceptable in MSS:

- FIPS Pub 128-1: 1993, Computer Graphics Metafile (CGM)- Interchange format for vector graphics data
- JPEG File Interchange Format (JFIF), Version 1.02, C-Cube Microsystems for raster graphics data encoded using the ISO 10918-1: 1994, Joint Photographic Expert Group (JPEG) algorithm
- The Tag Image File Format (TIFF)

The following format is preferred for future use:

- The Portable Network Graphics (PNG) format

4.2.1.6 Communication Services

Communication services support distributed applications requiring data access and applications interoperability in heterogeneous or homogeneous networked environments. These services may include application-oriented network services, transport-oriented network services, and subnetwork technologies services. The standards identified in the JTA shall apply when the corresponding function is implemented.

4.2.1.7 Operating System Services

Operating system services are the core services needed to execute and administer the application platform and provide an interface between the application software and the platform. Application programmers will use operating system services to access operating system functions. Operating system services may include kernel operations, real-time extensions, clock/calendar, fault management, shell and utilities, operating system object services, and media handling. The standards identified in the JTA shall apply when the corresponding function is implemented.

4.2.1.8 Information Management Resources

Information Management Resources provide data containers and data storage, retrieval, replication, and removal. Containers may be used for databases, collected data, or for finished reports. All forms of data may be stored within the same container or distributed across multiple containers. Distributed data storage allows linked data and corresponding metadata to reside in different data containers. Metadata standards allow all forms of data to be located regardless of where they reside. This supports ease of access and processing by appropriate users and resources. The standards identified in the JTA shall apply when the corresponding function is implemented.

4.2.1.9 Distributed Computing Services

These services allow various tasks, operations, and information transfers to occur on multiple, physically or logically dispersed computer platforms. These services include, but are not limited to, global time; data, file, and name services; thread services; and remote process services. There are two categories of Distributed Computing Services, Remote Procedure Computing and Distributed Object Computing. The standard identified in the JTA shall apply when the corresponding function is implemented.

4.2.2 Information Processing (Hard Real-Time)

The JTA has mandated DII COE, and it is successfully being used in client server applications. The many benefits derived from its use have been well documented. The DII COE has not yet developed a kernel around a real-time operating system; therefore, it cannot be directly applied to

real-time software development. However, the concepts employed by the DII COE can be applied in principle to real-time software applications development with the same resulting benefits. Standardizing on APIs written in accordance with the mandated JTA POSIX standards will significantly enhance the probability of successfully porting the software application for reuse.

During the software development process, a primary emphasis must be placed on writing reusable and extensible software applications. Standard functions and services should be used by the developers and not rewritten for each new application.

It is recognized that imposing standards on real-time software development increases the associated overhead. Wherever possible, this additional overhead should be accounted for in the design (i.e., during hardware selection). When event timing or throughput requirements cannot be met within the purview of a mandated standard, an exemption from that specific portion of the standard shall be requested.

Applicable standards for real-time software development are listed in the JTA.

4.2.3 Data

4.2.3.1 Shared Data Environment (SHADE)

SHADE was developed for the DII COE for data handling. For true interoperability, all data users must be able to use the data received without having to reformat or translate it. SHADE is a strategy for data management and sharing and it provides the mechanisms needed to access existing large legacy databases on mainframes. It includes the required data access architectures, data sharing methodology, reusable software and data components, and guidelines and standards for the development and migration of systems that meet the user's requirements for timely, accurate, and reliable data (See Figure 4-2). Documents and additional information can be obtained from the DII COE home page. The DII COE mandates SHADE.

4.2.3.2 Digitized Audio

Digitized audio refers to the formatting techniques and encoding schemes used to convert analog audio sensor data into digital audio for data transmission and storage.

4.2.3.2.1 Digital Audio Routing to Support JTSA Systems

There are two primary methods of providing digital audio data to JTSA processing and analysis systems at Regional Security Operations Centers (RSOC): (1) USSID 126 Collected Signals Data Format (CSDF) formatted digital audio files forwarded asynchronously via the wide area network (WAN) and, (2) Real-time continuous synchronous T1 digital audio trunks.

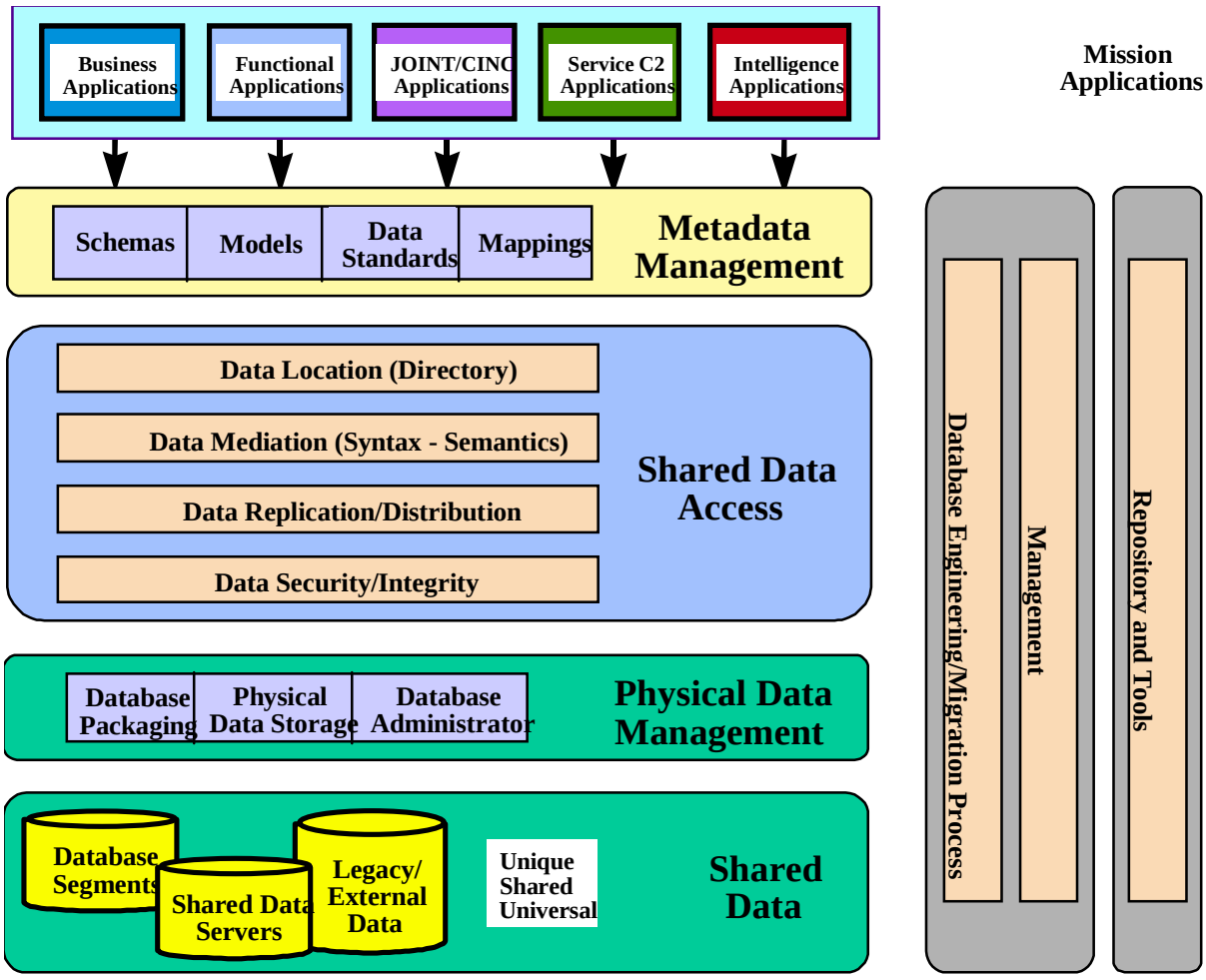

Figure 4-2: SHADE

4.2.3.2.1.1 Asynchronous Distribution

Some MSS currently employ USSID 126 formatting techniques to provide collected audio data to JTSA systems. USSID 126 and MSH Signal Related Information (SRI) mandates are used to convert mission data into rigidly formatted files. The main computer center (MCC) then transmits the files over the WAN to client/server subscribers for processing and analysis.

Numerous Government-Off-The-Shelf (GOTS) products support the distribution of asynchronous CSDF compliant audio files. Formatting mission data into CSDF compliant audio improves interoperable distribution and storage among JTSA systems. In subsequent versions of the MSH, a small sub-set of mandates will be listed to improve asynchronous audio encoding, distribution, and storage.

4.2.3.2.1.2 Synchronous Distribution

MSS are not currently providing digital audio via standard T1 feeds to JTSA client-server processing and analysis systems, but this option requires consideration for future operations. The JASA Standards Working Group (JSWG) Interoperability Subcommittee, in collaboration with the RSOC Program Management Office, is currently leading efforts to define a standard community digital audio format for storage and transmission -- synchronous and asynchronous. The current de facto standard for real-time remoted collection feeds utilizes an 8 bit μ-law digital audio encoding scheme in accordance with ITU G.711. The encoded audio is transported via 1544 kbit/s trunks in accordance with ITU G.703 and G.733.

Real-time audio collection and transmission from MSS to JTSA processing centers shall be capable of complying with:

- ITU CCITT G.711, Digitally encoded audio samples with the 8-bit μ-law compression scheme

Real-time audio transmission from MSS shall comply with a synchronous T1/E1 rate structure as specified in the following:

- ITU CCITT G.703, Physical/Electrical Characteristics of Hierarchical Digital Interfaces (Supplemented by ANSI T1.102-1993)
- ITU CCITT G.733, Characteristics of Primary PCM Multiplex Equipment Operating at 1544 Kbps: Supplemented by ANSI T1.403-1995, Network to Customer Installation – DSI Metallic Interface
- ITU CCITT G.732, Characteristics of Primary PCM Multiplex Equipment operating at 2048 Kbps

4.2.3.2.2 Digital Audio Encoding Schemes

Currently, the digital audio encoding scheme for basic audio interoperability is 8 bit μ-law in accordance with ITU G.711. For internal use and common application sharing, other audio digitization algorithms (such as signal-native) are more appropriate.

4.2.3.3 Data Formats

Standard data formats are critical to sharing and exploiting unprocessed or semi-processed cryptologic intelligence data between MSH-compliant sensors and ground/surface stations. Moreover, standard data formats are a key to enhanced national and tactical integration efforts under the UCA and JTSA concepts. The CSDF manual prescribes overall format guidance for collected signals and associated SRI.

The CSDF manual, promulgated by USSID 126, provides specifications for data formats that facilitate the exchange of collected signals data and SRI between processing subsystems. The formats prescribe rigid record and field-format requirements that enable networked computer

systems to share data. The supplemental references listed in 4.2.3.3.1 provide CSDF implementation details.

4.2.3.3.1 Signal and Signal Related Information (SRI)

Data formats of SRI reports shall comply with the following:

- USSID 126 Collected Signals Data Format (CSDF)
- The Collected Signals Data Format (CSDF) Manual

The following supplemental government documents provide CSDF implementation references:

- Voice Processing Systems Data Element Dictionary, 13 Mar 1997
- Facsimile Data Element Dictionary (DRAFT), 13 Mar 1997
- Voice Transfer Control Protocol, Version 1, 3 Feb 1994

4.2.3.3.2 Digitized Pre-detected Intermediate Frequency Data

Data formats for pre-detected IF or baseband data shall comply with the following:

- TBD

4.2.3.4 Dissemination Reports

The following SIGINT directives apply when the associated reporting function is required:

- USSID 126 Collected Signals Data Format (CSDF)
- USSID 205 Standardized Technical Reporting Using Modules (STRUM)
- USSID 300 Signals Intelligence Directive
- USSID 301 Critical Information Reports
- USSID 341 Technical ELINT Reports
- USSID 350 Universal Reporting Format
- USSID 369 KLIEGLIGHTs and Tactical Reports

4.3 Emerging Technologies

The following are POSIX real-time processing standards that are currently in the approval cycle of their respective IEEE committees.

4.3.1 Operating Systems Services

IEEE 1003.13: 1997 POSIX-Realtime Application Support (AEP)

4.3.2 Distributed Computing Services

IEEE 1003.21LIS: 1996 POSIX-Realtime Distributed Systems Communications Applications Programming Interface

4.3.3 Object Oriented Software Development

Object Management Group (OMG) Real-Time CORBA 2.0 Specification

4.3.4 Common Signal External Data (SED) Format

To facilitate data sharing and worldwide signal fusion and analysis, a common Signal External Data (SED) Descriptor Word (DW) format is required. This format is a subset of the Interactive ELINT Processor (IEP) format being developed to support cross-mission geolocation efforts. The SED DW is consistent with both the IEP file structure and field content and is applicable to all types of SIGINT data capture. The modular nature is designed to support both signal parameterization and data sampling while providing the flexibility to add or delete individual data types without affecting the others. The format mandates only the minimum set of fields for each data set. This enables the collector to add system unique fields (i.e., calibration, unique collection capabilities and maintenance functions) to the format without disturbing interoperability.

5 HUMAN COMPUTER INTERFACE

5.1 Introduction

HCI defines the “look and feel” of information systems. A common “look and feel” or common workstation allows experienced operators the ability to operate different platforms with little or no additional training.

This chapter does not attempt to define a common operator workstation. Instead it provides guidelines to establish a commonality in the “look and feel” of the operator interfaces for MSS.

5.2 Mandates

The following shall be used:

- TAFIM Version 3.0, Volume 8 - HCI Style Guide
- The User Interface Specifications for the DII, Version 2.0

6 INFORMATION TRANSFER SERVICES

6.1 Introduction

Information transfer services identify the standards and protocols to achieve interoperability and connectivity among and within MSS. These services include digital network services, data link interfaces, and Reach Back/Reach Forward interfaces. Digital network services provide a mechanism for data transfer and exchange within the SIGINT sensor. Data link interfaces provide a mechanism to control the SIGINT sensor and to distribute the sensor data for further processing and display. Reach Back/Reach Forward interfaces provide the ability for the SIGINT sensor system to connect to the intelligence community for the purpose of data sharing.

6.2 Mandates

6.2.1 Digital Network Services

Digital network services provide the capability necessary for information transfer and exchange. The data flow network provides the transport and distribution functions for real-time exchange of digital data between Front End Processing and Information Processing and among some information processing assets. The multimedia network provides for the distribution of processed sensor data (e.g., digital audio, panoramic display data video images). The C2I network provides distributed commands to all architectural elements and provides synchronized control in concert with a precision timing reference. (See Appendix D.)

6.2.1.1 High Speed Networks

High speed networks shall use:

The following network protocols are acceptable:

- ATM: User-to-Network Interface (UNI) Version 3.1
- ANSI T1.115

The following high speed network is preferred:

- Fibre Channel Physical and Signaling Interface: ANSI X3.230-1994 (FC-PH). FC-PH consists of FC-0, FC-1, and FC-2. Note: Unidirectional point-to-point implementations shall use FC-0 and FC-1 and FC-2 with exceptions of the use of Primitive Signal Receiver_Ready (R_RDY) (FC-PH Clause 16.3.2), Primitive Sequences (FC-PH Clause 16.4), Port States (FC-PH Clause 16.5), and Primitive Sequence Protocols (FC-PH Clause 16.6).

6.2.1.2 Lower Speed Networks

The acceptable lower speed networks are:

- 10 base 2 or 10 base-T IEEE 802.3 x Ethernet
- FDDI - Media Access Control (MAC), ANSI X3.139-1987
- The preference for lower speed networks is Ethernet: IEEE 802.3u 100 Base Ethernet

6.2.2 Data Link

The data link provides near real-time communications between the maritime platform and either off-board sensors or other sources of data. The standards identified in the JTA shall apply when the corresponding function is implemented.

6.2.2.1 Common Data Link (CDL) Intra-System Protocol

Common Data Link (CDL) refers to a family of five classes of line-of-sight (LOS) and beyond LOS (BLOS) intra-system protocols that are full duplex and jam resistant. The majority of DoD CDL interoperability and standardization efforts to this point have been focused on the Class I LOS CDL standard. Class I LOS CDL standard addresses ground/surface platform remote operation of airborne MSS operating at up to 80,000 ft. The current maritime implementation of Class I CDL is the Common High Bandwidth Data Link (CHBDL). CDL Classes II through V cover the remainder of LOS and BLOS intra-system protocols based on maximum altitude ceilings: Class II 150,000 feet; Class III 500,000 feet; Class IV 750 nautical miles, and Class V above 750 nautical miles. OASD/C3I designated CDL as the DoD standard in a December 1991 policy memorandum.

CDL implementations shall comply with the following:

- OASD/C3I Tactical Data Link Policy Memorandum, 18 Oct 94
- OASD/C3I Common Data Link Program Policy Memorandum, 13 Dec 91
- System Specification for the CDL Segment, Class I, Specification #7681990 – Revision D, 29 Jan 97
- System Description Document for CDL, Specification #7681996, 5 May 93

6.2.2.2 Tactical Message Protocols

The following protocol is used in communications with the U.S. Army Intelligence Electronic Warfare Common Sensor (IEWCS) systems: IEWCOMCAT. IEWCOMCAT specifications are contained in the “Intelligence and Electronic Warfare Character-Oriented Message Catalog.” Other standards, identified in the JTA, shall apply when the corresponding function is implemented.

