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Submarine Communications Master Plan (December 1995)

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SOURCE

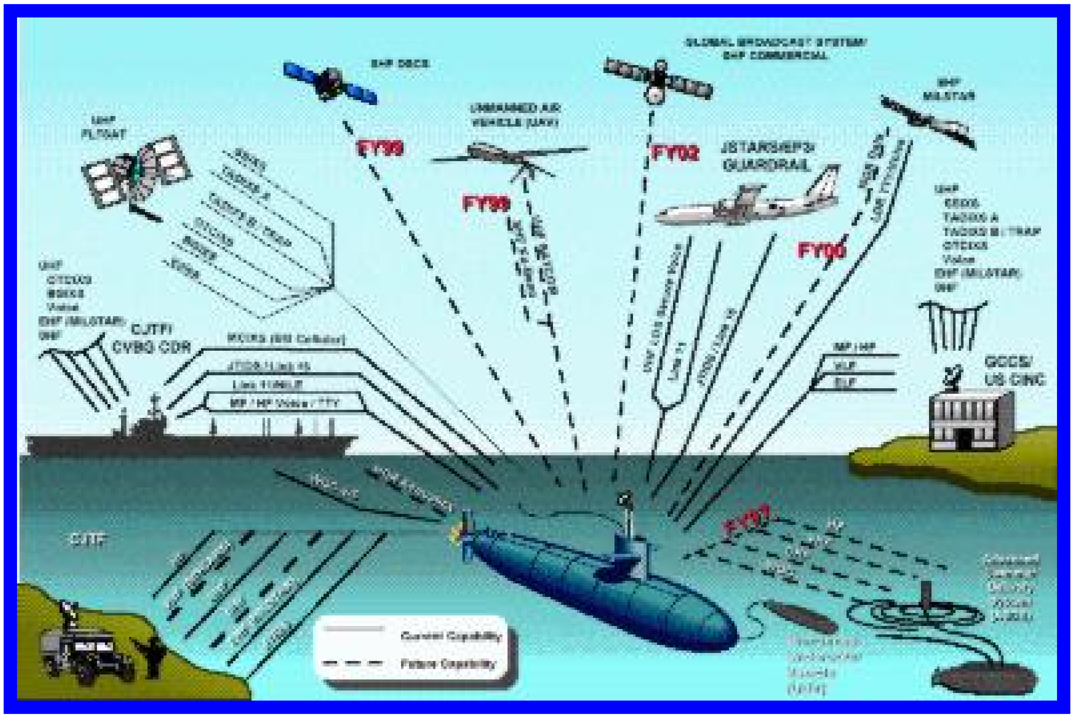
Submarine Communications Master Plan (December 1995)

EXECUTIVE SUMMARY

This Submarine Communications Master Plan (SCMP) is an integral part of the Submarine Force Strategic Plan. It is an integrated and comprehensive document that promulgates: (a) current and projected submarine communications requirements, (b) overall acquisition strategy, (c) program schedules, and (d) component program descriptions. It has been developed by the Submarine Communications Program Manager (Space and Naval Warfare Systems Command [SPAWAR] PMW 173) for the Assistant Chief of Naval Operations (ACNO), Submarine Warfare Division (N87) and the Director, Space and Electronic Warfare (N6). It is intended for use by military staffs, systems commands, and industry in planning, developing, and fielding submarine communications systems.

The end of the Cold War brought about policy changes which have already dramatically altered the focus of naval doctrine and spawned a new theater of "Information Warfare." Emphasis is now placed on Joint and Combined operations in the littoral regions of the world rather than on massive, open-ocean engagements of past scenarios. National policy shifts, in concert with Department of Defense (DOD) budget and force structure drawdowns, have infused the Navy's Command, Control, Communications, Computers and Intelligence (C 4 I) programs with new importance. To remain an effective fighting force in this changed environment, the submarine must be indispensable to the Battle Group.

The ongoing world telecommunications revolution is driving both military and civilian information transfer systems toward a design of open architecture, multicast resource, shared and integrated networks; the most common example being the commercial telephone system. Under the Copernicus concept, the Navy will provide seamless, transparent, secure communications between the fleet and the entire global grid. For the Submarine Force to be interoperable with Joint and Navy systems, our submarines must be able to communicate within the same communications environment. Although our existing submarine communications systems have been proven to be robust and reliable, they are limited to low data rates and feature "stove-piped," closed system architectures which are not compatible with the emerging technologies, and are costly to maintain and upgrade. In an effort to alleviate these problems, Commander, Submarine Forces, U.S. Atlantic Fleet (COMSUBLANT) and Commander, Submarine Forces, U.S. Pacific Fleet (COMSUBPAC) have issued coordinated submarine communications requirements. The phased improvements in submarine connectivity requirements are illustrated in Figure (i).



Execution of this SCMP implements these requirements and integrates the Submarine Force into the Navy's overall communications upgrade by transitioning the force to a standard Submarine Communications Support System (SCSS) which will be fully interoperable with the Navy's Communication Support System (CSS). The SCSS is a cost-effective system architecture which will be common to all classes of submarines, with each class having only minor variations to account for installation and interface differences. This comprehensive development and installation plan integrates all current communications improvement programs in a phased delivery. To achieve full interoperability, the Submarine Force will be an active participant in the development of new systems and applications including the Navy's CSS and Joint Maritime Command Information System (JMCIS), the Joint Staff's "C 4 I for the Warrior" communication architecture, and Defense Information Systems Agency's (DISA) Global Command and Control System (GCCS).

The Navy's CSS acquisition strategy is to incrementally implement the new equipment, usually simultaneously with Battle Group deployments. Although prototyping and interim installations have already occurred and will continue, full scale CSS production is not scheduled until 1998. The submarine acquisition strategy is to remain synchronized with the Navy CSS implementation so that deploying submarines are interoperable within the Battle Groups. To provide immediate benefit to the submarine force, we will conduct early, force-wide installations of those portions of the Navy CSS that will be included in the ultimate design. For example, the automated Baseband System (BBS) will be installed in submarines force-wide beginning in 1997. The resulting submarine CSS will be a hybrid of existing and new components integrated into an open systems backbone that will allow for cost-effective insertion of new technology in the future. New communication equipment and capabilities will be system engineered to incrementally replace present submarine communication systems using "Block

Upgrade" installations in approximately two year increments. These installations will be scheduled to coordinate multiple equipment upgrades to save installation costs and minimize submarine downtime. Common, open systems architecture (OSA) hardware and software used by other forces will be used whenever feasible. To take advantage of advances in commercial technology, the active participation of industry will be requested and encouraged at all phases. To provide near-term Battle Group interoperability, full demand assigned multiple access (DAMA) capability will continue to be accelerated under the Miniaturized UHF DAMA (Mini-DAMA) and Improved AN/BRA-34 antenna programs. To improve submarine radio room operability, the Submarine Message Buffer (SMB) program has been expanded to include fully automated message processing, electronic internal distribution, and replacement of the current UGC-136 teletypes with a quiet, reliable commercial printer. The communications suites on all submarine classes will be managed as an integrated program with close coordination between the fleet users, Systems Commands, and the larger Navy/Joint community. During and after the transition to SCSS, SSBNs must maintain survivable/nuclear hardened communications to support strategic nuclear mission requirements in accordance with the Chairman, Joint Chiefs of Staff (CJCS) Nuclear Technical Performance Criteria.

This plan contains the following information:

The overall planned SCSS Implementation Strategy schedule is illustrated in Tab A, which is located directly after Section 5 of this document. A list of all acronyms is contained in the glossary (Appendix F).

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SECTION 1 UNDERLYING CONCEPTS

1.1 BACKGROUND

The reprioritized roles and missions to be performed by the Navy and by the Submarine Force, as outlined in the Secretary of the Navy’s white papers “From the Sea” and “Forward From The Sea,” require greater information throughput than is presently available within existing submarine communication shore and shipboard systems. The new communication suites must support strategic communications including multiple pathways capable of performing command and control (C^2) functional requirements throughout a nuclear conflict. They must also permit seamless interoperability and access to the common tactical picture found within the Battle Group Joint Maritime Command Information System (JMCIS), reception of large data file transfers for Tomahawk strike planning, and reception and transmission of video, voice, facsimile, and imagery while operating with combined and joint forces in the littoral regions. Submarine and Navy Command, Control, Communications, Computers and Intelligence (C^4I) must be interoperable with the Global Command and Control System (GCCS) being deployed by the Department of Defense (DOD) and the DISA. JMCIS will be the Navy’s implementation of GCCS and is required on-board all submarines.

1.2 PURPOSE

The SCMP provides a coordinated basis for planning, programming, and budgeting. The SCMP is the primary and authoritative document for planning, organizing and controlling the end products of the Navy’s submarine-related communication programs. This summary is intended to consolidate planning and improve total communications performance for all classes of attack (SSN) and ballistic missile (SSBN) submarines by organizing and controlling program objectives across the various lines of authority and responsibility. The SCMP is also intended to act as the focal point through which advances in communication systems and combat control systems are coordinated. This SCMP is an update of the plan approved in May 1994 to reflect programmatic changes and to coordinate improvements in the submarine communications suite with ongoing improvements in the submarine combat control systems (CCS).