6.2.3 Reach Back/Reach Forward Interfaces

The Reach Back interface will allow an active collection asset to Reach Back into the databases of surface/ground and national facilities to retrieve information that will assist them in satisfying their operational tasking. An MSS operator will be able to obtain historical data as well as current information provided by other sensors in the same operational theater. Conversely, the Reach Forward interface will allow personal in the surface/ground and national facilities to obtain current information from active MSS. An analyst in an intelligence center will be able to obtain additional current information to support cross-system cueing, data correlation, or other intelligence functions.

Reach Back/Reach Forward services provide the capability for each MSS to obtain preprocessed or partially processed sensor data, information, and database items from other MSS and with specialized processing sites.

Reach Back and/or Reach Forward transactions consist of three primary elements: standardized common data link for transport, standardized data formats for data element transactions, and precision timing and navigation information. Community efforts are underway to further define and refine these standards.

Reach Back/Reach Forward implementations shall comply with the following as applicable:

- Common Data Link
- Precision timing, frequency, navigation and geodesy: MSH Version 1.0, Chapter 3
- Digital Audio Formats: ITU CCITT G.711

6.3 Emerging Technologies.

Additional data link protocols and services will be addressed in future versions of the MSH.

7 SECURITY SERVICES

7.1 Introduction

Security Services or Information Security (INFOSEC) identifies the standards to be used to minimize the risk associated with sharing and disseminating information. The goal of providing a seamless flow of information requires standard interoperable security services.

Security Services are cross-area services that affect all areas of the MRM. Several areas of security services are addressed by the JTA, such as access controls, authentication, auditing, etc. Three security services of critical interest to the maritime SIGINT community that are not sufficiently covered in the JTA are:

- Multi-level Trust
- Encrypted Storage or Media Encryption
- Data Link Encryption

The objective of Multi-level Trust is to share information and resources with networks that have different levels of trust. Pieces of a framework that would enable this sharing include guards, firewalls, and trusted object request brokers. Encrypted Storage (also referred to as Media Encryption) permits users to encrypt classified data before storage. Encrypting the data written to disk protects the information and can minimize the need for special handling. Data Link Encryption provides secure transfer of data between the platform and the ground station.

7.2 Mandates

INFOSEC standards identified in the JTA shall apply when the corresponding function is implemented.

7.2.1 Multi-level Trust

MSS must use guards and firewalls to ensure a logical boundary between trusted and less trusted environments. At this time, a specific class of firewalls is not mandated; however, subsequent versions of the MSH will mandate specific classes of firewalls (i.e., proxy firewall or unidirectional guard) to mitigate the risks associated with interoperable data sharing in a Multi-level Trust environment.

7.2.2 Encrypted Storage/Media Encryption

MSS shall implement embedded-hardware media encryption, because embedded-hardware encryption provides higher levels of assurance than software encryption approaches. Small Computer Systems Interface (SCSI) media encryption is the only available hardware implementation at this time.

It is expected that future versions of the MSH will endorse the use of software media encryption approaches; however, at this time software assurance processes are too immature for general use.

7.2.3 Data Link Encryption

For future MSS wideband data links, the KGV-135, KG-194A and KIV-7HS are acceptable alternatives.

8 PHYSICAL SERVICES

8.1 Introduction

Physical Services identify the standards necessary to integrate SIGINT sensors into a maritime environment. These services include chassis, backplanes, circuit cards, power quality, and Electromagnetic Compatibility (EMC).

8.2 Mandates

8.2.1 Chassis

The preferred equipment chassis standard is:

- EIA-310C 19” Rack Standard

8.2.2 Backplanes

Backplanes with primarily RF boards shall use IEEE STD 1155-1992 (VXI-C).
The acceptable backplane for primarily digital boards is:

- ANSI/IEEE 1014-1987 (VME32-B)

The preferred backplane for primarily digital boards is:

- ANSI/VITA 1-1994 (VME64-B).

8.2.3 Circuit Cards

The acceptable circuit card assembly (CCA) is:

- ANSI/VITA 1014-1987 (VME32-B)

The preferred CCAs are either:

- ANSI/VITA 1-1994 (VME64-B) or
- IEEE STD 1155-1992 (VXI-C)

Systems requiring conduction cooling shall comply with IEEE 1101.2.

8.2.4 Power Quality

Power quality shall be as specified by the individual systems.

8.2.5 Environmental Standards

Equipment environmental standards shall be as specified by the individual systems.

8.2.6 TEMPEST

For equipment that may tie directly to a transmitter or Communications Security (COMSEC) device or that may impinge on the red-black interface, TEMPEST requirements and applicability must be considered. The following shall apply:

- NACSIM 5112, NONSTOP Evaluation Techniques

8.2.7 EMI/EMC

Commercial items shall comply with FCC Title 47, part 15 (Radio Frequency Devices) rules.

To minimize interference, electronic equipment shall comply with MIL-STD-461D-EMI Compatibility Standard, Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference as tailored by Table 8-1 and tested in accordance with MIL STD 462.

Table 8-1: Emission and Susceptibility Requirements

TEST	LIMIT as Specified in Table 1 of MIL-STD-461D
CE102	Paragraph 5.3.2.2 with Figure CE102-1
CE106	Paragraph.5.3.3 and sub-paragraphs
RE102	Paragraph 5.3.1.3.2 with Figure RE102-1 using Army internal requirements
CS101	Paragraph 5.3.4 and sub-paragraphs with Figure CS101-1
CS103	Paragraph 5.3.5 and sub-paragraphs. Limits based on receiver performance
CS104	Paragraph 5.3.6 and sub-paragraphs. Limits based on receiver performance
CS105	Paragraph 5.3.7 and sub-paragraphs. Limits based on receiver performance
CS114	Paragraph 5.3.9.2 with Figure CS114-1 limited to 200 MHz
CS115	Paragraph 5.3.11.2 with Figure CS 115-1
RS103	Paragraph 5.3.16 and sub-paragraphs

8.3 Emerging Technologies

8.3.1 Backplanes

The preferred technology for digital architectures is:

- ANSI/VITA 1.1-1995 (VME64-E)
- The Peripheral Component Interconnect (PCI) and follow-on bus technology

8.3.2 Circuit Cards

The preferred technology for digital architectures is:

- ANSI/VITA 1.1-1995 (VME64-E).
- The Peripheral Component Interconnect (PCI) and follow-on bus technology

Appendix A

Acronym List

ACRONYM	EXPANSION
µs	Microsecond
A&T	Acquisition and Technology
AEP	1) Automatic ELINT Processor 2) Application Environment Profile
AM	Amplitude Modulation
ANSI	American National Standards Institute
AOA	Angle of Arrival
AOITF	Airborne Overhead Interoperability Task Force
API	Application Programming Interfaces
APP	1) Application Program 2) Application Portability Profile
APSK	Amplitude Phase Shift Keying
ASCII	American Standard Code for Information Interchange
ASD	Assistant Secretary of Defense
ATM	Asynchronous Transfer Mode
BER	Bit Error Ratio
BII	Battlespace Information Infrastructure
BIT	Built in Test
BITE	Built-in Test Equipment
BLOS	Beyond Line-of-Sight
bps	Bits per Second
Bps	Bytes per Second
C2	Command and Control
C2I	Command, Control and Intelligence
C3I	Command, Control, Communications, and Intelligence
C4I	Command, Control, Communications, Computers and Intelligence
C4ISR	Command, Control, Communications, Computers and Intelligence, Surveillance and Reconnaissance
CALS	Continuous Acquisition and Life Cycle Support
CCA	Circuit Card Assembly
CCIR	Co-channel Interference Reduction
CCITT	Consultative Committee for International Telephony and Telegraph (now ITU)

CDL	Common Data Link
CEP	Circular Error Probability
CGI	Computer Graphics Interface
CGM	Computer Graphics Metafile
CHBDL	Common High Bandwidth Data Link
CII	Common Information Infrastructure
CINC	Commander-in-Chief
CIO	Chief Information Officer
CNO	Chief of Naval Operations
COE	1) Carry-On Equipment 2) Common Operating Environment
COMINT	Communications Intelligence
COMSEC	Communications Security
CORBA	Common Object Request Broker Architecture
COTS	Commercial Off-The-Shelf
CRWG	Copernicus Requirements Working Group
Cs	Cesium (Atomic Clock Reference)
CSDF	Collected Signal Data Format
CW	Continuous Wave
DARO	Defense Airborne Reconnaissance Office
DASN	Deputy Assistant Secretary of the Navy
dB	Decibel
dBc	Decibels referenced to Carrier
dBm	Decibels referenced to 1 mW
DB	Database
DBMS	Database Management System
DD	Differential Doppler
DF	Direction Finding
DGPS	Differential Global Positioning Service
DII	Defense Information Infrastructure
DII COE	Defense Information Infrastructure Common Operating Environment
DISA	Defense Information Systems Agency
DMA	Defense Mapping Agency
DNS	Domain Name Server
DOA	Direction of Arrival
DoD	Department of Defense
DON	Department of the navy
DSI	Defense Simulation Internet
DSP	Digital Signal Processing
DTED	Digital Terrain Elevation Data
DW	Descriptor Word
EEI	1) Essential Elements of Information 2) External Environment Interface

EHF	Extremely High Frequency (30 – 300 GHz)
EIA	Electronic Industries Association
ELINT	Electronic Intelligence
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ETDU	Estimated Time Delay Uncertainty
EW	Electronic Warfare
FCC	Federal Communications Commission
FC-PH	Fibre Channel Physical and Signaling Interface
FDDI	Fiber Distributed Data Interface
FDOA	Frequency Difference of Arrival
FIPS	Federal Information Processing Standards
FISINT	Foreign Instrumentation Signals Intelligence
FM	Frequency Modulation
FOA	Frequency of Arrival
FOM	Figure of Merit
FPGA	Field Programmable Gate Array
FRM	Functional Reference Model
FTP	File Transfer Protocol
FWSEB	Force Warfare Systems Engineering Board
GB	Gigabyte, 1000 Megabytes (10^9)
GHz	GigaHertz
GOTS	Government Off-The-Shelf
GPRA	Government Performance and Results Act
GPS	Global Positioning System
GSH	Ground SIGINT Standards Handbook
GUI	Graphical User Interface
HCI	Human Computer Interface
HF	High Frequency (3-30 MHz)
HMI	Human Machine Interface
HOL	High Order Language
HPI	High Probability of Intercept
HTML	Hypertext Mark-up Language
Hz	Hertz
I&RTS	Integration and Runtime Specification
IAW	In Accordance With
ICD	Interface Control Document
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IEP	Interactive ELINT Processor
IF	Intermediate Frequency

INFOSEC	Information Security
INS	Inertial Navigation System
IO	Information Operations
IP	Internet Protocol
IRIG	Inter-Range Instrumentation Group
ISO	International Standards Organization
IT	Information Technology
ITF	Integrated Task Force
ITMRA	Information Technology Management Reform Act
ITSA	Integrated Tactical SIGINT Architecture
ITU	International Telecommunications Union (formerly CCITT)
JASA	Joint Airborne SIGINT Architecture
JASS	Joint Airborne SIGINT System
JCS	Joint Chiefs of Staff
JFIF	JPEG File Interchange Format
JMCIS	Joint Maritime Command Information System
JPEG	Joint Photographic Expert Group
JSH	JASA Standards Handbook
JSWG	JASA Standards Working Group
JTA	Joint Technical Architecture
JTIDS	Joint Tactical Information Distribution System
JTSA	Joint Tactical SIGINT Architecture
JTWS	Joint SOF Threat Warning System
K	Kilo (1000)
KB	Kilobyte
Kbps	Kilobits per second
LAN	Local Area Network
LOB	Line of Bearing
LOS	Line of Sight
m/s	meters/second
MAC	Media Access Control
MARCORSYSCOM	Marine Corps System Command
Mb	Megabit
MB	Mega Byte
Mbps	Megabits per second
MCA	Maritime Cryptologic Architecture
MCC	Main Computer Center
MCCDC	Marine Corps Combat Development Command
MCG&I	Mapping, Charting, Geodesy, and Imaging (a functional area of the DII COE)
MHz	Mega Hertz

MIDS	Multifunctional Information Distribution System
MIL-STD	Military Standard
MLG	Multi-Level Guard
MLS	Multi-Level Security
MOOTW	Military Operations Other Than War
MRM	MSA Reference Model
ms	millisecond
MSA	Maritime SIGINT Architecture
MSH	Maritime SIGINT Architecture Technical Standards Handbook
MSS	Maritime SIGINT System
mW	milli-Watt
NACSIM	National COMSEC Information Memorandum
NAVAIR	Naval Air Systems Command
NAVSEA	Naval Sea Systems Command
NAWG	Naval Architectures Working Group
NCS-21	National Cryptologic Strategy for the 21st Century
NDI	Non-Developmental Item
NIS	1) National Input Segment 2) Network Information Service
ns	nanosecond
NSA	National Security Agency
NSWC	Naval Surface Warfare Center
OA	Operational Architecture
OASD	Office of the Assistant Secretary of Defense
ODBC	Open Database Connectivity
OLE	Object Linking and Embedding
OMG	Object Management Group
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
OSE	Open Systems Environment
OUSD	Office of the Under Secretary of Defense
OV	Operational View
PCI	Peripheral Component Interconnect
PCM	Pulse Code Modulation
PNG	Portable Network Graphic format (a replacement for the proprietary GIF format)
POSIX	Portable Operating System Interface for Computer Environments
Post-D	Post Detected
PPP	Point to Point Protocol
PPS	1) Precise Positioning Service (GPS) 2) Pulses Per Second
Pre-D	Pre Detected

PW	Pulse Width
QAM	Quadrature Amplitude Modulation
QPSK	1) Quadrature Phase Shift Keying 2) Quarternary Phase Shift Keying
q.v.	Which see
RF	Radio Frequency
RFC	Request for Comment (Internet)
RISC	Reduced Instruction Set Computers
RMS	1) Requirements Management System 2) Root Mean Square
RSOC	Regional Security Operations Center
RSS	Root Sum of Squares
Rx	Receiver
SA	Systems Architecture
SCSI	Small Computer Systems Interface
SED	Signal External Data
SGML	Standard Generalized Markup Language
SHF	Super High Frequency (3 - 30 GHz)
SHADE	Shared Data Environment
SIGINT	Signals Intelligence
SLIP	Serial Line Internet Protocol
SMTP	Simple Mail Transfer Protocol
SOF	Special Operations Forces
SPAWAR	Space and Naval Warfare Systems Command
SPAWARSYSCOM	Space and Naval Warfare Systems Command
SRI	Signal Related Information
STRUM	Standardized Technical Reporting Using Modules
SV	Systems View
SWAP	Size, Weight and Power
TA	Technical Architecture
TAD	Theater Air Defense
TADIL	Tactical Data Information Link
TAFIM	Technical Architecture Framework for Information Management (DoD)
TAWG	Technical Architecture Working Group
TBD	To be determined
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
TCSEC	Trusted Computer Systems Evaluation Criteria
TCSWG	Tactical Cryptologic Systems Working Group
TDMA	Time Division Multiple Access
TDOA	Time Difference of Arrival

TEP	Time Event Pulse
TIDP-TE	Technical Interface Design Plan – Test Edition
TIFF	Tag Image File Format
Tkit	Toolkit
TOA	Time of Arrival
TRM	Technical Reference Model
TSPO	Tactical SIGINT Program Office
TSWG	Tactical Standards Working Group
TTL	Transistor-to-Transistor Logic
TV	Technical View
Tx	Transmitter
UCA	Unified Cryptologic Architecture
UCAO	Unified Cryptologic Architecture Office
UNI	User-to-Network Interface
UPE	User Portability Extension
USCS	United States Cryptologic System
USNO	United States Naval Observatory
USSID	United States Signals Intelligence Directive
USSOCOM	United States Special Operations Command
UTC	Universal Time Coordinated
VME	Versa Module Eruocard
VMF	Variable Message Format
VRMS	Volts RMS
VTCP	Voice Transfer Control Protocol
VXI	VME Extension for Instrumentation
W3C	World Wide Web Consortium
WAGE	Wide Area GPS Enhancement
WAN	Wide Area Network
WGS	World Geodetic System
WRT	With Respect To
WWW	World Wide Web

Appendix B

Glossary

Accuracy -- The degree to which something corresponds to that of an accepted definition. [5] The quality of freedom from mistake or error, that is, of conformity to truth or rule, or to an international standard. [10]

Active-Array Radar -- An array in which all or parts of the elements are equipped with their own transmitter or receiver or both. [24]

Advanced Cryptologic Carry-On Exploitation System – A system that provides automatic and manual intercept and collection of COMINT. It can function either as a stand-alone system or in concert with other JMCIS systems. Also called ACCES.

Advanced Submarine Tactical ESM Combat System -- A permanently installed system designed for the New Attack Submarine. This system is comprised of three component subsystems providing COMINT intercept and wideband and narrowband ELINT coverage. The systems are integrated using a Controls and Display Subsystem which forms an integral reporting part of the Combat System architecture. Also called ASTECS.

Advanced Integrated Electronic Warfare System -- An advanced "new" generation ELINT system designed as a tactical electronic warfare asset for major surface combatants. This system will be fully integrated into the shipboard Combat System. Also called AIEWS.

Amplitude Modulation -- A modulation technique in which the amplitude of the signal carries the information. [13] A type of modulation in which the carrier is modulated in a discrete or continuous pattern for the duration of the pulse. [14] Also called AM.