1.3 ACQUISITION STRATEGY SUMMARY

To achieve the objective of affordable interoperability, sound acquisition strategies and a common radio room plan must be used. The overall strategy for installing a common radio room throughout the submarine fleet will be accomplished by soliciting early participation from industry and by performing class–specific installations. Technical concepts will be demonstrated and evaluated through a series of prototype SCSS installations prior to selection of a specific implementation for full production and introduction into the fleet. Installations supporting these evaluations will be coordinated with the Type Commanders (TYCOMs) such that the submarine evaluating prototype equipment will receive a comprehensive package of all upgrades. This coordination of prototype installations will allow a synergistic evaluation of the prototype systems operating together on a dedicated submarine, and will also reduce test and evaluation costs.

Starting with LOS ANGELES class submarines, a hybrid-design SCSS will be provided in which new communication systems such as Extremely High Frequency (EHF), Miniaturized Demand Assigned Multiple Access (Mini-DAMA), and a Baseband System (BBS) will be installed to complement existing communication systems. This hybrid SCSS will be developed in phases: (1) Submarine Message Buffer (SMB) Phase (FY94 – FY96); (2) BBS Phase (FY97 – FY98); and (3) Submarine Automated Radio Room (SARR) Phase (FY99+). These phases are described in greater detail in Section 3. Installations will be coordinated through the TYCOMs, scheduling major ship and operational alterations (SHIPALTs and OPALTs) (e.g., EHF, BBS or Mini-DAMA) concurrently to minimize cost and the need to repeatedly disrupt the radio room and operating schedule of the submarine.

Due to the high cost of integrating new systems into the existing TRIDENT radio room, the plan will “freeze” the radio room at revision 5.3.1 until FY01, with the exception of EHF installations and the requirement for multiple high data rate (HIDAR) receivers to be installed prior to January 2000. The potential for installation of DAMA capability prior to the planned FY01 SCSS block upgrade for TRIDENT is being assessed. After FY01, newer communication systems will be “packaged” so that a group of communication equipment such as EHF, Mini-DAMA, Submarine Low Frequency/Very Low Frequency (LF/VLF) VMEbus Receiver (SLVR), Antenna Distribution System (ADS), and BBS can be installed during one installation period. For the SEAWOLF class, modernized communication equipment and capabilities will be installed following Post-Shakedown Availability (PSA) periods. Finally, the New Attack Submarine (NSSN) class will receive its variant of the SCSS/Exterior Communications System (ECS) during the new construction period via a “turn-key” installation strategy. The SCSS ECS implementation strategy for each submarine class is described in Section 5 (Sections 5.2 - 5.4).

1.4 MANAGEMENT

The overall integrated plan for the acquisition, installation, and maintenance of a common radio room on-board all classes of submarines requires a cooperative, coordinated effort among many organizations. Specifically, United States Strategic Command (USSTRATCOM), Commander-in-Chief Special Operations Command (CINCSOC), the Submarine TYCOMs, the Chief of Naval Operations (CNO) Staff (N6, N8), the Naval Systems Commands (SPAWAR, NAVSEA), and Naval Laboratories (NCCOSC, NUWC) must work closely together to clearly articulate the requirements, solutions, and implementation of the plan. The Submarine Communications Systems Program Manager, SPAWAR PMW 173, is designated as the overall coordinator of all aspects of submarine communications.

PMW 173 has designated the Navy Command, Control, and Ocean Surveillance Center (NCCOSC), Research, Development, Test and Evaluation Division (NRaD) as lead laboratory for submarine communication design architecture since they are the lead activity for all Navy communication architectural and system engineering designs. The Naval Undersea Warfare Center (NUWC), Newport Division has been designated lead laboratory for submarine platform integration. NCCOSC In-Service Engineering Division, East (NISE East) has been designated the lead organization for coordinating submarine communications system in-service engineering management, including installations and life cycle support. Submarine communications installations, currently managed by multiple organizations, will transition to a single, integrated management in 1996. Submarine Development Squadron Twelve will continue to develop communication operational concepts and submarine communication procedures. As submarine missions evolve, the SCSS and supporting communications concepts must also evolve. The mix of missions carried out by both attack and ballistic missile submarines (and potentially Guided Missile Submarines (SSGNs)) has changed significantly since the end of the cold war. This change in mission emphasis is driving the revolution in submarine communications.

1.5 SUBMARINE MISSIONS

The demise of the Soviet Union has altered the roles and missions of both the U.S. Navy and its Submarine Force. The submarine communications system (ashore and afloat) must support mission requirements for both SSNs and SSBNs. The finite assets and capabilities of the submarine communications system had previously been optimized to support cold war missions. These tradeoffs must now be reviewed as the submarine communication systems and its supporting acquisition programs are “re-optimized” to reflect the Navy’s and submarine force’s reprioritized mission emphasis.

1.5.1 Joint Services and Navy-wide

The Naval services are in an unprecedented period of change. This change provides a unique opportunity to redirect the Naval forces to best support their future employment. The Secretary of the Navy (SECNAV) White Papers, “...From The Sea,” and “Forward From the Sea”, define this new direction as “...to provide the Nation with Naval Expeditionary Forces which are:

- Tailored for National Needs
- Shaped for Joint Operations
- Operating ‘Forward From the Sea’”

The new direction set forth by these white papers shifts the emphasis of naval operations from preparing for and executing open-ocean warfare against the Soviet Union to preparing for and executing Joint operations, conducted from the sea, in littoral regions. The four key operational capabilities required to execute this new direction as stated in “...From the Sea” are:

(1) Command, Control, and Surveillance;
(2) Battlespace Dominance;
(3) Power Projection; and
(4) Force Sustainment.

To ensure that Navy acquisition programs support this new direction, the CNO initiated an assessment process based on seven Joint Mission Areas (JMAs) and two Support Areas. These JMAs (Joint Strike; Joint Littoral Warfare; Joint Surveillance; Joint Space and Electronic Warfare/Intelligence; Strategic Deterrence; Strategic Sealift/Protection; Forward Presence) and Support Areas (Readiness Support and Infrastructure; Manpower, Personnel, and Shore Training) are employed to assess an acquisition program's contributions to the key capabilities. In addition to their traditional roles, such as Anti-Submarine Warfare (ASW), submarines can and will conduct warfare tasks in support of all seven JMAs. The SCSS and its associated acquisition programs must be able to support these JMAs with interoperable communications that provide effective C 2 links, as well as support C 4 I requirements.

The submarine communication systems must also provide the communication support necessary for the SSBN force to ensure continued deterrence of nuclear aggression. "From the Sea" states "As long as the United States maintains a policy of nuclear deterrence, our highly survivable nuclear powered ballistic missile submarines will remain critical to national security". Although the current radio room adequately supports the strategic communications requirements, these vital links must not be degraded as tactical connectivity is improved by reprioritizing assets or communications-related acquisition programs.

1.5.2 Tailored Expeditionary Forces

"...From The Sea" also presented the concept of tailorable expeditionary forces. To support this concept, the Navy and Marine Corps must be restructured around flexible, forward-deployed Naval Expeditionary Forces which expand on and capitalize upon the Naval Services' traditional expeditionary roles. "From the Sea" states "Naval Expeditionary Forces provide unobtrusive forward presence which may be intensified or withdrawn as required on short notice". The Naval Service will provide the Unified Commanders in Chief (CINCs) an Expeditionary Force Package, flexibly and dynamically configured from the available Naval Forces, which ranges from an Aircraft Carrier Battle Group (CVBG) and its assigned aircraft, submarines, and surface ships, to Special Operations Forces (SOF) teams. The Submarine Force and its communications systems must be capable of supporting this flexible Expeditionary Force during operations with joint and combined task forces.

1.5.3 Submarine Force

Mirroring the changes in Navy-wide mission priorities, the Submarine Force has shifted its mission emphasis from global sea control to the support of regional conflict ashore [2]. The Submarine Force Strategic Plan provides a Submarine Force Vision and Mission Statement. The Vision statement states:

> “The U.S. Submarine Force will remain the world’s preeminent submarine force. We will aggressively incorporate new and innovative technologies to maintain dominance throughout the maritime battlespace. We will promote the multiple capabilities of the submarines and develop tactics to support national objectives through battlespace preparation, sea control, supporting the land battle and strategic deterrence. We will fill the role as the Navy’s stealthy, general purpose warship”.

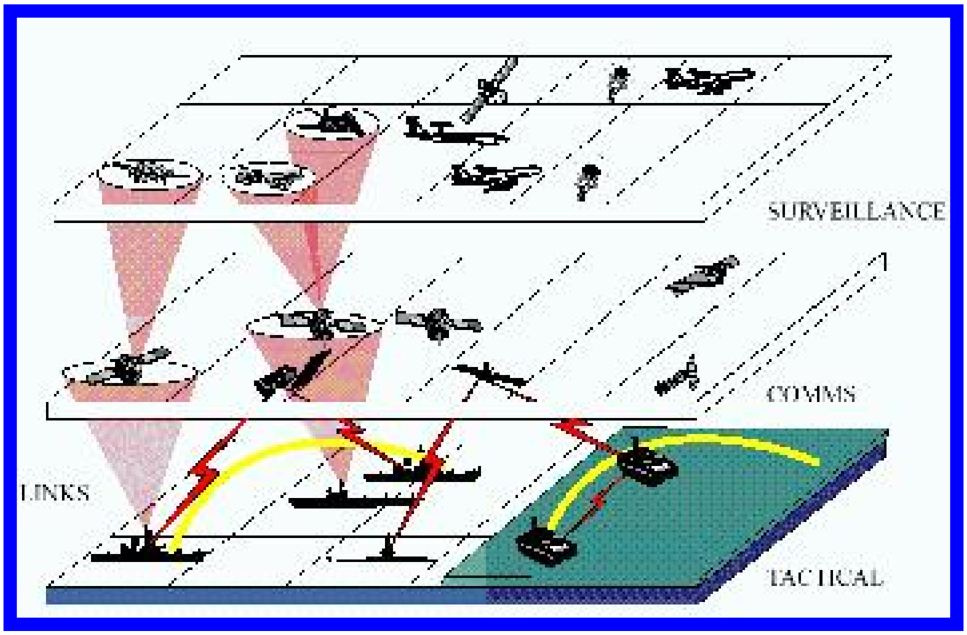
The Submarine Force Mission statement states:

> “The Submarine Force will provide the National Command Authority, Theater Commanders and Joint Task Force Commanders with:
>
> - A survivable force capable of deterring regional aggression or global strategic attack.
> - Early, accurate and sufficient knowledge of pre-crisis situations at sea and on land, as well as the battlefield on which power may be projected from the sea.
> - Clandestine and timely striking power against critical targets at sea and ashore.
> - Capabilities to prepare the battlespace and enable the establishment and support of an expeditionary force on land.
> - The naval superiority to defeat enemy forces, control sea lines of communication and dominate the maritime battlespace.”

1.6 Copernicus Concept

The original Copernicus pillars have evolved to support the shift to “Forward...From the Sea” and “Operational Maneuver From The Sea.” In “Forward...From the Sea,” it was recognized that the most important role for Naval forces, short of war, is to be engaged in forward areas, preventing conflicts and controlling crisis. The Copernicus evolution reflects the need for the C 4 I infrastructure to support the architecture, down to the shooter and the weapon. Deployed forward, Naval C 4 I gives the joint commander C 2 on arrival.

Copernicus supports worldwide C 4 I coverage to the shooter. Fixed and mobile elements now provide the shooter the same information previously available only to decision makers in command centers. Conceptually, platforms are linked by moving information around the information spectrum. The information spectrum consists of three integrated grids (Figure 1-1).



Surveillance Grid: A capabilities grid blanketing the battle space instead of a series of single sensors. This grid consists of national, theater, and platform sensors that the warfighter can access directly through Global Information Exchange System (GLOBIXS) and Tactical Data Information Exchange Subsystem (TADIXS).

Communications Grid: An overlaying wide area network (WAN) of pathways that uses multiplexing and digital technology to move data and information into and around the battlespace. Copernican connectivity facilitates the movement of information among operators and analysts.

Tactical Grid: A tactical network of communications links that ties together all units of a force regardless of the platform or component. This grid connects the units Combat Control Systems (CCSs) to provide fire-control grade information across the battle cube to the shooters. The Battle Cube Information Exchange System (BCIXS) can "plug" and "play" to access C 4 I information directly by using Tactical Digital Information Links (TADILs) tied to higher echelon Tactical Command Centers (TCCs) and the tactical grid itself.