Amplitude Phase Shift Keying -- A form of digital modulation that uses both amplitude and phase modulation. [12] Also called APSK.

Analysis -- A process in the production step of the intelligence cycle in which intelligence information is subjected to systematic examination in order to identify significant facts and derive conclusions. [3]

Angle of Arrival -- The horizontal component, sometimes referred to as the Azimuth of Arrival, of the angle with respect to North or a "mark" or a point on an array or platform or system from which an emitter's RF wavefront appears to arrive (can be corrupted by multipath, diffraction, etc.). Also called AOA.

Application Platform -- The collection of hardware and software components that provide the services used by support and mission-specific software applications. [9]

Application Programming Interfaces -- A documented interface designed to allow the programmer of a client process to access the capabilities of a server. Typically these take the form of a library and header file that are linked and included respectively into the application. The documentation is in the form of manual pages, and may be supplemented by more descriptive documentation. [25] Also called API.

Architecture -- 1. System model with well defined functions, design rules, and interface standards [1],
2. The structure of components, their interrelationships, and the principles and guidelines governing their design and evolution over time. (IEEE STD 610.12) [9],
3. Organizational structure of a system or component. (IEEE STD 610.12) [9],
4. An architecture is a composition of (1) components (including humans) with their functionality defined (Technical), (2) requirements that have been configured to achieve a prescribed purpose or mission (Operational), and (3) their connectivity with the information flow defined (System). [28]

Area of Interest -- That area of concern to the commander, including the area of influence, areas adjacent thereto, and extending into enemy territory to the objectives of current or planned operations. This area also includes area occupied by enemy forces who could jeopardize the accomplishment of the mission. [21] Also called AOI.

Assignment -- The selection of a solution paradigm to achieve the optimization defined in the correlation step, resulting in the assignment of sensor data to entities. [14]

Association -- The definition and calculation of a closeness metric on which the assignment of sensor data items to entities will be decided. [21]

Attitude -- Inclination of the three principal axes of an aircraft relative to the wind, to the ground, etc.

Attribute -- An identity or class-revealing characteristic of an object as either measured by a sensor or derived from the sensor data. [21]

Automated Copy -- Upon detection, a signal is collected without operator intervention.

Automated Search -- See Search.

Automatic Link Establishment -- Feature used to establish HF links automatically. [13] Also called ALE.

Autonomous Operations -- Independent collection, processing, and timely reporting of intelligence data by the airborne sensor when datalink line of sight or satellite tether operations with a remoted processing facility are not available or desired. [7]

Availability -- The probability that system functional capabilities are ready for use by a user at any time, where all time is considered, including operations, repair, administration, and logistic time. Availability is further defined by system category for both routine and priority operations. (JOPES ROC) [9]

Average Bearing -- 1. Formally; the quotient obtained when the number of observations divides the arithmetic total of all bearings on a target,
2. In DF operations, commonly considered the average of usable bearings. [6]

Bandwidth --.Range of frequencies passed by a filter or an electrical system. Bandwidth is defined such that it includes the portion lying between the points at which the power has dropped to half (3 dB) the center of the band.

Baseline -- A specification or product that has been formally reviewed and agreed upon, that thereafter serves as the basis for further development, and that can be changed only through formal change control procedures or a type of procedure such as configuration management. (IEEE STD 610.12) [9]

Battle Group Passive Horizon Extension System -- A C2W system that provides over-the-horizon indications and warning. It allows exploitation of conventional communications signals of interest and local receiving capability. Also called BGPHES.

Battlespace Information Infrastructure -- The shared or interconnected system of computers, communications, data, applications, security, people, training, and other support structures serving the tactical commander's information needs. The Battlespace Information Infrastructure connects DoD mission support, command and control, and intelligence computers through voice, telecommunications, imagery, video, and multimedia services. It provides information processing and services to subscribers over the Defense Information Systems Network and includes command and control, tactical intelligence and commercial communications used to transmit DoD information.

Baud -- A unit of signaling speed equal to the number of discrete conditions or signal events per second. For example, one baud equals one half dot cycle per second in Morse code, one bit per second in a train of binary signals, and one 3-bit value per second in a train of signals each of which can assume one of 8 different states. The bit rate and baud are not synonymous and shall not be interchanged in usage. Preferred usage is bit rate, with baud used only when the details of a communication modem or channel are specified. [10]

Bearing -- In DF, an indication of the horizontal direction from which a target's signal is received, expressed by the angle in degrees between a pre-established direction, usually true north, and the apparent direction of the target. Preferred term for line of bearing. [6]

Best Point Estimate -- A reference point, located within a fix-confidence region, which is derived from evaluation of three or more bearings and is used in determining the shape and area of the region. Preferred term for "fix point." [6] Also called BPE.

Binary Frequency Shift Keying -- A modulation technique in which the instantaneous frequency is shifted between two discrete values called the mark and space frequencies. [13] Also called BFSK.

Binary Phase Shift Keying -- A form of modulation that uses absolute encoding of the original binary waveform to create two phase states which are 180 degrees apart. [12] Also called BPSK.

Bit -- 1. An abbreviation of binary digit. [10];
2. A single occurrence of a character in a language employing exactly two kinds of characters. [10];
3. A unit of storage capacity. The capacity, in bits, of a storage device with logarithm to the base two of the number of possible states of the device. [10]

Bit Error Ratio -- The ratio of the number of bit errors to the total number of bits transmitted in a given time interval. BER may be measured directly by detecting errors in a known signal, or approximated from code violations or framing bit errors. Numerical values of error ratio should be expressed in the form n*10p, where p is an integer greater than zero. When n is omitted, the implied value is 1. [10] Also called BER.

Bit Rate -- 1. The rate of data throughput on the medium (in b/s or Hz, whichever is more appropriate to the context). [10];
2. The number of bits transmitted per unit of time, usually expressed in bits per second (bps). [10] Also called BR.

Built In Test -- Detailed system, sub-system, or box level internal tests. The primary means of isolating faults to broken or out-of-tolerance Line Replaceable Units. Also called BIT.

Burst Transmission -- 1. A communications scheme in which data is compressed over time and transmitted in a fraction of the time it would have taken to transmit the data in real time. As an example, in a Time Division Multiple Access (TDMA) system a terminal transmits only during its allocated time slot;
2. A communications scheme in which a transmission is on the air long enough to complete the transmission of a relatively brief message. An example is command and control communications. In this case, the data may or may not be compressed in time;
3. Doing #1 or #2 above to deny unauthorized access to the signal (low probability of intercept). [7]

Byte -- 1. (signals and paths, microcomputer system bus) A group of eight adjacent bits operated on as a unit. [10];

2. (signals and paths, 696 interface devices) A set of bit-parallel signals corresponding to binary digits operated on as a unit. Connotes a group of eight bits where the most significant bit carries the subscript 7 and the least significant bit carries the subscript 0. [10]

C4I Tactical Data Link -- A link that connects C4I systems for the purpose of transmitting and receiving tactical data. It is made up of separate elements that permit the transfer of data. The physical hardware or devices forming the communications equipment/medium (e.g., radio, data communications protocols) and data processor, and the message standard (e.g., message formats, data elements, and protocols) and operational procedures that permit end-to-end transfer, acceptance, and use of digital information. Also called C4I TDL. Key characteristics include:

1) Computer-to-computer data exchange. Information must be processed before use by the warfighter.
2) Digital information structure. Typically bit-oriented, but may include characters bit-encoded messages for transmission.
3) Real-time or near real-time information exchange. [26]

Carrier Frequency -- The frequency of the carrier wave. [13]

Cryptologic Carry-On Program -- Provides cryptologic equipment, functionality, and technology to the warfighter through a "quick response" fast track program. Also called CCOP.

Characterization of Environment -- Mapping signal levels, activity, direction/ geolocation, etc., for a given area.

Characterization of Signal -- Determining enough parameters of a signal to allow subsequent collection and processing (e.g., center frequency, bandwidth, modulation, baud rate).

Circular Error Probability -- An indicator of the delivery accuracy of a weapon system, used as a factor in determining probable damage to a target. It is the radius of a circle within which half of a missile's projectiles are expected to fall. [21] Also called CEP.

Circular Fix-Confidence Region -- A fix-confidence region which is described by a best point estimate expressed in coordinates of latitude and longitude, and the radius (in units of linear measure) of a circle centered on that point. Preferred term for "circular error of probability." [6]

Classification -- 1. The determination by any means whereby the identity, class, or category of an entity (person, object, or target) is provided (e.g., naval class, country of origin, aircraft type, etc.). [21]

2. Determination of modulation scheme.

Cooperative OUTBOARD Logistics Update -- Updates the OUTBOARD system by replacing outdated equipment and improved logistic supportability. This upgrade uses a common core system using modular/LAN concepts and NDI from other programs. Also called COBLU.

Cochannel Copy -- Interception (q. v.) in the presence of another (or multiple) signal(s) within the information bandwidth.

Cochannel DF -- Direction Finding (q. v.) in the presence of another (or multiple) signal(s) within the processing bandwidth.

Cochannel Interference -- 1. Interference caused in one communication channel by a transmitter operating in the same channel. [10];
2. More than one source of RF energy within a given signal channel.

Code Division Multiple Access -- Means by which a group of stations representing several different communications links may share a repeater or other terminal; achieved by assigning each link a different spectrum spreading code to avoid interference. [11] A multiple access technique that uses a pseudorandom code to spread each individual transmission over the entire bandwidth. [13] Also called CDMA.

Code Generator -- A device that determines the sequence of frequency hops in a frequency hopping signal. [13]

Cold Start -- A complete restart of a system or subsystem to a baseline setting

Collateral -- All national security information classified under the provisions of an Executive Order for which Special Intelligence community systems or compartmentation (i.e., sensitive compartmented information) are not formally established. [21]

Collect -- 1. In SIGINT, when used generically, to search, acquire, monitor, and record electromagnetic emissions. Contrast with intercept. Note: Collection implies the keeping and using of the material collected. Intercept, on the other hand, is not limited until and unless it becomes collection. [14];
2. In SIGINT, to record electromagnetic emissions onto specified media. Preferred term for “copy” (def 1). [14];
3. Tune to a signal/frequency and capture (digitize, record) a specified length (fixed time, as long as signal is above threshold, etc.) of what is present.

Combat DF -- Provides a state-of-the-art follow-on to the OUTBOARD. CDF is based on a distributed architecture with interfaces to RF and DF hardware across a system-wide ethernet bus. Also called CDF.

Commercial Item -- 1. Any item customarily used by the general public for other than governmental purposes, that has been sold, leased, or licensed to the general public, or that has been offered for sale, lease or license to the general public.

2. Any item that evolved from an item described in 1) above through advances in technology or performance that is not yet available in the commercial market, but will be available in time to meet the delivery requirements of the solicitation.
3. Any item that, but for modifications of a type customarily available in the commercial market or minor modifications made to meet DoD requirements, would satisfy the criteria in 1 or 2 above.
4. Any combination of items meeting the requirements of 1, 2, or 3 above or 5 below that are of a type customarily combined and sold in combination to the general public.
5. Installation services, maintenance services, repair services, training services, and other services if such services are procured for support of any item referred to paragraphs 1, 2, 3, or 4, above, if the sources of such services:
   -- offer such services to the general public and the DoD simultaneously and under similar terms and conditions, and
   -- offers to use the same work force for providing the DoD with such services as the source used for providing such services to the general public.
6. Services offered and sold competitively, in substantial quantities, in the commercial marketplace based on established catalog prices of specific tasks performed and under standard commercial terms and conditions.
7. Any item, combination of items, or service referred to in 1 through 6 above notwithstanding the fact that the item or service is transferred between or among separate divisions, subsidiaries, or affiliates of a contractor.
8. A non-developmental item developed exclusively at private expense and sold in substantial quantities, on a competitive basis, to State and local governments. (The NDI Handbook DoD 5000.37H, 30 June 1995 draft) [28]

Commercial-like Product -- See Commercial Item. [28]

Commercial-off-the-shelf -- 1) Refers to an item of hardware or software that has been produced by a contractor and is available for general purchase. Such items are at the unit level or higher. Such items must have been sold and delivered to government or commercial customers, must have passed customer's acceptance testing, be operating under customer's control, and within the user environment. Further, such items must have meaningful reliability, maintainability, and logistics historical data. [9]; 2) See Commercial Item. [28] Also called COTS.

Commercial Product -- See Commercial Item. [28]

Common -- Modules that can be used without modification to build a scalable system. [8]

Common High Bandwidth Data Link -- The high bandwidth variant of the CDL signal used with BGPHES ground stations to allow reception of wideband data from Navy and Joint airborne sensor platforms. Also called CHBDL.

Common Information Infrastructure -- A web of communications, networks, computers, software, databases, applications, and other capabilities that will meet the information processing and transport needs of users within the cryptologic community. Also known as CII.

Common Operating Environment -- The runtime environment. It allows segments developed by separate developers to function together and act as an integrated system. [based on 25] Also called COE.

Computer Software Configuration Item -- This is the software level lowest in the JMCIS attention range. The CSCI is one or more executable or data files that fill a set of user requirements. These components do not have meaning on their own to the end user. Their components only have meaning to developers. [25] Also called CSCI.

Copy -- 1. In SIGINT, the preferred terms are collect and intercept. Copy is operator slang for the process of collection or intercept.;
2. The material produced as the result of collection. [14]

Core -- Core is a designation that indicates that a particular piece of software is depended upon by a large body of other CSCI. Changes to such components require significant consideration by a configuration control board that represents the needs of the client software producers. [25]

Correlation -- The structural, functional, or qualitative correspondence between comparable entities; a decision-making process which employs an association metric as a basis for allocating or assigning sensor measurements and/or reports to the hypothesized entities of interest. [21]

Correlation/Tracker Algorithms -- Algorithms or systems which perform the process of correlation and tracking. These processes are typically derived from modern estimation theory and operate on kinemetric data or estimates to produce a statistically-optimal, fused estimate of an object's position. [21]

Cueing -- A collection asset management technique whereby coarse grain (detection, general location, and possible recognition) information obtained from wide areas surveillance systems is used to concentrate the efforts of secondary sensor systems with more detailed information gathering capability to obtain fine grain (location, recognition, and possibly identification) information in order to identify the composition of enemy units for decision-making purposes and to acquire targets. [21]

Cut -- 1. In DF, the lines of bearing;
2. A recording of a single intercept of a single signal.

Critical Failure -- The failure of any component, or set of components, which causes the complete loss of system functionality or the loss of principle assigned mission functions.

Cryptologic Material -- Documents, equipment, and devices used in signals intelligence or communications security. [3]

Continuous Wave -- 1. Unmodulated RF carrier, either normal on or sometimes (HF usage) on-off keyed;
2. In ELINT, a pulse (modulated or unmodulated) greater than a specified duration;
3. A modulated RF signal that is almost always on. Also called CW.

Data Element -- A basic unit of information built on standard structures having a unique meaning and distinct units or values. (Joint Pub 1-02) [26]

Data Fusion -- A process dealing with the association, correlation, and combination of data and information from single and multiple sources to achieve refined position and identity estimates, and complete and timely assessments of situations and threats as well as their significance. [21]

Data Fusion Functional Levels -- Level 1 products are those which specify position, identity, and amplifying kinematic and classification characteristics such as features. Level 2 products are those which specify relationships among entities such as tactical intent and estimate lethality. Level 2 processes generally perform contextual analyses of the Level 1 products by employing numerous a priori databases. Level 2 fusion results in a Situation Assessment which includes various behavioral characteristics of the hostile force (events and activities analyses). Level 3 products provide a Threat Assessment by estimating hostile force lethality and intent and other higher level intelligence functions. [21]

Database Architecture -- The logical view of the data models, data standards, and data structure. It includes a definition of the physical databases for the information system, their performance requirements, and their geographical distribution. (DoD 8020.1-M, Appendix J) [9]

Defense Information Infrastructure -- The shared or interconnected systems of computers, communications, data, applications, security, people, training, and other support structures serving DoD local, national, and worldwide information needs. The Defense Information Infrastructure connects DoD mission support, command and control, and intelligence computers through voice, telecommunications, imagery, video, and multimedia services. It provides information processing and services to subscribers over the Defense Information Systems Network and includes command and control, tactical intelligence and commercial communications systems used to transmit DoD information. Also called DII. (This term and its definition are approved for inclusion in the next edition of Joint Pub 1-02)

Dehop -- Despreading of frequency hopper to collapse signal into its information bandwidth.

Deinterleave -- 1. In ELINT, separation of pulses into trains of pulses from a common emitter;
2. In COMINT, reordering of/processing of bits to restore original order of bits (e.g., block error code deinterleavers).

Delta Modulation -- A form of digital modulation that encodes an analog signal by measuring and transmitting the signal's slope polarity. [12] Also called DM.

Demodulation -- 1. The process of recovering the modulating waveform from a modulated carrier. [14];
2. The process which restores a modulated signal to its original form. [12] Multiple levels of modulation may be present in complex signals.

Depression Angle -- An angle of arrival of a received signal at an airborne platform measured below the horizontal plane. [6]

Detail Specification -- A specification that specified traceable design requirements, such as materials to be used, how a requirement is to be achieved, or how an item is to be fabricated or constructed. A specification that contains both performance and detail requirements is still considered a detail specification. (MIL-STD-961D modified by OSJTF 1995) [28]

Detect -- An output of a discriminating process indicating signal plus noise rather than noise.

Detection -- 1. Decision that the received output is due to signal plus noise rather than noise alone;
2. In tactical operations, the perception of an object of possible military interest, but unconfirmed by recognition. [21];
3. In surveillance, the determination and transmission by a surveillance system that an event has occurred. [21];
4. In arms control, the first step in the process of ascertaining the occurrence of a violation of an arms control agreement (JCS). [21]

Diagnostics -- Functional tests directed at specific operations to further isolate failures to a single Line Replaceable Unit

Differential Doppler -- The difference in absolute frequency of a signal received at two points. Also called DD.

Differential Phase Shift Keying -- A form of digital modulation that transmits information based on phase shifts relative to preceding phase changes in the carrier. [12] Also called DPSK.

Digital Signal Processing -- Performing various operations, such as filtering, on signals after they have been converted to a stream of digital numbers. [24] Also called DSP.

Direct Current -- 1. Unidirectional current; as used in IEEE Std 400-1991, the term denotes a practically nonpulsating current. [10];
2. The time average value of the current in the dc link. [10] Also called dc.

Directed Search -- See Search.

Direction Finding -- The process of determining the azimuth of an emitter by the use of a direction finder. [6] Also called DF.

Dissemination - The timely distribution of intelligence products (in oral, written, or graphic form) to intelligence consumers in a suitable form.

Distributed Database -- 1. A database that is not stored in a central location but is dispersed over a network of interconnected computers. [10],
2. A database under the overall control of a central database management system but whose storage devices are not all attached to the same processor. [10],
3. A database that is physically located in two or more distinct locations. (FIPS PUB 11-3) [9]

Distributed Processing -- A design in which all data is not processed in one processor. Multiple processors in the master station or in the remote stations, or both, share the functions. [10]

Distributed System -- A computer system in which several interconnected computers share the computing tasks assigned to the system. [10]

Domain -- A Domain is a grouping of related items within a certain area of interest. DoD domains include Operational Domains (e.g., Joint Strike, Strategic Deterrence) and Functional Domains (e.g., communications, navigation, fire control). (TRI-SERVICE Open Systems Architecture Working Group) [28]

Doppler shift -- Change in the frequency of a wave caused by motion of its source or the observer. [11]

Double Sideband Amplitude Modulation -- A form of amplitude modulation that transmits both the upper and lower sidebands of the modulated signal. [12] Also called DSB-AM.

Duct -- A region in the troposphere which can trap radio waves. [11]

Duty Cycle -- 1. Of an emitter - in any system with intermittent or pulsed operation, the ratio of the active or on time to the duration of the specified period. In systems with a periodic repetition cycle it is the ratio of the on time during one cycle to the total period of one cycle,

2. Of a signal - The ratio of the on or non-zero valued time interval to the total time interval for a (usually) periodic feature of a signal. Depending upon the structure of the signal, it can have several duty cycles, one for each feature.

Dwell Time -- The amount of time that a carrier frequency remains constant in a frequency hopping signal. (Also called hop interval or hopping period.) [13]

Dynamic Calibration -- Performed during actual mission. This process corrects for any environmental or platform oriented-biases and/or ambiguities. It is required in systems where fine-resolution measurements are needed for signal intercept and direction finding. The calibration tables relate to parametric changes in measurement components brought about by variations in temperature caused by changes in platform elevation.

Dynamic Range -- 1. The difference in decibels between the overload level and the minimum acceptable signal level in a system or transducer. Note: The minimum acceptable signal level of a system or transducer is ordinarily fixed by one or more of the following -- noise level, low-level distortion, interference, or resolution level. [10],
2. The range measured in dB from the noise floor to the 1-dB compression point (the input RF power level at which conversion loss increases by 1 dB).

Electronic Order of Battle -- A listing of non-communications electronic devices including site designation, nomenclature, location, site function, and any other pertinent information obtained from any source and which has military significance when related to the devices. [21] Also called EOB.

Electronics Intelligence -- Technical and intelligence information derived from foreign non-communications electromagnetic radiations emanating from other than atomic detonation or radioactive sources, by other than the intended recipients. [3] [21] Also called ELINT.

Elliptical Fix-confidence Region -- A fix confidence region which is described by a best point estimate expressed in coordinates of latitude and longitude, the lengths of the semimajor axis and semiminor axis of the ellipse in units of linear measure, and the azimuthal orientation of the major axis in degrees, with regard to true north. Preferred term for "elliptical error of probability." [6]

Encapsulation -- Data is said to be encapsulated when access to the data (either for reading or manipulating) is restricted to calls through functions. In this way the programmer of the client software is unaware (either practically or more often just due to lack of direct access) of the actual implementing details of the data structures he or she is utilizing. As a result, the implementation may be modified without invalidating the client programs as long as the interfacing function calls have not changed and as long as the behavior of the server has not altered. [25] Also called Data Encapsulation.

Encryption -- A technique used to encode or scramble data in order to enhance message security. [13]

Environmental Map -- A process by which the frequency spectrum of interest is searched for emitters. Once energy is detected, the mapping consists of identifying the signal type (classification) and locating its source geographically. [7]

Environmental Search -- Searching a frequency range and logging all energy (frequency, bandwidth) and its direction of arrival or, preferably, its geolocation.

Epoch (time) -- A selected instant in time used as a reference point. [5]

Evolution -- A process of continuous change from a lower, simpler, or worse to a higher, more complex, or better state. [20]

Evolutionary Acquisition/Development -- An alternate approach to developing systems to that of structured development. Evolutionary techniques create interim deliverables that allow the user to get some of the capabilities of the final system earlier. This allows the user to help better define requirements for the system by creating a frame of reference that both the user and the developer can understand. In developing such systems, opportunities for reuse can come from bottom-up analysis. [25]

Exploit -- To obtain intelligence information from a signal. This includes information which characterizes the signal itself (parameters) or information which is being conveyed by the signal (voice or data).

Exploitation -- The process of obtaining intelligence information from any source and taking advantage of it for intelligence purposes. [21]

External Environment Interface -- The interface that supports information transfer between the application platform and the external environment. (APP) [9] Also called EEI.

Fading -- The variation of radio field intensity due to changes in the transmission medium and transmission path. [13]

Failure -- A hardware or software anomaly which results in an inability to perform a specific mission function and which generates a documented job assignment for maintenance action.

False Alarm -- 1. In maintenance, whenever the system indicates a failure has occurred and, in fact, there is no failure,

2. In signal detection, whenever the detector indicates an event has occurred and, in fact, no event has occurred.

Fast Frequency Hopping -- There is a frequency hop for each transmitted symbol. [18]

Feature -- 1) In cartography, any object or configuration of ground or water represented on the face of the map or chart (JCS).; 2) Generically, any identity or class-revealing characteristic of an entity as either measured by a sensor or derived from sensor data. [21]

First Syllable Detection -- For a limited set of a priori frequencies, the capability of detecting a signal and providing audio to the operator within the first syllable of conversation.

Fix – 1. The best point estimate of the intersection of three or more bearings,
2. To locate a target with a required degree of accuracy,
3. Pertaining to the capability to plot a fix. [6]

Fix-confidence Region -- A geographic area which has been computed by a fixing algorithm or the use of manual plotting procedures and in which a given target(s) is presumed to be located to a given degree of probability (usually 90% probable). The region is described by (1) the geographic coordinates of the best point estimate for the target(s), and (2) depending on its shape, by a radius given in units of linear measure (circle) or a semimajor axis and semiminor axis and the azimuthal orientation of the target in degrees, with regard to true north (ellipse or rectangle). The area may also be given if the regions are elliptical or rectangular. The radius of a circle equivalent in size to the given ellipse is also provided. [6]

Frequency of Arrival -- FOA is the frequency of the intercepted signal as derived by the equipment.

Foreign Instrumentation Signals Intelligence -- Technical and intelligence information derived from intercept of foreign instrumentation signals. [3] Also called FISINT

Forward Line of Own Troops -- A line which indicates the most forward positions of friendly forces in any kind of military operation at a specific time. The FLOT normally identifies the forward location of covering and screening forces (JCS). [21] Also called FLOT.

Frame -- A portion of a signal which displays a repetitive characteristic. [12]

Frequency Adaptivity -- The ability to choose frequencies by evaluating frequency availability and environmental conditions. [13]

Frequency Agility -- The ability to move from one frequency to another quickly and easily. [13]

Frequency Diversity -- A technique where the same information is transmitted on different frequencies at the same time. [13]

Frequency Division Multiple Access -- Means by which a group of stations representing several different communications links may share a repeater or other terminal; achieved by dividing the terminal's frequency range among the links. [11] Also called FDMA.

Frequency Division Multiplexing -- Process by which the frequency spectrum of a communications channel is divided into portions for the purpose of placing several information channels within it. [11] Also called FDM.

Frequency Hopping -- A type of spread spectrum signal modulation in which the transmitted frequency hops from one frequency to another in a pseudorandom manner. [13] Also called FH.

Frequency Hopping/Direct Sequence -- A hybrid spread spectrum modulation technique in which the carrier of a direct sequence signal follows a frequency hopping pattern. [13] Also called FH/DS.

Frequency Hopping Pattern -- The sequence of frequencies selected in a frequency hopping system. Also called frequency hopping sequence. [13]

Frequency Modulation -- Variation of the frequency of the carrier proportional to the instantaneous amplitude of the information or modulating signal. [13] Also called FM.

Frequency Scanning -- A radar technique whereby different beam positions are associated with different frequencies. [13] Also called Frescan.

Frequency Separation -- The distance between any two adjacent carrier frequencies.

Frequency Shift Keying -- A form of digital modulation that transmits a separate frequency for each discrete signal state. [12] Also called FSK.

Frequency/Time Hopping -- A hybrid spread spectrum modulation technique in which the frequency of a transmitted burst changes from one time slot to the next. [13]

Full Duplex -- Capability for simultaneous two-way transmissions over a communications link. [11]

Functional Architecture -- The framework for developing applications and defining their interrelationships in support of an organization's information architecture. It identifies the major functions or processes an organization performs and their operational interrelationships. (DoD5000.11-M) [9]

Fusion Reporting -- In SIGINT use, the term "fusion" refers to the process of integrating or combining information from more than one source to the extent that each source loses its individual identity in the product. [3]

Force Warfare Systems Engineering Board -- Established to provide a total warfare systems engineering focus aimed at achieving naval warfare interoperability, enhanced commonality, and consistent standardization practices with the Deputy Assistant Secretary

of the Navy for Command, Control, Communications, Computers, Intelligence/Electronic Warfare/ Space (DASN (C4I/EW/Space)) designated as its chair. Also called FWSEB.

General Search -- See Search.

Geolocate -- The process of establishing the geographical location of a signal of interest. [6], [8]

Gisting -- The act of an operator/analyst determining and recording the sense or main thought of a transmission rather than producing a verbatim text.

GPS Time -- The integer and fraction number of seconds that have passed since midnight Saturday night/Sunday morning.

Graceful Degradation -- One function/sub-function/module ceasing proper operation does not imply that other functions/sub-functions/modules also cease proper operation.

Ground Station -- A facility on the ground or sea which supports or conducts operations of an airborne asset; may generically apply to a facility on an aircraft which is used to control assets on another aircraft.

Half Duplex -- Capability for only one-way transmission at any one time over a communications link. [11]

Hard Real-Time -- Deadlines are deterministic and must be met. Data is lost or loses its value after a deadline expires. Failing to process the information in a buffer before it is overwritten is an example.

Heading -- The direction of a ship, aircraft, or other object with reference to true, magnetic, compass, or grid north. [6]

High Band Prototype -- Prototype JASS hardware building on SENIOR SMART and SENIOR SMART technology insertion efforts. Will demonstrate modular/reconfigurable hardware and software, commercial off the shelf computer processors, and multi-channel and wide band ELINT functional capabilities.

High Capacity Multichannel -- A historical division of multichannel systems within the SIGINT community, referring to those systems with more than either 120 or 132 (definition varied between using organizations) channels.

Hop Interval -- The amount of time that a frequency remains constant in a frequency hopping signal. (Also called dwell time.) [13]

Hybrid Spread Spectrum Modulation -- A modulation technique that combines two or more spread spectrum modulation techniques. [13]

Identification -- 1. In SIGINT, determination of the type of emitter generating an intercepted signal.
2. The process of determining the friendly or hostile character of an unknown detected contact. [21]
3. In arms control, the process of determining which nation is responsible for the detected violations of any arms control measure. [21]
4. In combat operations, discrimination between recognizable objects as being friendly or enemy, or the name that belongs to the object as a member of a class (e.g., IFF, NCTI, NCTR) (JCS). [21] Also called ID.

Identification Friend or Foe -- Equipment used for transmitting radio signals between two stations located on ships, aircraft, or ground, for automatic identification. [24] Also called IFF.

Impulse Waveform -- A unidirectional surge generated by the release of electric energy into an impedance network. [24]

Information Exchange Requirements -- A statement of the need to exchange information between two (or more) entities, organizations, command and control facilities, etc. The information to be exchanged must be specified in the context of mission areas. [26] Also called IER.

Information Operations -- Actions taken to affect adversary information and information systems while defending one's own information and information systems. Also called IO. (This term and its definition are approved for inclusion in the next edition of Joint Pub 1-02). IO is broadly defined by DoD to include the five original disciplines of Command and Control Warfare (Psychological Operations, Operations Security, Deception, Electronic Warfare, and Physical Destruction), plus the new disciplines of Computer Network Attack and Computer Network Defend. This broad definition recognizes that all of these topics are interdependent and synergistic. IO is a set of enabling disciplines. The Intelligence Community does not conduct the full range of IO activities, but its activities are often essential elements of U.S. Government IO programs and they always support larger U.S. Government objectives. (Draft Director of Central Intelligence Directive 7/3-1 of 4 Dec 98)

Instantaneous Bandwidth -- 1. The bandwidth centered around the carrier frequency for one hopping period in a frequency-hopping signal. [24]
2. For a receiver, same as bandwidth (q.v.).
3. For a SIGINT system, the total continuous signal bandwidth available for signal processing. When the system instantaneous bandwidth is greater than the bandwidth of a single receiver, the system instantaneous bandwidth is established by tuning a sufficient number of receivers to center frequencies slightly less than one receiver bandwidth apart and combining each receiver's bandwidth output to form a continuous whole. Also called IBW.

Intelligence Analysis -- A larger view process encompassing Situation Abstraction, Situation Assessment, and Threat Assessment for intelligence purposes.

- **Situation Abstraction** - The construction of a generalized or specialized representation of a situation from all available (yet perhaps incomplete) data.
- **Situation Assessment** - The process of interpreting and expressing the environment based on Situation Abstraction products and information from technical and doctrinal data bases. The Situation Assessment produces estimates of the situation elements, those information items that in the aggregate form the assessment. This process generally reveals constituency/dependency relations among the elements, and the behavioral activities of the objects within the scope of the estimate.
- **Threat Assessment** -- A multi-perspective process of interpreting estimates of lethality and risk. Done in terms of the ability of our own forces to engage the enemy effectively, and indications and warning of enemy intentions. Produced by coupling products of Situation Assessment with the information provided by a variety of technical and doctrinal data bases. [21]

Intelligence Cycle -- The processes by which information is acquired and converted into intelligence and made available to customers. There are usually five steps in the cycle:

- **Planning and Direction** - Determination of intelligence requirements, preparation of a collection plan, issuance of orders and requests to information collection entities, and a continuous check on the productivity of collection entities.
- **Collection** - Acquisition of information or intelligence information, and the processing of the information into a form more suitable for the production of intelligence.
- **Processing** - Conversion of collected information and/or intelligence into a form more suitable for the production of intelligence.
- **Production** - Conversion of information or intelligence information into finished intelligence through the integration, analysis, evaluation, and/or interpretation of all available data and the preparation of intelligence products in support of known or anticipated customer requirements.
- **Dissemination** - Conveyance of intelligence in suitable form to customers. [21]

Intercept -- In SIGINT, to acquire electromagnetic emissions intended for others without obtaining the consent of the originator or the intended addressees. Preferred term for copy (def 1). Contrast with collect (def 1). Note - intercept is not limited until and unless it becomes collection. Collection, on the other hand, implies the keeping and using of the material collected. [14]

Interface Standard -- A standard that specifies the physical or functional interface characteristics of systems, subsystems, equipment, assemblies, components, items or parts to permit interchangeability, interconnection, interoperability, compatibility, or communications. (MIL-STD-962C draft dated 14 June 1995) [28]

Interference -- 1. Any signal or electromagnetic disturbance that hinders the reception of a desired signal. [13]

2. In a signal transmission path, either extraneous power which tends to interfere with the reception of the desired signals or the disturbance of signal which results. [10]
3. In optics, the interaction of two or more beams of coherent or partially coherent light. [10]

Intermediate Frequency -- 1. A frequency to which a signal wave is shifted locally as an intermediate step in transmission or reception. [10]
2. The frequency resulting from a frequency conversion before demodulation. [10]

Intermodulation -- The modulation of the components of a complex wave by each other. As a result, waves are produced that have frequencies equal to the sums and differences of integral multiples of those of the components of the original complex wave. [10]

Intermodulation Distortion -- Nonlinear distortion of a system or transducer characterized by the appearance in the output of frequencies equal to the sums and differences of integral multiples of the two or more component frequencies present in the input wave. Harmonic components also present in the output are usually not included as part of the intermodulation distortion. When harmonics are included, a statement to that effect should be made. [10]

Interoperability -- 1. Ability of systems, units, or forces to provide services to, and accept services from, other systems, units, or forces, and to use the services so exchanged to enable them to operate effectively together.
2. The condition achieved among communications-electronics systems when information services can be exchanged directly and satisfactorily between them and/or their users. The degree of interoperability should be defined when referring to specific cases. [1]
3. The ability of two or more systems or components to exchange data and use information. (IEEE STD 610.12) [28]

J-Series Family of Tactical Data Links -- The family of data links based on common data elements, consisting primarily of the J-Series data elements, J-Series messages, and the communications protocols and hardware for Link 16 (TADIL J), Link 22, and VMF, as well as point-to-point, multi-point, and radio/satellite broadcast J-Series data link capabilities developed in the future. [26]

JASA Compliant -- Conforms to the Joint Airborne SIGINT Architecture. In particular, complies fully with the established standards and interfaces approved for JASA.