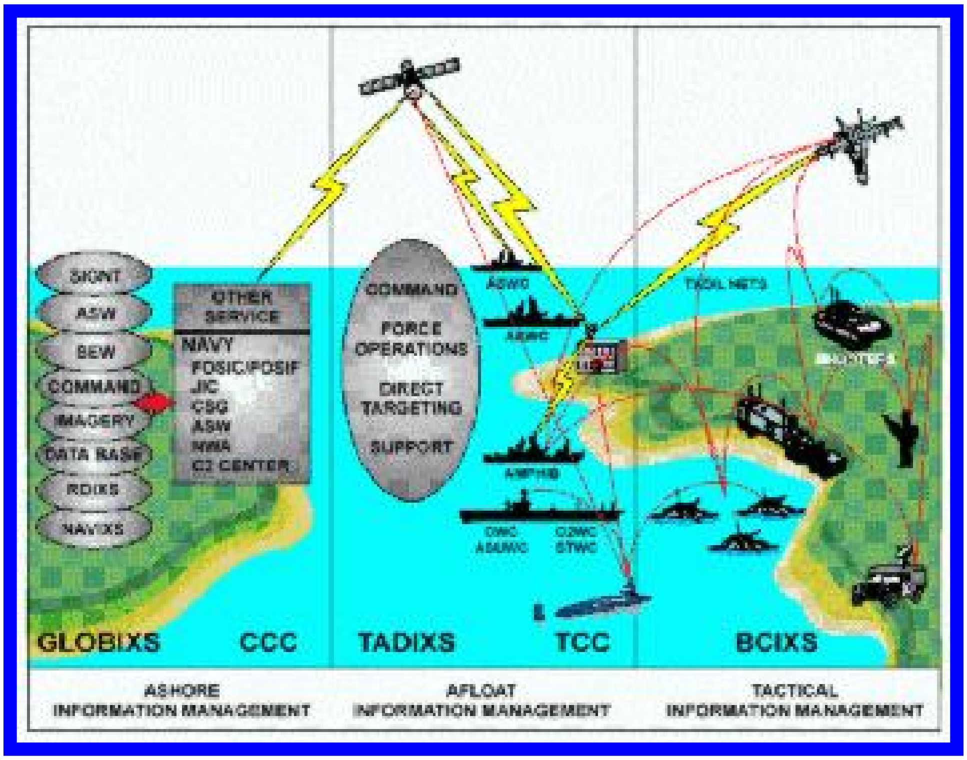
1.6.1 Information Warfare

Information Warfare (IW)/Command and Control Warfare (C 2 W) is any action to exploit, manipulate or destroy an adversary's information and/or information systems while leveraging and defending friendly information and information systems to achieve information dominance. IW can be employed before and during hostilities and is fought in the information battle space. IW permeates strategic, operational and tactical levels; encompasses political, economic, physical and military infrastructures; expands the spectrum of warfare from competition to conflict; redefines traditional military and national security concepts; and spans the spectrum from peace through warfighting. C 2 W, the military and submarine force implementation of IW, is the integrated use of operations security, military deception, psychological operations, electronic warfare and physical destruction to deny information to, influence, degrade or destroy an adversary's C 2 capabilities, while protecting friendly C 2 capabilities against such actions.

1.6.2 Connectivity and Battle Cube Information Exchange System

Connectivity links nodes throughout Copernicus to implement the sensor-to-shooter construct. Rapid and reliable connectivity is the cornerstone of all C 4 I provided by GLOBIXS, TADIXS and BCIXS. Connectivity is critical to the Common Tactical Picture (CTP) because it provides the managed bandwidth for timely transmission of imagery, video, voice, and data. Connectivity is critical to the Defense Information Infrastructure (DII) users in peace, crisis, conflict, humanitarian support, and war. It is the widely-distributed, user-driven infrastructure composed of the information assets owned by all the military Services into which the warfighter can gain access from any location, for all required information.

Initially, there were four pillars of the Copernicus architecture: the GLOBIXS, the CINC Command Complex (CCC), the TADIXS, and the TCCs. As the Copernicus architecture evolved, a new pillar emerged — BCIXS (Figure 1-2). The initial pillars flowed and filtered information to and from the TCC for use in the battle space. The Copernicus battle space is defined as the entire military and political infrastructure that spans the range of the pillars to the TCC. The BCIXS extends the architecture to include the battle cube — the area in which shooters and weapons reside. The battle cube is a conceptual, multi-dimensional area that includes subsurface, surface, air and space as the environment for conducting warfare. BCIXS represents the battle cube in which tactical forces operate. The boundaries of the BCIXS are fluid and defined by the dynamics of the battle. Shooters operating in the battle cube form the operational nodes in the BCIXS. Shooters are equipped with C 4 I tools that allow them to receive and process information from the Copernicus architecture.



1.6.3 Copernicus Sensor-to-Shooter Concept

The Sensor-to-Shooter Concept within the Copernicus architecture focuses on the process of putting a weapon on target. This includes surveillance and reconnaissance, acquisition and localization, combat identification, targeting, engagement and guidance, and battle damage assessment. Historically, systems were developed to engage a specific threat with little regard for the interrelationship with other systems or supporting infrastructure. Stovepipe systems made it difficult for platforms to share information in a timely manner causing inefficiencies, especially in joint and allied operations. The sensor-to-shooter construct integrates all systems in the weapon procurement and employment process.

1.6.4 Common Tactical Picture: Command, Control, Communications, Computers and Intelligence/Communications Support System Integration

Within the Copernicus architecture, the CTP refers to all information spanning the spectrum from the sensor to the shooter that allows tactical commanders to understand the battle space. CTP consists of surveillance, intelligence, identification, environmental and positioning inputs and tactical decision aids. Key factors in the CTP include timeliness, coverage, sensor revisit rates, accuracy and completeness. All users then share the same scalable picture and can extract the pieces relevant to their specific needs and tactical situation. Reducing fratricide during hostilities is an objective of national policy. This depends on a near-perfect tactical picture with common grid (location) references on all platforms.

Reduced reaction times, combined with increasingly capable threat weapons, makes full C 4 I/CCS integration a critical objective of Copernicus. Fewer nodes and integration of C 4 I/CCS accelerates the decision making process and assists the joint warfighter in achieving information dominance over the enemy. Copernicus is accomplishing this integration by prescribing the interfaces between C 4 I systems and CCS, empowering platforms to react immediately to threats. These interfaces depend on common standards and protocols so that systems in the architecture can transfer data. The first major step in fielding Copernicus was implementing JMCIS. The JMCIS architecture links C 2 systems into functional categories and creates an environment for Services to field interoperable systems with common user interfaces. JMCIS has already migrated several stovepipe systems into one workstation to produce a CTP. More Navy and Marine Corps C 4 I systems will continue to migrate into the JMCIS architecture as Copernicus evolves. JMCIS is the maritime implementation of the GCCS. GCCS supports an open system environment for automated information processing at all warfighting levels of the DOD.