JASA Compliant System -- Fully satisfies a platform's operational requirements and conforms to the JASA.

Jitter (timing) -- The movement of zero crossings of a signal (digital or analog) from its expected times of occurrence.

Joint Airborne SIGINT Architecture -- An open systems architecture that will facilitate airborne SIGINT system modernization and interoperability. JASA will support the implementation of a family of modular, functional SIGINT capabilities through standardized airborne SIGINT components, enhancing interoperability, and supportability while reducing duplicative development efforts. Its system model is defined by the JASA Functional Reference Model and the standard and interfaces recommended by the JASA Standards Working Group. Also called JASA.

Joint Airborne SIGINT System -- The former name for a partial implementation of the Joint Airborne SIGINT Architecture. Now replaced by Joint SIGINT Avionics Family.

Joint SIGINT Avionics Family -- The evolutionary acquisition program which is building elements to implement JASA in the DoD airborne SIGINT fleet. It includes hardware and software prime mission equipment, platform Group A, related data links, and surface modules. JSAF employs the JASA open systems approach with non-proprietary standard interfaces and protocols to provide hardware and software commonality, modularity, and reconfigurability. There may be several configurations based upon each platform's Operational Requirements Document (ORD) and physical constraints. Also called JSAF.

Kernel -- This layer is the minimal set of software elements required on every workstation in the system. It will normally consist of an operating system, basic system administration functions, basic security functions, operator templates, and COE tools for segment installation.

Key Encryption Key -- Key used in rekey procedures to wrap (encrypt) or unwrap (decrypt) a key for transmission over hardwire or RF links. KEKs are also used to wrap/unwrap keys before they are placed in storage outside the KG boundary. Also called KEK.

Keying Rate -- The reciprocal of the duration of the keying interval expressed in baud. Also referred to as the modulation rate. [12]

Latency -- 1. The time interval it takes to process a signal from when it is detected to the output report.
2. The time interval between the instant at which an instruction control unit initiates a call for data and the instant at which the actual transfer of data begins.

Legacy Systems -- Systems that are candidates for phase-out, upgrade, or replacement. Generally, legacy systems are in this category because they do not comply with data standards or other standards. Legacy system work loads must be converted, transitioned, or phased out (eliminated). Such systems may or may not operate in a legacy environment. [9]

Line of Bearing -- Preferred term is bearing. [6] Also called LOB.

Line of Position -- In time difference of arrival (TDOA) applications, the isocline of all possible transmitter positions that would yield a constant time of arrival difference between signals arriving at two fixed receiver sites. [6] Also called LOP.

Line of Sight -- Radio wave propagation in which signals travel directly from the transmitting to the receiving antenna without undergoing significant refraction, scattering, or other modification. [11] Also called LOS.

Line Replaceable Unit -- Unit (box, circuit card assembly, component, etc.) which can be replaced at the organizational level. [7]

Linearity -- Linearity implies that the system response **g**(t) to any excitation **f**(t) can be described by the solution of a set of differential equations with constant coefficients, and thus the principle of superposition is also implied.

LINK 22 -- A tactical data link that provides tactical, beyond line-of-sight requirements not met by Link 16, to replace Link 11. It is a secure, flexible, tactical digital data link for real-time data exchange over high frequency (HF) and ultrahigh frequency (UHF) bands between maritime command and control processor (C2P) equipped platforms. Link 22, using an F-Series message standard based upon TADIL J, is designed to overcome the major deficiencies of Link 11 (e.g., vulnerability to loss of single network control station, low data rate, susceptibility to electronic counter measures (ECM)). The associated physical medium is provided by the NATO Improved Link Eleven (NILE) Communications Equipment (NCE) that uses TDMA architecture for multi-netted communications. [26]

Locate -- Determine the probable position of an emitter. [8]

Location -- The determination of the position of an object or activity with sufficient accuracy to permit its exploitation within the framework of area under surveillance. [21]

Logistics Reliability -- Average hours of operation between unscheduled maintenance events.

Low Band Subsystem -- A subsystem being acquired by the JASPO for inclusion in the JASS prime mission equipment. Also called LBSS.

Low Capacity Multichannel -- A historical division of multichannel systems within the SIGINT community, referring to those systems with less than either 120 or 132 (definition varied between using organizations) channels.

M-ary -- Multilevel digital modulation. (A 2 level modulation is binary.)

Maintainability -- The ability of the system to be retained in or restored to an operational condition.

Maritime SIGINT System -- An MSS is defined as any Navy, Marine Corps, or USSOCOM ship, submarine, manned or unmanned aircraft, ground vehicle, or manpack that has permanently or temporarily installed SIGINT equipment. This equipment provides SIGINT collection and processing elements, operator elements, intra-system data links, and associated internal and external interfaces. It also includes mechanical, electrical, and software interfaces that support the SIGINT system.

Market Acceptance -- Market acceptance means that an item has been accepted in the market as evidenced by annual sales, length of time available for sale, and after-sale support capability. (The NDI Handbook DoD 5000.37H, 30 June 1995 draft) [28]

Mean Repair Time -- Measure of on-equipment corrective maintenance time. Starts when the technician arrives at the aircraft and begins work.. Unless otherwise specified, it includes all necessary corrective maintenance actions, such as: preparation. Troubleshooting, accessing and repairing the equipment, making adjustments, and any verification functions.

Mean Time Between Failure -- For a specific interval, the ratio of total operating time to the number of failures in the same interval. [15] Also called MTBF.

Mean Time to Repair -- The total corrective maintenance time divided by the total number of corrective maintenance actions during a given period of time. [15] Also called MTTR.

Message -- A communication prepared in a form suitable for transmission by any means. [6]

Message Externals -- Those components of the preamble and postamble of a transmitted message that are discernible to the analyst, regardless of whether or not the text is encrypted. [3]

Meteor Burst -- Radio communications technique which uses scattering by the ionized trails of meteors entering the atmosphere to return signals to earth. [11]

Migration -- To move from one place to another. [20]

Militarized -- Items which are designed and manufactured to military requirements. (MIL-STD-2036B) [28]

Minimum Detectable Signal -- 1. The weakest signal the receiver can detect. [17]

2. The MDS is considered as the lower limit of the dynamic range, and is defined as a signal 3 dB greater than the equivalent noise level for a specified IF bandwidth. [19]
3. In radar, the minimum signal level which gives reliable detection in the presence of white Gaussian noise. Being a statistical quantity, it must be described in terms of a probability of detection and a probability of false alarm. [10] Also called MDS.

Minimum Shift Keying -- A form of FSK modulation where the keying rate and frequency shift are related. [13] Also called MSK.

Miss Distance -- A measure of DF accuracy. The shortest distance in linear units between the best point estimate and the target's location. [6]

Mission -- 1. A flight operation of a single aircraft or a group of aircraft charged with the performance of a specific task.
2. A specific task assigned to an individual, unit or organization, e.g., the tasks assigned to an intercept station.
3. Pertaining to or of a mission. [6]

Mission Reliability -- The probability that an available system will complete an assigned mission.

Modem -- A piece of equipment which can modulate and demodulate a signal. [12]

Modular -- Pertaining to the design concept in which interchangeable units are employed to create a functional end product. (FED-STD-1037C) [28]

Modulation -- The process that uses an information signal characteristic to alter the amplitude, frequency, or phase of a carrier signal. [12]

Module -- 1. The smallest electronic assembly (complete electronics chassis or circuit card assembly) that can be used to configure a scalable system. [8]
2. An interchangeable item that contains components.
3. In computer programming, a program unit that is discrete and identifiable with respect to compiling, combining with other modules, and loading. (FED-STD-1037C) [28]

Monitor -- In SIGINT, to observe or listen to, or for, an electromagnetic emission. [14]

MSH Compliant -- Conforms fully with the established standards and interfaces approved for the Maritime SIGINT Architecture.

Multichannel -- A system of communications in which two or more independent communication channels are carried simultaneously on the same medium [27]

Multi-function Radar -- A radar that performs two or more of the following functions: Early Warning, Target Acquisition, Target Tracking, Missile Guidance, or Target Illumination. [24]

Multipath -- The propagation of a wave from one point to another by more than one path. When multipath occurs in radar, it usually consists of a direct path and one or more indirect paths by reflection from the surface of the earth or sea or from large man-made structures. At frequencies below approximately 40 Megahertz, it may also include more than one path through the ionosphere. [10]

Multipath Transmission -- The propagation phenomenon that results in signals reaching the receiving antenna by two or more paths. When two or more signals arrive simultaneously, wave interference results. The received signal fades if the wave interference is time varying or if one of the terminals is in motion. [10]

Multiplex -- To combine more than one channel of information into one signal for transmission. [11]

N-ary -- Frequency Shift Keying (N-ary FSK) A form of FSK where N frequency subchannels are used to transmit data. [13]

Navigation -- Provide three dimensional position, attitude, and velocity information.

Net -- 1. A communications structure consisting of associated groups or links, all controlled at a common location and, presumably, serving the same immediate superior. [3]
2. In DF, three or more DF outstations operating under the direction of a net-control station; pertaining to or of a net. [6]

Node -- A network element with communication links to two or more other network elements, which may be other nodes or end users. [7]

Noise Power Ratio -- The decibel ratio of the noise level in a measuring channel with the baseband fully noise loaded to the level in that channel with all of the baseband noise loaded except the measuring channel. [16] Also called NPR.

Non Developmental Item -- A Non Development Item may be:

1. Any commercial item.
2. Any previously developed item in use by a US Federal, State or Local government agency or a foreign government with which the US has a mutual defense cooperation agreement.
3. Any item described in subparagraph 1 or 2, above, that requires only minor modification in order to meet the requirements of the procuring agency.
4. Any item currently being produced that does not meet the requirement of paragraph 1, 2, or 3 above, solely because the item is not yet in use. (The NDI Handbook DoD 5000.37H, 30 June 1995 draft) [28]

Non-Government Standard -- A standardization document developed by a private sector association, organization or technical society which plans, develops, establishes, or coordinates standards, specifications, handbooks, or related documents. The term does not include standards of individual companies. (DoD 4120.3-M) [28] Also called NGS.

Objective Architecture -- The architecture which is desired and planned.

Open Specifications -- Public specifications that are maintained by an open, public consensus process to accommodate new technologies over time and that are consistent with international standards. (IEEE POSIX 1003.0/D15) [28]

Open Standards -- Guideline documentation that reflects consensus based agreements on products, practices, or operations by nationally or internationally recognized industrial, professional, trade associations or governmental bodies. These standards support interoperability, portability, and scalability and are equally available to the general public at no cost or with a moderate license fee. (OSJTF 1995) [28]

Open System -- A system that implements sufficient open specifications for interfaces, services, and supporting formats to enable properly engineered components to be utilized across a wide range of systems with minimal changes, to interoperate with other components on local and remote systems, and to interact with users in a style that facilitates portability. An open system is characterized by the following:

- Well defined, widely used, non-proprietary interfaces/protocols
- Use of standards which are developed/adopted by industrially recognized standards bodies
- Definition of all aspects of system interfaces to facilitate new or additional systems capabilities for a wide range of applications
- Explicit provision for expansion or upgrading through the incorporation of additional or higher performance elements with minimal impact on the system (IEEE POSIX 1003.0/D15 as modified by the Tri-Service Open Systems Architecture Working Group) [28]

Open Systems Approach -- Acquisition programs shall follow an open systems approach for military systems design. This approach is a business and engineering strategy, implemented by the IPT process, to choose commercially supported specifications and standards for selected system interfaces (logical and physical), products, practices, and tools. Selection of commercial specifications and standards shall be based on:

- those adopted by industry consensus based standards bodies or de facto standards (those successful in the market place);
- market research that evaluates the short and long term availability of products built to industry accepted specifications and standards;
- a disciplined systems engineering process that examines tradeoffs of performance, supportability and upgrade potential within defined cost constraint; and
- allowance for continued access to technological innovation supported by many customers and a broad industrial base.

Open Systems Architecture -- A system architecture produced by an open systems approach and employing open systems specifications and standards to an appropriate level. (OS-JTF 1995) [28] Also called OSA.

Open Systems Standards -- Standards which control and fully define attributes for software, hardware, interface design, network protocol, circuit board design, etc. These standards have been developed and maintained in a commercial consortium or higher organization such as ISO or IEEE group consensus process. Standards have requirements for compatibility and interoperability at the interface, but they do not define the performance of a given product. A commercial manufacturer may change the performance of a product without government knowledge (consent is not required since we are now only another customer) and still comply with the standard. (NGCR Acquisition Guide 6 Mar 1995 Draft modified by OSJTF 1995) [28]

Operational Architecture -- A description (often graphical) of the operational elements, assigned tasks, and information flows required to support the warfighter. It defines the type of information, the frequency of exchange, and what tasks are supported by these information exchanges.

Operational ELINT -- The category of ELINT concerned with the introduction, disposition, movement, use, tactics, and activity levels of known foreign non-communications emitters and, where applicable, associated military systems. Operational ELINT may be used for the satisfaction of current intelligence needs and for Indications and Warning purposes. [3] Also called OPELINT.

Operational Readiness Test -- A system level test conducted by maintenance personnel to verify proper operations of mission functions by identifying all critical failures and giving indications of other failures. Can be run using only onboard equipment, but may use additional support equipment for more thorough testing.

Operational View -- A description of the tasks and activities, operational elements, and information flows required to accomplish or support a military operation. (C4ISR Architecture Framework V2.0)

Order of Battle -- Intelligence pertaining to identification, strength, command structure, and disposition of the personnel, units and equipment of any foreign military force. [21]

Partial Response -- A multilevel coding scheme that uses prescribed amounts of intersymbol interference to increase the transmission rate in a given bandwidth. [15]

Phase Reversal Keying -- A form of phase shift keying that uses two phases 180 degrees apart. [12] Also called PRK.

Phase Shift -- A change in the phase of a signal. It may either be deliberately introduced or be the result of natural causes. [24]

Phase Shift Keying -- A form of digital modulation that uses phases to represent bits of information. [12] Also called PSK.

Phased Array -- An antenna whose beam is steered by controlling the phase of the excitation applied to the individual radiating elements. [24]

Plesiochronous -- The relationship between two signals such that their corresponding significant instants (transitions) occur at nominally the same rate, any variation in rate being constrained within a specified limit. [15]

Portability -- 1. The ease with which a system or component can be transferred from one hardware or software environment to another. (IEEE STD 610.12)
2. A quality metric that can be used to measure the relative effort to transport the software for use in another environment or to convert software for use in another operating environment, hardware configuration, or software system environment. (IEEE TUTOR)
3. The ease with which a system, component, data or user can be transferred from one hardware or software environment to another. (TA) [9]

Precision -- The quality of being exactly or sharply defined or stated. [10]

Precision Location -- The location of an electronic emitter with sufficient accuracy for targeting of weapons systems. [8]

Preventive Maintenance -- Periodic tests or corrective actions to prevent anticipated failures. Primarily accomplished by visual inspection, cleaning, tightening, and minor adjustments to keep the equipment operational.

Prime Mission Equipment -- Equipment essential to a mission's operation, normally referring to the airborne segment. Also called PME.

Process Gain -- The improvement in signal-to-noise ratio from the receiver input to the receiver output. [13]

Processing -- Conversion of collected or intelligence information into a form more suitable for the production of intelligence. [3]

Product -- An intelligence report disseminated to users by an intelligence agency. In SIGINT terminology, the intelligence information derived from analysis of SIGINT materials and published as a report or translation for dissemination to users. [3]

Profile -- A set of one or more base standards, and, where applicable, the identification of those classes, subsets, options, and parameters of those base standards, necessary for accomplishing a particular function. (P1003.0/D15) [9]

Program -- Budget line and acquisition effort. [1]

Programmed Maintenance -- Scheduled maintenance to overhaul and/or test for degradation of operational performance. May include installation of modifications.

Proprietary -- 1) Data that was developed at private expense (i.e. not reimbursed by, or developed on, a government contract. 2) Information that is used, produced, or marketed under exclusive legal rights of the author, inventor, or maker. Proprietary data is comprised mainly of trade secrets and strategic marketing data, but it can include any information vulnerable to acts of embezzlement, perpetrated fraud, vengeful acts by a disgruntled employee, and/or industrial espionage.

Proprietary Specifications -- Specifications which are exclusively owned by a private individual or corporation under a trademark or patent, the use of which would require a license. (OS-JTF 1995) [28]

Pseudorandom Sequence -- A sequence of bits that is selected by a definite computational process, yet satisfies tests for statistical randomness (i.e., appears to be random). [13]

Pulse Amplitude Modulation -- The modulation technique that uses pulses to represent samples of an analog waveform where the pulse amplitudes are dependent on the sample amplitudes. [12] Also called PAM.