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SECTION 2 COMMUNICATIONS SYSTEM REQUIREMENTS

The mission and roles discussed in Section 1 place certain minimum requirements on the C 4 I links to and from submarines. This section summarizes these communications requirements, as referenced in the appropriate Mission Needs Statement (MNS), Operational Requirements Document (ORD) and joint COMSUBLANT/COMSUBPAC requirements letters. Integrated submarine C 4 I includes SCSS, JMCIS, CCS, and a platform local area network (LAN).

2.1 SUBMARINE COMMUNICATIONS REQUIREMENTS

OPNAV, USSTRATCOM, CINCSOC, COMSUBLANT and COMSUBPAC have jointly identified the following requirements for submarine communications:

- Be fully interoperable with and be able to send/receive mission related information to/from the JTF. [Interoperability]
- Submarine radio rooms must be based on an Open System Architecture (OSA), in step with the Copernicus architecture and be CSS capable. [Open Systems Radio Room]
- Sufficient throughput for timely transfer of strike and surveillance data, including imagery. [Throughput]
- Be able to maintain continuous record traffic without mast exposure. [Covert receipt of record communications]
- Connectivity to Super High Frequency (SHF) link absolutely essential.
- Submarine High Data Rate (HDR) information throughput requirements of 128 kilobits per second (kbps) in 1995, 256 kbps in 1998, 512 kbps in 2002, and 1.544 megabits per second (Mbps) (T1) in 2006, are needed to support Task Force operations, Intelligence gathering, Tomahawk Strikes, and SOF missions.
- SSBNs must possess highly survivable and robust communications capable of satisfying CJCS Nuclear Technical Performance Criteria.

Submarine requirements for HDR satellite communications (SATCOM) were defined by COMSUBLANT in a requirement's letter of 29 November 1994. The Joint COMSUBPAC/COMSUBLANT requirements letter dated 04 November 1993 identified several specific requirements, concentrated in two areas: (1) New Antenna Design and Configuration and (2) Interoperability. Tables 2-1 through 2-5 address these requirements and summarize the capabilities being fielded by current (FY96) and planned acquisition programs. These requirement letters may be found in Appendix E.

Table 2-1. Submarine Communications Requirements/Capabilities/Programs

Requirement	Capability	Program: Current	Program: Planned
Interoperability with JTF	HF	ANDVT, Link 11	Improved Link 11 HFRG, ALE
	UHF	ANDVT, Link 11, OTCIXS SSIXS, DAMA TEMPALT	Mini-DAMA LINK 16 TADIXS B, CTT/JTT
	SHF		SHF
	EHF	EHF LDR (2.4 KB)	EHF MDR (64KB)
Open Systems Radio Room	OSA	Incremental Implementation of Navy Comms Support System	
Throughput FY95:128kbps FY98:256kbps FY02:512kbps FY06:1.544Mbps	Transfer Strike and Surveillance Mission Imagery/Video	SSIXS, DAMA EHF-LDR	Mini-Dama SHF DSCS Commercial SATCOM EHF MDR GBS
Covert receipt of record communications	Receive VLF/LF/ELF	Ship: VERDIN/EVS Shore: FRT/95A, SSPAR, VERDIN (AN/URT-30)	SLVR ISABPS-PIP IVTT

Table 2-2. Submarine Communications Requirements/Capabilities/Programs

Requirement	Capability	Program: Current	Program: Planned
Data Link	Link 16/JTIDS Improved Link 11	Link 11, TADIXS A, OTCIXS, JTIDS	MIDS Improved Link 11
BG Connectivity	BGIXS DAMA	BGIXS DAMA TEMPALT	HF E-mail Mini-DAMA
Accelerated DAMA	DAMA	DAMA TEMPALT	Mini-DAMA
Common Tactical Picture with BG	NTCS-A/JMCIS	JOTS	NTCS-A/JMCIS
SSBN Upgrades	Interoperability/Reliability Open Architecture Replace Obsolete Equipment	EVS	HIDAR, Mini-DAMA, SLVR, EHF LDR

Table 2-3. Submarine Communications Requirements/Capabilities/Programs

Antenna Requirement	Antenna Capability	Antenna Program: Current	Antenna Program: Planned
Higher Frequency and Throughput	UHF	BRA-34	Improved BRA-34
	SHF		SHF/EHF Dual Band Antenna
	EHF LDR	Type 8 MOD 3 Scope Ant.	
	EHF MDR		Global Broadcast System (GBS)
Assured Connectivity Across Spectrum of Conflict with JTF Interoperability	Reliable Antennas for Robust Communications in Stressed Environment		Continued SIAS Developments
	ELF	HSBCA	
	VLF/LF	OE-207, BRR-6	
	HF	OE-315	
	UHF	BRA-34	Improved BRA-34
	VHF	Type 18 Sleeve	Improved BRA-34
	SHF		SHF/EHF Dual Band Antenna
	EHF	Type 8 MOD 3 (Scope)	