Pulse Code Modulation -- 1. The modulation technique that samples an analog waveform and quantizes the sample amplitudes to form a digital signal. [12]

2. A process in which a signal is sampled, and the magnitude of each sample is quantized independently of other samples and converted by encoding to a digital signal. [15] Also called PCM.

Pulse Doppler -- A radar or a waveform that uses a series of pulses that are processed for their velocity content. [24]

Quadrature Amplitude Modulation -- A form of modulation that amplitude modulates two orthogonal channels with the same carrier frequency. [12] Also called QAM.

Quadrature Partial Response -- 1. A form of quadrature modulation that uses partial response signaling on each channel. [12]

2. The use of partial response filtering on the two orthogonal channels of a QAM system to increase the bandwidth efficiency of QAM. [15] Also called QPR.

Quadrature Phase Shift Keying -- A form of modulation where two carriers which are phase shifted by 90 degrees are modulated by separate data streams. Four phase conditions are used. [12] Also called QPSK.

Radio Frequency -- 1. (Loosely) The frequency in the portion of the electromagnetic spectrum that is between the audio-frequency portion and the infrared portion. [10]

2. A frequency useful for radio transmission. Note: The present practicable limits of radio frequency are roughly 10 kilohertz to 100,000 MHz. Within this frequency range electromagnetic radiation may be detected and amplified as an electric current at the wave frequency. [10] Also called RF.

Raw Traffic -- Intercepted traffic showing no evidence of processing for COMINT purposes beyond sorting by clear address elements, elimination of unwanted messages, and the inclusion of a case number or an arbitrary traffic designator. [3]

Real-Time -- Real-time is a mode of operation. Real-time systems require events, data, and information to be available in time for the system to perform its required course of action. Real-time operation is characterized by scheduled events, data, and information meeting their acceptable arrival times. (OS-JTF 1995) [28]

Real-Time Systems -- Systems which provide a deterministic response to asynchronous inputs. (OS-JTF 1995) [28]

Recognition -- Determination of information type (e.g., voice, data modem, fax, encrypted data/voice, etc.).

Reconnaissance -- A mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or potential enemy; or to secure data concerning the meteorological, hydrographic or geographic characteristics of a particular area. [21] Also called RECCE or RECON.

Reference Model -- A reference model is defined to be a generally accepted abstract representation that allows users to focus on establishing definitions, building common understandings and identifying issues for resolution. For Warfare and Warfare Support systems (WWSS) acquisitions, a reference model is necessary to establish a context for understanding how the disparate technologies and standards required to implement WWSS relate to each other. A reference model provides a mechanism for identifying the key issues associated with applications portability, modularity, scalability and interoperability. Most importantly, Reference Models will aid in the evaluation and analysis of domain-specific architectures. (TRI-SERVICE Open Systems Architecture Working Group) [28]

Remote Operating Facility -- A facility which conducts operations using sensors at a remote controlled facility (RCF).

Remote Operating Facility, Airborne -- A facility which conducts operations using sensors at an airborne remote controlled facility (RCF).

Repeatability -- The degree to which a measurement will produce the same value from one occasion to the next given the same input.

Report -- 1. A summary of selected data on a specified subject which is prepared for a management authority or by its direction.
2. Pertaining to or of a report. [6]

Re-radiation -- 1. The unintentional radiation of signals generated in a radio receiver, causing interference or revealing the location of the receiver.
2. In emitter location, the phenomenon which occurs when a propagated signal strikes a conducting object located near the antenna of a direction finder, and the object retransmits the signal to the antenna. [6]

Resolution -- The degree to which nearly equal values of a quantity can be discriminated. [10]

Response Time -- The ability to react to requests within established time criteria. To be operationally effective, the system must produce the desired output in a timely manner based on system category for routine or priority operations. (JOPES ROC) [9]

Scalability -- 1. The ability to use the same application software on many different classes of hardware/software platforms from personal computers to super computers (extends the portability concept). (USAICII) The capability to grow to accommodate increased workloads. [9]
2. Ability to increase/decrease throughput capacity by adding/ deleting modules. At the lower limit, this can mean a specific function's throughput can be reduced to zero, allowing the system to delete capabilities and functions to achieve SWAP restrictions and/or tailor sensor operational capabilities for specific missions.

Scalable -- Mission equipment designed such that it contains modules that can be sized relative to the needs and requirements of a particular Service's platform to perform the required mission. [8]

Scintillation -- Variations of a radar signal reflected from a target due to changes in the aspect of the target; also called target noise. [13]

Search -- Search is the process which finds and assigns meaningful names to energy events in the RF spectrum. This can range from a very general type of search (e.g., any RF signals that are detected) to very tightly defined searches (e.g., a certain ELINT emitter). There are three modes of search – manual, interactive, and automatic; and two search techniques – general and directed –within each mode.

Modes of Search:

- *Manual*: The operator is able to select and control a specific subset of the collection system
- *Interactive*: The operator provides input to the process in response to system formatted requests (tables, masks, etc)
- *Automatic*: Performing a search function with minimal, if any, operator intervention

Search Techniques:

- *General*: Tuning over a frequency range to detect energy events
- *Directed*: The process of using prior knowledge to examine a specified frequency or frequency band, geographic area, or a bearing relative to the collection platform to increase the probability of finding specific target signals.

Segment -- Segment is a collection of CSCI. The segment is the level of software where the user environment requirements are common. In other words, all elements in a segment could share a common .cshrc, .xsession, and other environment setting scripts. Segments are also the level to which software development is grouped for management purposes. Typically a single development organization creates a segment. [25]

Segment Description File -- The SDF is used to create a table of contents of a segment. It consists of a list of CSCI and their versions. [25] Also called SDF.

Sensor -- A technical device designed to detect and respond to one or more particular stimuli and which may record or transmit a resultant impulse for interpretation or measurement; often called a technical sensor. "Special sensor" is an unclassified term used, as a matter of convenience, to refer to a highly classified or controlled technical sensor. [3] [21]

Service Cryptologic Elements -- Components of the three US military services whose SIGINT activities are subordinate to DIRNSA/CHCSS. The SCEs are the US Army Intelligence and Security Command, the Naval Security Group, and the Air Force Air Intelligence Agency. Also called SCE.

Shared Data Environment -- A strategy for data sharing that is built upon a flexible data infrastructure. It promotes systems interoperability and data sharing through management of metadata, use of standard data access mechanisms, use of DoD and federal data standards, common management mechanisms for physical data stores, and a set of shared database segments. Also called SHADE. (UCA Technical Architecture)

Ship's Signals Exploitation Equipment -- An evolutionary program using COTS, GOTS, and NDI to function as building blocks for improved tactical cryptologic, information operations, and information warfare exploitation capability. Also called SSEE.

Signals Intelligence -- Intelligence information comprising, either individually or in combination, all Communications Intelligence (COMINT), Electronics Intelligence (ELINT), and Foreign Instrumentation Signals Intelligence (FISINT), however transmitted. [3] Also called SIGINT.

SIGINT Collection -- Equipment based access to specific signals in the RF environment to satisfy critical intelligence requirements levied in support of national and tactical tasking requests. [7]

SIGINT Processing -- The algorithmic based capabilities which control the RF access, select the specific signals of interest, and either produce reportable information or produce data to be sent off the sensor for further processing to satisfy critical intelligence requirements levied in support of national and tactical tasking requests. [7]

SIGINT Subsystem Segment -- SIGINT collection/processing/reporting entity which interfaces with its host platform. [1]

Signal Bandwidth -- The frequency band that is available for signal use. The difference between the maximum and minimum frequencies available. [13]

Signal of Interest -- 1. The measured parameters of the signal meet the criteria established by the operator.
2. The signal contains the information of interest to the operator. Also called SOI.

Signal Not of Interest -- 1. A signal whose measured parameters do not meet the criteria established by the operator.
2. The signal does not contain the information of interest to the operator. Also called SNOI.

Signal to Interference Ratio -- The ratio of the magnitude of the signal to that of the interference or noise. Note: The ratio may be in terms of peak values or root-mean-square values and is often expressed in decibels. The ratio may be a function of the bandwidth of the system. [10]

Signal to Noise Ratio -- 1. The ratio of the value of the signal to that of the noise. Notes: a) This ratio is usually in terms of peak values in the case of impulse noise and in terms of the root-mean-square values in the case of the random noise. b) Where there is a possibility of ambiguity, suitable definitions of the signal and noise should be associated with the term, as, for example, peak-signal to peak-noise ratio, etc. c) This ratio may be often expressed in decibels. d) This ratio may be a function of the bandwidth of the transmission system. [10]
2. (Mobile communications) The ratio of a specified speech-energy spectrum to the energy of the noise in the same spectrum. [10] Also called SNR.

Signal Type Recognition -- The process of determining general or specific signal characteristics for further processing. The degree of type recognition should be defined when referring to specific cases. [8]

SINAD -- An acronym for “signal plus noise plus distortion to noise plus distortion ratio” expressed in decibels, where the signal plus noise plus distortion is the audio power recovered from a modulated radio frequency carrier, and the noise plus distortion is the residual audio power present after the audio signal is removed. This ratio is a measure of audio output signal quality for a given receiver audio power output level. [10]

SINAD Sensitivity -- The minimum standard modulated carrier-signal input required to produce a specified sinad ratio at the receiver output. [10]

Single Point Failure -- The failure of a single component which causes the complete loss of system functionality or the loss of principle assigned mission functions.

Single Sideband Amplitude Modulation -- A form of amplitude modulation that transmits only one of the modulated signal's sidebands. [12] Also called SSB-AM.

Slip -- The irretrievable loss or gain of a set of consecutive bits without loss of alignment. Also called timing slip. [15]

Slow Frequency Hoppers -- Slow hopping systems have a hopping rate that is slower than the traffic data.[13] Two or more symbols are transmitted in the time interval between frequency hops. [18]

Soft Real-Time -- Timing must be explicitly managed and the value of data diminishes after a deadline expires. This could be the response time to an operator action, time required to make a database query, or any other time-constrained event.

Software Environment -- A software environment is a virtual platform designed to be hardware neutral. By using a software environment, components are portable among computers that run the environment. A software environment also aids in the integration of modules into a system, by ensuring that resources and definitions that are accessed by the component will be structured and behave as advertised. [25]

Specification -- A document that prescribes, in a complete, precise, verifiable manner, the requirements, design, behavior, or characteristics of a system or system component. (IEEE P1003.0) [28]

Spread Spectrum (SS) Modulation -- A modulation technique used to widen the RF bandwidth of a signal. Common types of SS modulation include frequency hopping, direct sequence, time hopping, and hybrid modulation. [13]

Stability, Long Term -- The absolute value (magnitude) of the fractional frequency change with time; an observation time sufficiently long to reduce the effects of random noise to an insignificant value is implied. Frequency changes due to environmental effects must be considered separately. [5]

Stability, Short Term -- The standard deviation of fractional frequency fluctuations due to random noise in an oscillator. Specification must include the number of samples, the averaging time, the repetition time, and the system bandwidth. [5]

Standard -- A document that establishes uniform engineering and technical requirements for processes, procedures, practices, and methods. Standards may also establish requirements for selection, application, and design criteria of material. (DoD 4120.3-M) [23]

Standard Deviation -- In DF, a computed figure for the spread (i.e., dispersion) of bearings around the average bearing (or true bearing, if known) from a given DF site on a given target after wild bearings have been discarded. The standard deviation is used as a reliability factor in determining the quality of bearings taken by that DF site. Compare with systematic error. [6] Also called SD.

Standards Based Architecture -- An architecture based on an acceptable set of standards governing the arrangement, interaction, and interdependence of the parts or elements that together may be used to form a Weapons Systems, and whose purpose is to ensure that a conformant system satisfies a specified set of requirements. (OS-JTF 1995) [28]

Standards Defacto -- Standards (q.v.) that are based on prevalent market usage, existing especially without lawful authority.

Standards Dejure -- Standards (q.v.) that are defined by a consensus-based standards body, normally of national or international standing.

Standards, Opens System -- Acquisition programs shall follow an open systems approach for military systems design. This approach is a business and engineering strategy, implemented by the IPT process, to choose commercially supported specifications and standards for selected system interfaces (logical and physical), products, practices, and tools. Selection of commercial specifications and standards shall be based on:

- those adopted by industry consensus based standards bodies or de facto standards (those successful in the market place);
- market research that evaluates the short and long term availability of products built to industry accepted specifications and standards;
- a disciplined systems engineering process that examines tradeoffs of performance, supportability and upgrade potential within defined cost constraint; and
- allowance for continued access to technological innovation supported by many customers and a broad industrial base.

Static Calibration -- The process by which RF subsystem components are calibrated under off-line conditions. Typically, calibration tables are generated to characterize the system. This process calibrates out most biases and/or ambiguities within the system.

Status Monitoring -- Continuously running self-test in background to indicate a go/no go condition of major Line Replaceable Units. Negative results are reported immediately.

Stovepipe System -- A system, often dedicated or proprietary, that operates independently of other systems. The stovepipe system often has unique, nonstandard characteristics. [9]

Strategy -- A cohesive approach to achieving an end. [1]

Super High Frequency -- 3000 - 30000 MHz (3 - 30 GHz). Also called SHF.

Superset -- The complete collection of source and object code available to the JMCIS community. The superset is managed as a library using configuration management tools. Portions of this library are accessible to all members of the community. Others are restricted due to classification and proprietary interests. All those portions that are available to be used and viewed are posted to the JMCIS on-line superset library which is available over the internet and through dial-in access. [25]

Superset Variant -- The JMCIS configuration that has all available software and capabilities. This is the version that is tested for integration success. [25]

Supportability -- The ability of personnel with the necessary skills, using prescribed procedures, to do maintenance at a specified level.

S**urveillance** -- The systematic observation of aerospace, surface, or subsurface areas, places, persons, or things by visual, electronic, photographic, or other means. [21]

Synchronous -- Signals are synchronous if their corresponding significant instants (transitions) have a desired constant phase relationship with each other. [15]

Synchronize -- To cause two or more systems or system elements to operate with exact (within specified error limits) coincidence in time or rate (X.2).

Syntonize -- To cause two or more systems or system elements to operate with exact (within specified error limits) coincidence in frequency.

System -- 1. Entire weapon system. [1]
2. Any organized assembly of resources and procedures united and regulated by interaction or interdependence to accomplish a set of specific functions. (FED-STD-1037C) [28]

System Architecture -- A systems architecture defines the physical connection, location and identification of key nodes, circuits, networks, warfighting platforms, etc., associated with information exchange and specifies system performance parameters. The systems architecture is constructed to satisfy operational architecture requirements per the standards defined in the technical architecture.

Systems Engineering -- 1. An interdisciplinary approach to evolve and verify an integrated and lifecycle balanced set of system product and process solutions that satisfy customer needs. Systems engineering (a) encompasses the scientific and engineering efforts related to the development, manufacturing, verification, deployment, operations,

support, and disposal of system products and processes, (b) develops needed user training equipment, procedures, and data, (c) establishes and maintains configuration management of the system, (d) develops work breakdown structures and statements of work, and (e) provides information for management decision making. [29]

2. Systems engineering is the management function which controls the total system development effort for the purposes of achieving an optimum balance of all system elements. It is a process that transforms an operational need into a description of system parameters to optimize the overall system effectiveness. [30]

System Latency -- See Latency.

Systems View -- A description, including graphics, of systems and interconnections providing for, or supporting warfighting functions. (*C4ISR Architecture Framework* Version 2.0)

Systematic Error -- In DF, a computed figure which represents the difference between the true bearing and the average bearing from a given DF site to a given target. The SE is used as a correcting factor in determining the quality of bearings taken by that DF site; it expresses a relatively permanent figure of error introduced by the site's equipment. Compare with standard deviation. Note: Systematic error is computed by using the following formula: SE=BM-BT, where BM is the mean bearing (average bearing) and BT is the true bearing. [6] Also called SE.

Tactical ELINT -- A formatted report containing ELINT locational and parametric information. The Tactical ELINT report is used to disseminate operational ELINT information. [3] Also called TACELINT.

TADIL J -- A secure, high-capacity, jam-resistant, nodeless data link which uses the Joint Tactical Information Distribution System (JTIDS) or Multifunctional Information Distribution System (MIDS) transmission characteristics and the protocols, conventions, and fixed-length message formats defined by the JTIDS Technical Interface Design Plan (TIDP). NATO's equivalent is Link 16. (Joint Pub 1-02) [26]

Target -- 1. An emitter whose location and/or identification is of interest. [6]

2. A geographical area, complex, or installation planned for capture or destruction by military forces. [21]
3. In intelligence usage, a country, area, installation, agency, or person against which intelligence operations are directed. [21]
4. An area designated and numbered for future firing. [21]

Target Signal Information -- Information about the communication or signal that is observable and measurable (that is, message externals, frequencies, modulation, network characteristics, etc.). [3]

Targeting Accuracy -- The precision location of an electronic emitter such that a weapons system can be targeted to deliver "steel on target" with a single round. [8]

TDL Message Standards -- A set of protocols consisting of rules, procedures, message and/ or data element definitions, syntax, vocabulary, or other conventions for information exchange. [26]

Technical Architecture -- A minimal set of rules governing the arrangement, interaction, and interdependence of the parts or elements whose purpose is to ensure that a conformant system satisfies a specified set of requirements. It identifies system services, interfaces, standards, and their relationships. It provides the framework, upon which engineering specifications can be derived, guiding the implementation of systems. Also called TV.

Technical ELINT -- The ELINT that provides detailed knowledge of the technical characteristics of a given emitter and permits estimation of its primary function, capabilities, modes of operation (including malfunctions), and state-of-the-art, as well as of its specific role within a complex weapons system or defense network. [3]

Technical Reference Model -- The document that identifies a target framework and profile of standards for the DoD computing and communications infrastructure. (TRM) [9] Also called TRM.

Technical View -- The minimal set of rules governing the arrangement, interaction, and interdependence of systems parts or elements, whose purpose is to ensure that a conformant system satisfies a specified set of requirements. (*C4ISR Architecture Framework* Version 2.0)

Technician -- Ground Technician at the remoted processing facility who communicates with the sensor via the datalink. Flight line - Technician at the aircraft home station who communicates with the sensor through the ground support equipment. Maintenance - Describes both the ground and flight line collectively. [7]

Time Difference of Arrival -- The difference in time between the arrival of a signal at two points. Also called TDOA.

Time Division Multiple Access -- Means by which a group of stations representing several different communications links may share a repeater or other terminal; achieved by assigning time slots to the links. [11] Also called TDMA.

Time Division Multiplexing -- A method of transmitting numerous channels over one transmission path by sequentially assigning time intervals to each channel. [12] Also called TDM.

Time Event Pulse -- A once per second analog signal provided by certain GPS units. There is an associated digital data word that provides the GPS time of validity for this signal. Also called TEP.

Time of Arrival -- 1. For a pulsed signal, the time with respect to UTC-USNO that the signal's leading edge is detected.
2. For non-pulsed signals, the time with respect to UTC-USNO that a measurable event in the signal occurs. Also called TOA.

Time on Station -- See Time over Target, definition 1.

Time Tagging -- Association of a data element to the specified time standard (in JASA, UTC (USNO)).

Time over Target -- 1. The time from the arrival of a platform in or over the target until it departs. Preferred term for "time on station." [6]
2. Time at which aircraft are scheduled to attack/photograph the target.
3. The actual time at which aircraft attack/photograph the target.
4. The time at which a nuclear detonation is planned at a specified desired ground zero. [22] Also called TOT.

Track -- 1. A record of the successive positions of a moving object. [6]
2. A series of related contacts displayed on a plotting board.
3. To display or record the successive positions of a moving object.
4. To lock onto a point of radiation and obtain guidance therefrom.
5. To keep a gun properly aimed, or to point continuously a target locating instrument at a moving target.
6. The actual path of an aircraft above, or a ship on, the surface of the earth. The course is the path that is planned; the track is the path that is actually taken (JCS). [21]

Track File, Composite -- The track file resulting from the application of a tracking process to an appropriate sensor data or to sensor specific tracks. [21]

Track Filtering -- A computational process by which best estimates of the states of an entity are derived from measurements. [21]

Track History -- A series of points representing the most recent position updates of a track which may be displayed on a display console at operator request. This aides the console operator in following the path of a maneuvering track. [21]

Track Initiation -- The process of establishing a new track in the system. [21]

Track Locator -- A reference number used to catalog within the system data base the aggregate of common information maintained on a specific track. [21]

Tracking -- 1. Precise and continuous position-finding of targets by radar, optical, or other means (JCS).
2. The computational process dealing with the estimation of an object's true position based on noisy observations (measurements) of it. Tracking may consist of filtering

(estimating the position at the time of the latest observation), smoothing (estimating the position at a point in the past), and prediction (estimating the position at a point in the future). [21]

Traffic Analysis -- The cryptologic discipline that develops information from communications about the composition and operation of communications structures and the organizations they serve. The process involves the study of traffic and related materials and the reconstruction of communications plans to produce signals intelligence. [3]

Traffic Encryption Key -- Used in communications between two equipments to protect traffic, control, and message header information. Also called TEK.

Transmission Security Key -- A key variable used to generate pseudorandom bit streams for TRANSEC purposes. Also called TSK.

True bearing -- 1. The horizontal angle between the meridian line and a line on the earth. 2. In DF, a line, as computed from geodetic data, representing the true direction of a target from a direction finder and shown in relation to true north. [6]

Ultra High Frequency -- 300-3000 MHz. Also called UHF.

Unified Build -- Unified Build is the name of a segment that contains several core (see definition above) CSCI for tactical systems. The segment name is UB. [25] Also called UB.

United States Cryptologic System -- The USCS is the aggregate of NSA's dual missions of SIGINT and INFOSEC. The term USCS is not interchangeable with the term USSS. [2] Also called USCS.

United States SIGINT System -- The United States SIGINT System consists of the SIGINT missions of NSA/CSS, the SCEs, those elements of the Central Intelligence Agency that perform SIGINT activities, and other U.S. Government entities authorized by the SECDEF to conduct SIGINT activities. [2] Also calles USSS. This term has been superseded by USCS.

Universal Time (UT1) -- 1. A measure of time that conforms, within a close approximation, to the mean diurnal rotation of the Earth and serves as the basis of civil timekeeping. Universal Time is determined from observations of the stars, radio sources, and also from ranging observations of the Moon and artificial Earth satellites. The scale determined directly from such observations is designated Universal Time Observed (UTO); it is slightly dependent on the place of observation. When UTO is corrected for the shift in longitude of the observing station caused by polar motion, the time scale UT1 is obtained. When an accuracy better than one second is not required, Universal Time can be used to mean Universal Time Coordinated (UTC). Also called ZULU time. Formerly called Greenwich Mean Time. [22]

2. A non-uniform time scale based on the earth's rotation and corrected for the effects of polar motion. [5]

Universal Time Coordinated -- 1. An atomic time scale that is the basis for broadcast time signals. Coordinated Universal Time differs from International Atomic Time by an integral number of seconds; it is maintained within 0.9 seconds of UT1 by introduction of Leap Seconds. The rotational orientation of the Earth, specified by UT1, may be obtained to an accuracy of a tenth of a second by applying the UTC to the increment DUT1 (where DUT1 = UT1 - UTC) that is broadcast in code with the time signals. [22]

2. An internationally agreed-upon time scale having the same rate as Atomic Time. UTC is corrected in one-second step adjustments, as needed, to remain within 0.7 seconds of Astronomical Time (UT1). [5] Also called UTC.

Usable bearing -- Any bearing falling within a given area produced by some composite intersection in the course of fix computation. [6]

User -- 1. Any person, organization, or functional unit that uses the services of an information processing system.

2. In a conceptual schema language, any person or any thing that may issue or receive commands and messages to or from the information system. (FIPS PUB 11-3) [9]

User Interface Service -- A service of the Platform entity of the Technical Reference Model that supports direct human-machine interaction by controlling the environment in which users interact with applications. (TA) [9]

UTC-USNO -- UTC as maintained by the U. S. Naval Observatory [5]

Variable Message Format -- A message format designed to support the exchange of digital data between combat units with diverse needs for volume and detail of information using various communications media. This flexibility is achieved through the information variability of each message and by use of message standards that are independent of the textual format of the message. Individual messages composed of data elements are adjusted in length to suit the information content of that particular message. Although bit-oriented, VMF can also accommodate character-oriented message (COM) encoding. VMF is the primary messaging component of Army and Marine Corps Battlefield Digitization initiatives. [26] Also called VMF.

Variant -- A variant is a fielded configuration of JMCIS on an individual workstation. Through the use of an installation program and a worklist, differing variants can be installed from the same installation tape set that will include all available JMCIS software. A variant can be defined that includes all JMCIS software. This is known as the superset variant. [25]

Vertical Testability -- The ability of intermediate and depot level maintenance to duplicate malfunctions discovered at the field level by using identical tests under identical conditions.

Very High Frequency -- 30-300 MHz. Also called VHF.

Warm Start -- Restarting a system or subsystem to clear running commands and return to normal operations without a cold start. Any new data or other updates not saved will be lost.

Weapon System -- A combination of one or more weapons with all related equipment, materials, services, personnel and means of delivery and deployment (if applicable) required for self sufficiency. (JCS Pub 1-02) [28]

Word -- 1. (signals and paths, microcomputer system bus) Two bytes or sixteen bits operated on as a unit. [10]

2. (signals and paths, 696 interface devices) A set of bit-parallel signals corresponding to binary digits operated on as a unit. Connotes a group of 16 bits where the most significant bit carries the subscript 15 and the least significant bit carries the subscript 0. [10]

ZULU Time -- See Universal Time. [22]

References:

[1] Advanced Airborne SIGINT Working Group Technical Sub-group Off-site Meeting, 24-25 October 1994

[2] USSID 1

[3] USSID 3

[4] The Airborne Reconnaissance Technical Architecture Program Plan (ARTAPP), draft version 7.0.

[5] Fundamentals of Time and Frequency Standards, HP Application Note 52-1.

[6] Glossary of Standard Emitter Location Terminology (STELT) promulgated by USSID 412.

[7] McGraw Hill Data Communications Dictionary, 1993.

[8] JASA Standards Working Group Meeting of 14 June 1995.

[9] DoD Technical Architecture Framework for Information Management, Volume 1: Overview, Version 2.0, 30 June 1994.

[10] The New IEEE Standard Dictionary of Electrical and Electronic Terms, IEEE Std 100-1992, 5th edition, 1993.

[11] Lower VHF Handbook, Office of Search, Dec 1985.

[12] Advanced Modulation Handbook, Office of Search, May 1989.

[13] Frequency Agile Working Aid, Office of Search, January 1993.

[14] Glossary of SIGINT Collection Terminology, NSACSS/P13D, 1 Aug 1986.
[15] Digital Transmission Systems, Smith, 1985
[16] The White Noise Book, Tant, 1974
[17] Introduction to Radar Systems, Skolnick, 1980
[18] Principles of Secure Communications Systems, Torrieri, 1985
[19] Radio Communications Receivers, Drentea, 1982
[20] Webster's Ninth New Collegiate Dictionary, 1986.
[21] Data Fusion Lexicon, The Data Fusion Subpanel of the Joint Directors of Laboratories, Technical Panel for C3, October 1991.
[22] Department of Defense Dictionary of Military and Associated Terms, Joint Pub 1-02, 23 March 1994.
[23] Department of Defense Joint Technical Architecture, Version 0.5 Preliminary Draft dated 12 March 1996.
[24] Wideband Radar Collection: Trends and Future Technology (W9T1-TIP-02-96), dated 27 March 1996.
[25] Joint Maritime Command Information System (JMCIS) Integration Standard, Version 1.3, dated Feb 1994.
[26] Department of Defense Command, Control, Communications, Computers and Intelligence (C4I) Joint Tactical Data Link Management Plan, dated Apr 1996.
[27] NSA Multichannel Course (EA-030)
[28] Open Systems Joint Task Force Terms of Reference, 1995.
[29] MIL-STD-499B Draft
[30] Systems Engineering Management Guide, January 1990
[31] Cryptologic System Architecture, draft dated 3 May 1996.

Appendix C

MSH Standards

Compliance Levels:

- M = Mandated (shall)
- R = Recommended (should)
- A = Acceptable
- P = Preferred
- PF = Preferred for Future use

Table C-1: Front End Processing Standards

MSA Handbook Paragraph and Service Area	MSA Standards	Compliance Level
3.2.1 Time, Frequency, Navigation, and Geodesy (TFNG)	MSH Table 3-1	M
3.2.1.1 Timing and Time Tagging	IRIG Document 104-70 IRIG Standard Time Formats	M
-	ICD GPS 151 (with rubidium standard)	M
-	MSH Table 3-2	M
3.2.1.2 Navigation	DMA WGS-84 World Geodetic System 1984 (user defined spheroids acceptable)	M
-	ICD GPS 151	M
-	MSH Table 3-3	M
3.2.1.3 Reference Frequency	MSH Tables 3-4,3-5	M
3.2.2.1 RF Control	IEEE 488.1, IEEE Standard Digital Interface for Programmable Instrumentation	A
-	IEEE-488.2, IEEE Standard Codes, Formats, Protocols, and Common Commands	A
-	RS-232	A
-	Universal Serial Bus	PF
-	VXI 1155/1993, Standard VMEbus extensions	P
3.2.2.2 IF Interfaces	10 MHz bandwidth at 21.4 MHz	M
-	100 MHz bandwidth at 160 MHz	M
-	600 MHz bandwidth at 1 GHz	M
-	The IF input, output and connecting coaxial cable impedance shall be 50 ohms (nominal)	M
3.2.3 Geolocation	DMA Digital Terrain Elevation Data (DTED) Level 1	A
-	WGS-84	P
-	DMA DTED Level 2 or 3	A
-	Navigational Spheroids per table	A

Table C-2: Information Processing Standards

MSA Handbook Paragraph and Service Area	MSA Standards	Compliance Level
4.2.1 Information Processing (Soft Real-Time)	DII COE I&RTS Version 2.0, LEVEL 5	M
-	DII COE I&RTS Version 2.0, LEVEL 7	P
4.2.1.1 Programming Languages	ANSI/ISO X3J16/95-0087 (Draft), Programming Languages -- C++	P
-	ANSI/ISO 9899:1992, Programming Languages -- C	A
-	ANSI/ISO XXX:YYYY, Programming Languages -- JAVA	PF
-	ANSI/ISO/IEC 8652:1995 (Ada 95), Ada Reference Manual, Language and Standard Libraries	A
4.2.1.2 User Interface Services	Technical Architecture Framework for Information Management (TAFIM) Version 3.0 Volume 8, DoD Human Computer Interface (HCI) Style Guide	M
-	The User Interface Specifications for the Defense Information Infrastructure(DII)	M
4.2.1.3 Data Management Services	FIPS Pub 127-2: 1993, Database Language for Relational DBMS[100]	M
-	Open Database Connectivity ODBC 2.0	A
4.2.1.4 Data Interchange Services	Refer to JTA Version 2.0 Section 2.2.2.1.4	M
4.2.1.4.1 Document Interchange	RFC-1866: 1995, Hypertext Markup Language (HTML), Internet Version 2.0	P
-	ISO 8879: 1986, Standard Generalized Markup Language (SGML)	A
4.2.1.5 Graphics Services	FIPS Pub 128-1: 1993, Computer Graphics Metafile (CGM)- Interchange format for vector graphics data	M
-	JPEG File Interchange Format (JFIF), Version 1.02, C-Cube Microsystems for raster graphics data encoded using the ISO 10918-1: 1994, Joint Photographic Expert Group (JPEG) algorithm.	M
-	PNG format	PF
-	TIFF format	A
4.2.1.6 Communication Services	Refer to JTA Version 2.0 Section 2.2.2.2.1.6	M
4.2.1.7 Operating System Services	ISO 9945-1: 1990, Information Technology - Portable Operating System Interface for Computer Environments (POSIX) - Part 1: System Application Program Interface (API) [C language]*, (as profiled by FIPS PUB 151-2: 1994)	A
-	ISO 9945-2: 1993, Information Technology - Portable Operating System Interface for Computer Environments (POSIX) - Part 2: Shell and Utilities, (as profiled by FIPS PUB 189: 1994)	A
-	IEEE 1003.2d: 1994, POSIX - Part 2: Shell and Utilities - Amendment: Batch Environment	A

-	IEEE 1003.1b: 1993, POSIX - Part 1: System Application Program Interface (API) Amendment 1; Real-Time Extension [C Language]*, (as profiled by FIPS Pub 151-2: 1993)	A
-	IEEE 1003.1i: 1995, POSIX - Part 1: System Application Program Interface (API) Amendment: Technical Corrigenda to Real-time Extension [C Language]	A
-	Win32 APIs, Window Management and Graphics Device Interface, Volume 1 Microsoft Win32 Programmers Reference Manual, 1993, Microsoft Press.	A
4.2.1.9 Distributed Computing Services	Refer to JTA Version 2.0 Section 2.2.2.2.2.4	M
4.2.2 Information Processing (Hard Real-Time)	Refer to JTA Version 2.0 Section 2.2	M
4.2.3.1 Shared Data Environment (SHADE)	DII Shade	M
4.2.3.2.1 Digital Audio Routing to Support JTSA Systems	ITU CCITT G.703, Physical/Electrical Characteristics of Hierarchical Digital Interfaces: Supplemented by ANSI T1.102-1993	TBD
-	ITU CCITT G.733, Characteristics of Primary PCM Multiplex Equipment Operating at 1544 Kbps: Supplemented by ANSI T1.403-1995, Network to Customer Installation – DSI Metallic Interface	TBD
-	ITU CCITT G.732, Characteristics of Primary PCM Multiplex Equipment operating at 2048 Kbps	TBD
-	ITU CCITT G.711, Digitally Encoded Audio Samples with the 8 bit μ-law Compression Scheme	TBD
4.2.3.3.1 Signal and Signal Related Information (SRI)	USSID 126 Collected Signals Data Format (CSDF)	M
4.2.3.4 Dissemination Reports	USSID 126, 205, 300, 369, 301, 341	A
4.3.4 Common Signal External Data (SED) Format	MSA Emerging Area	TBD

ELINT Resources

MSA Handbook Paragraph and Service Area	MSA Standards	Compliance Level
Dissemination Reporting Services	USSID 369	M
Digitized Detected IF (Video) Service	No current industry standard, potential standards under review.	TBD
Digitized Audio Services	No current industry standard, potential standards under review. Will depend on Digitized Video Services.	TBD
Geolocation Services	DMA Digital Terrain Elevation Data (DTED) Level 1	M
-	WGS-84	P
-	DMA DTED Level 2 or 3	A

Table C-4: Information Transfer Standards

MSA Handbook Paragraph and Service Area	MSA Standards	Compliance Level
6.2.1.1 High Speed Networks	ANSI X3.230-1994, Information Technology - Fibre Channel - Physical and Signaling Interface (FC-PH)	P
-	ATM: User-to-Network Interface (UNI) Version 3.1	A
-	ANSI T1.115	A
6.2.1.2 Lower Speed Networks	100 BASE Fast Ethernet - IEEE Std. 802.3u - 1995 Media Access Control (MAC) Parameters for 100 Mb/s Operation.	P
-	10 base 2 IEEE 802.3 x Ethernet	A
FDDI	Media Access Control (MAC), ANSI X3.139-1987	A
6.2.2.1 Intra-System Protocols/Bridge Interfaces	Common Data Link-System Description: Specification # 7681996	M
-	Common Data Link-Segment Class 1: System Specification # 7691990	M
6.2.2.2 Tactical Message Protocols	IEWCOMCAT	A
6.2.3 Reach Back/Reach Forward	Common Data Link: MSH Version 1.0, Chapter 6	M
-	Standardized Data Formats: MSH Version 1.0	M
-	Precision and Timing, Frequency, Navigation and Geodesy: MSH Version 1.0, Chapter 3	M
-	Digital Audio Formats: ITU CCITT G.711	M

Table C-6 Security Services Standards

MSA Handbook Paragraph and Service Area	MSA Standards	Compliance Level
7.2 Mandates	Refer to JTA Version 2.0 Section 2.6.2	M
7.2.3 Data Link Encryption	KGV-135	A
-	KG-194A and KIV-7HS	A

Table C-7: Physical Services Standards

MSA Handbook Paragraph and Service Area	MSA Standards	Compliance Level
8.2.1 Chassis	EIA 310 C Racks, Panels, and Associated Equipment	P
8.2.2 Backplanes	ANSI/VITA 1-1994 (VME64-B)	P
-	ANSI/IEEE 1014-1987 (VME32-B)	A
-	IEEE 1155-1992 Standard VMEbus extensions for Instrumentation: VXIbus	P
-	Peripheral Component Interconnect (PCI) bus	A
8.2.3 Circuit Cards	ANSI/VITA 1-1994 (VME64-B)	P
-	ANSI/IEEE 1014-1987 (VME32-B) 6u	A
-	IEEE 1155-1992 Standard VMEbus extensions for Instrumentation: VXIbus, Type C	P
-	IEEE 1101.2 for Conduction Cooling	A
8.2.5 Environmental Standards	Platform Specified	M
8.2.6 TEMPEST	NACSIM 5112, NONSTOP Evaluation	A
8.2.7 EMI/EMC	MIL-STD-461D, EMI Compatibility Standard, Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference	A
-	MIL-STD-462, Electromagnetic Emission and Susceptibility test methods for measurement of electromagnetic emission and susceptibility	A
-	FCC Title 47, part 15 (Radio Frequency Devices) rules Apply for Commercial Hardware; Apply Class B	A
8.3 Emerging Technology	Peripheral Component Interconnect (PCI) and follow-on bus technology	PF

Appendix D

Functional Reference Model (FRM)

Introduction:

This appendix expands the MSA Functional Reference Model (Figure D-1) to explain what is intended by the functional blocks. In this figure, not all connections to the Command and Control/Information (C2I) network and the precision timing and navigation network are shown. Although physical implementation is not addressed in this document, functions and functional flow are. This generic architecture is intended to comprise all aspects of the MSA for all maritime platforms. The goals of the MSA are maximum interoperability, minimum duplication of development, flexibility, adaptability to new requirements (preferably through software reconfiguration), leveraging of new technology and standards, optimization for mission and platform, provisions for required legacy systems, and support to multiple platform operations, such as geolocation using similar and dissimilar platforms.

The coverage provided by the MSA, in frequency, simultaneous processing channels, and in the mix and type of signals, is intended to be scalable in order to meet the requirements of the missions and the restrictions of the platforms. Implementations of the MSA will use GOTS and COTS hardware and software, and standards based upon commercial hardware and software to the maximum extent possible.

RF Distribution:

This block must be heavily tailored to the platform as it interfaces with the platform's antennas. Included in this block are such functions as antenna selection, band selection, antenna steering, interference cancellation for on-board emitters, blanking for high powered transmitters, RF processing for beamforming, cochannel, and within-band interference reduction, and sources for equalization, calibration, and built in test (BIT). Not all of these functions will necessarily be included in all paths or in the implementations on all platforms; rather, they will be included as needed and appropriate. The functional components must support the dynamic range, coherency, and phase/amplitude matching requirements for ALL processing (direction finding (DF), time difference of arrival (TDOA), Differential Doppler (DD), pulse code modulation (PCM), etc). While RF Distribution will largely be a platform-specific implementation, many components can and should be common across maritime platforms.

This functional block may also include block downconverters and/or preamplifiers, possibly collocated with the antennas, for SHF and EHF paths. Antenna selection may incorporate a combination of non-blocking and blocking access.

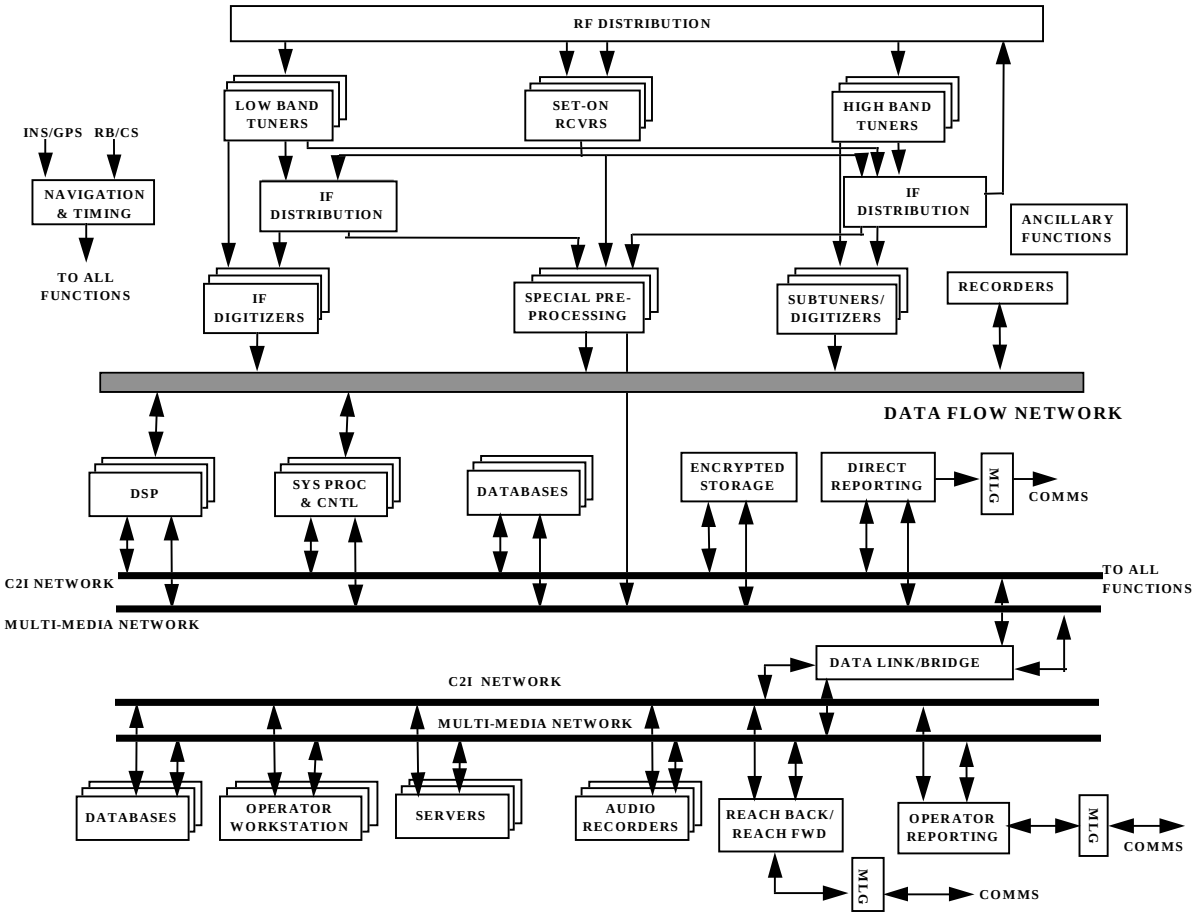

Figure D-1: MSA Functional Reference Model

Low Band and High Band Tuners:

At the top level, the same functional description applies for both high band and low band tuners. However, signal densities and properties, propagation factors, and semiconductor physics necessitate different basic implementations.

The tuners will provide preselection of a portion of the RF spectrum and convert it to one of the standard IF center frequencies. This allows the addition or replacement of tuners and/or preprocessors/digitizers without needing to replace the entire “receiver.” Standard IF bandwidths corresponding to the standard IFs have also been identified. The tuner's technical specifications need to reflect the requirements to allow DF, TDOA, and DD, co-channel interference reduction (CCIR), etc. The IF from the high band tuners may feed through the IF Distribution back into the RF Distribution function to allow further selection and processing by the low band tuners and assets for narrowband signals. The IF from the low band tuners may feed into the high band IF

Distribution function to allow further selection and processing for wideband signals. Actual implementation must provide seamless processing of all required signals.

The frequency coverage and number of channels will be a function of the platform and mission requirements. The tuners may provide pre-Detected (Pre-D) output at either IF or near baseband.

Set-On Receivers

The architecture incorporates provisions for a pool of set-on receivers to enhance collection if the platform's operational mission requires this. These receivers would be included when system constraints prohibit contiguous coverage, when additional throughput is required, or to provide additional coverage of specified signals. The set-on receiver outputs may be digital audio, digital IF (filtered), or analog (Pre-D or Post-D). The numbers, types, frequency range, modulations, and outputs of these receivers will be determined by mission requirements.

IF Distribution

The architecture allows for multiple IFs to exist in the system, for which standards are specified in this document. The IF Distribution accepts the various inputs from the tuners and receivers and routes them to the outputs specified via the C2I bus. The IF switches and distribution elements must support the dynamic range, phase noise, linearity, bandwidth, isolation and other functional specifications required of their collective applications.

IF Digitizer

The IF digitizer accepts the output of the tuners and IF Distribution, and performs the analog to digital (A/D) conversion. It may include such functions as downconversion and signal conditioning. This digital output is connected to the data flow network. The digitizers may be comprised of multiple speed, bandwidth and dynamic range converters (reflecting the different processing bandwidth/dynamic range trade-offs required for different signals). Data shall accept and pass a precision time stamp and system clock.

Subband Tuners/Digitizers

The subband tuners/digitizers accept the output of the high band tuners and IF Distribution. This module will support such tasks as: automatic and manual search with DF (antenna/array dependent); spectral analysis; signal characterization; sample incoming IF energy; and measure phase shift of IF energy. These functions must provide high performance (e.g., sensitivity, dynamic range, interference cancellation) and allow reprogrammability (scan plans, signal parameters, etc.). Signal data will be provided to the data flow network. This functional block must accept time synchronization and system clock, and tag the digitized data as required.

Special Preprocessing

This function provides for special preprocessors to accept IF or baseband analog input and support functions which are either not implementable in the digital domain, or optimized by analog preprocessing. Such functions may include wideband ELINT processing and multichannel processing. The output will be signals in digital format, which may take several forms, such as digitized IF, digitized audio, or pulse descriptor words.

The architecture allows for variations of special preprocessors to coexist in the system. The variations will be optimized to provide specific mission functions. The processors will have common interfaces for timing, to include both coherency and absolute time, and for command and control. The output of the processors will be interfaced to the data flow network and, if applicable, to the multimedia network.

Recorders

The wideband digital recorders provide a capability for such functions as recording preprocessed data and autonomous unmanned operations. Technological limitations may require the usage of non-digital media.

Ancillary Functions

The ancillary functions include such things as pre-mission programming, resource management, off-line playback, maintenance, training, and transcription.

Data Flow Network

The data flow network provides the transport and distribution functions for real-time exchange of digital data between Front End Processing and General Processing and among Front End Processing functions. The data flow network shall have a low deterministic end-to-end latency and must be non-blocking.

Multimedia Network

The multimedia network provides for the near real-time distribution of processed sensor data (e.g., digital audio, panoramic display data). The multimedia network provides distribution to processing elements, recorders, reporting elements, databases, and to/from the operator workstations. It shall be expandable to support distribution of imagery to support correlation and cross-cueing.

Command and Control Information (C2I) bus

The command and control information bus provides distributed commands to all architectural elements and provides synchronized control in concert with a precision system clock. It provides a transport/distribution pathway for ancillary information and processed data. It allows top level

reconstruction of system configuration during mission and post mission processing. This shall be expandable to imagery to support such functions as correlation and cross-cueing.

Digital Signal Processing

The digital signal processing (DSP) function takes the digital data off the data flow network and performs such functions as: digital drop receivers (set-on receiver), subband tuners, channelizers, FFTs, detection, single target copy and DF, cochannel copy and DF, search, delay memory, snapshot memory, spectral display generation, pulse processing, signal analysis and processing, signal parameterization and tracking, modulation type classification, SEI, demodulation, beamforming, recording, decoding, audio analysis and processing, equalization, correlation, fusion, geolocation, TDOA, single sensor cochannel interference reduction (list is not all inclusive).

A variety of DSP implementations (including Reduced Instruction Set Computers (RISC), Field Programmable Gate Arrays (FPGA), etc, as well as dedicated DSP) will exist due to platform and mission requirements. Components of the DSP will use GOTS, CI, and standards based upon commercial hardware and software to the maximum extent possible.

Commercial BIT/BITE shall be used as well as systems engineering approaches to test and maintenance.

System Processing and Control

The system processing and control will support such functions as the following: system initialization and downloading of application programs; system status assessment including fault isolation; system report generation and dissemination; system configuration and resource management, based on mission priorities, degradation and tasking; control of input/ output data links, communications or LAN to include data compression and encryption/ decryption of data; data fusion; navigation processing; time conditioning; conflict resolution; periodic system recalibration; database management functions such as access, updating, downloading, and searching.

Databases

Database structure will allow for collection, storage and retrieval of both static and dynamic data. Databases can include nationally generated data, locally generated data, mapping data, DF calibration data, or any data required to successfully accomplish the mission. Databases may reside at platform specific support sites or can be transmitted via communications link from the support site to the platform directly. These databases shall also include necessary entries to support the emerging national databases, command and control, reporting, and other similar functions that are necessary to support Warfighters at all levels. The databases will be scalable to support a given operation, to meet the constraints of the platform, and to fit the payload functionality. Synchronization and normalization among distributed databases must be maintained.

Encrypted Storage

The encrypted storage provides the capability to store classified algorithms, data, etc., necessary to support the mission.

Aboard maritime aircraft, this storage must allow the aircraft to be unclassified when unkeyed. When properly keyed for a mission, the SIGINT system is capable of full operation at a system high level.

Operator Workstations

The operator workstation, which may be collocated on the maritime platform or remoted, provides the human machine interface (HMI) between operator and system. These functions include control of search; DF; precision location tasking; monitoring audio and performing gist/ transcription functions; control of ancillary processing; and report generation and review/release. Standard HMI will be used to minimize training and development cost and to maximize joint operational potential.

Servers

The servers support operator functions in the collection, analysis, reporting, resource management and, for maritime aircraft, pre-mission planning and post mission analysis.

Recorders

Recorders are functionally shown on both the data flow network and on the multimedia network. The recorders provide digital recording capability compatible with existing national recording formats. They also provide real-time recording and playback functionality and support a multiplicity of storage mediums (e.g. hard disk, magnetic tape, and optical drives) and existing audio/SRI data transfer protocols.

Command & Data Link/Bridge

The command data link/bridge must allow for control of SIGINT equipment and the distribution and transportation of data and status. This may be via an internal bridge to collocated processors and operator workstations or external communications pathways (e.g., CHBDL) to ground/surface processing sites and other reconnaissance system, both ground, surface and airborne.

Navigation and Timing

The MSA components will interface with the platform's navigation/timing system to accurately distribute precision platform time and navigation data internally. The platform time will be tightly synchronized to United States Naval Observatory - Coordinated Universal Time (USNO-UTC),

and will include a common precision frequency reference (based on a precision frequency reference such as a rubidium or cesium reference). Accuracy, precision, latency and distribution requirements will be set to meet SIGINT processing requirements.

Reach Back/Reach Forward/Reach Between

The Reach Back/Reach Forward function provides a mechanism for the system to connect to the community for such purposes as: passing of selected signals (new modulations, etc.); passing of database updates; downloading of activity files; uploading of parameters; mission tasking, etc., and passing of COMSEC keys. When the Reach Back/Reach Forward connectivity is used between two systems, it is known as Reach Between.

Reporting

Both operator generated reporting and operator directed automatic reporting are included in the architecture. The reporting functions provide connectivity to existing/required dissemination systems, utilizing the approved standards compatible with the reporting vehicles and databases.

Multilevel Reporting Guards

The architecture will support a system high operational environment in both self-contained and remoted configurations. The architecture will allow for multilevel reporting over appropriately secured transmission systems. The data link(s) for any remoted operations will be secured by COMSEC key for appropriate level of operations.