Table 2-4. Submarine Communications Requirements/Capabilities/Programs

Requirement	Capability	Program: Current	Program: Planned
Use Standard Equipment	Navy/Joint Equipment to Replace Obsolete	NKDS NESP DAMA (TD-1271)	BBS, HFRG NTCS-A, MIDS, Mini-DAMA, MCIXS (SSN only)
New Expansion Concepts	Auto Message Distribution	SMB	SUB LAN, SMB Rehost BBS Integrated Network Manager
	VVFD		VVFD
	Interoperable Imagery	CLUSTER KNAVE	NTCS-A
	Automated Switching	Baseband and RF patch panels	BBS, ADS
Other RF Signals	IFF/GPS	BRA-34	Improved BRA-34
SOF Communications	Standard SOF Interface to Radio Room	Ad Hoc	Submarine CSS Interface through ADS
GMDSS Navigation/Warning (SAFETYNET)	Receive Navy and Maritime Safety Broadcasts		NAVTEX

Table 2-5. Submarine Communications Requirements/Capabilities/Programs

Requirement	Capability	Program: Current	Program: Planned
SSBN EHF LDR	EHF LDR	NESP	EHF LDR (NESP & Type-8 Mod 3 Periscopes)
HDR Antennas	SHF and EHF MDR for SSNs		SHF/EHF Dual Band Antenna
Stealth Sail Antennas	TBD		Future Development

2.2 SUBMARINE COMMUNICATIONS SUPPORT SYSTEM REQUIREMENTS

One of the immediate tasks delineated by the Navy in "From the Sea" is to continue the full integration of SSNs into expeditionary task forces. To be effective units of a Naval Task Group within a joint, Tailored Forward Element (TFE), submarines must be fully interoperable with both Naval and Joint communication systems. Submarines must be capable of tailoring on-board capabilities to optimize their support for the Joint Task Force (JTF) and Naval Component Commanders. The SCSS strategy is to provide a radio room architecture with open system features that will provide a much improved level of communications flexibility and interoperability for submarines.

SCSS requirements are evolving and will continue to evolve over time with the Navy's CSS requirements and as a subset of the Joint Chiefs of Staff (JCS) "C 4 I for the Warrior" and the Navy's Copernicus communication architectures. The Submarine CSS program will implement an open system, multimedia, circuit sharing architecture which: (1) allows users to share all communication circuits available; (2) permits easy, cost effective expansion to accommodate new capabilities; (3) reduces development, production, and support costs by using common hardware and reusable software; and (4) will be fully interoperable with Navy JMCIS.

2.3 SUBMARINE COMMUNICATIONS SUPPORT SYSTEM COMPATIBILITY WITH OTHER NAVY SYSTEMS

In addition to operational requirements determined by the submarine force, the SCSS must be compatible with Navy/Joint and various commercial systems and standards. The major ones are discussed in the following paragraphs.

2.3.1 Submarine Communications Support System Interface with the Joint Maritime Command Information System

The SCSS will be interoperable with the Navy JMCIS in three ways. First, for interoperability with the submarine Command and Control systems (e.g., Joint Operational Tactical System [JOTS], Navy Tactical Command System - Afloat [NTCS-A]), the SCSS will make use of the Generic Front End Control Processor (GFCP). The GFCP provides flexible input/output (I/O) processing and protocol conversion between the SCSS and the submarine CCSs enabling JMCIS data to be used and displayed. The GFCP replaces the Sensor Interface Unit (SIU) presently used on-board most submarines. Second, submarines will strive for JMCIS compliance by using JMCIS/Unified Build software and operating systems whenever feasible in the deployment of the SCSS C 4 I systems. Finally, items such as the SCSS Integrated Network Manager (INM), which is part of the Submarine BBS program, will be JMCIS-compliant.

2.3.1.1 Joint Maritime Command Information System Description

JMCIS refers to two things: (1) a "Superset" collection of software modules which can be customized and configured to build a Command Information System; and (2) a Navy fielded Command Information System (e.g., a collection of software and actual fielded systems). The Navy developed JMCIS software is the "software core" around which Office of the Secretary of Defense (OSD) and DISA are deploying the GCCS. JMCIS will be the Navy's implementation of GCCS Afloat.

Submarine JMCIS refers to an open architecture system and a software development environment that offers a collection of services and already built software modules for Command Information System components. Figure 2-1 shows a high level architectural view of Integrated Submarine C 4 I.

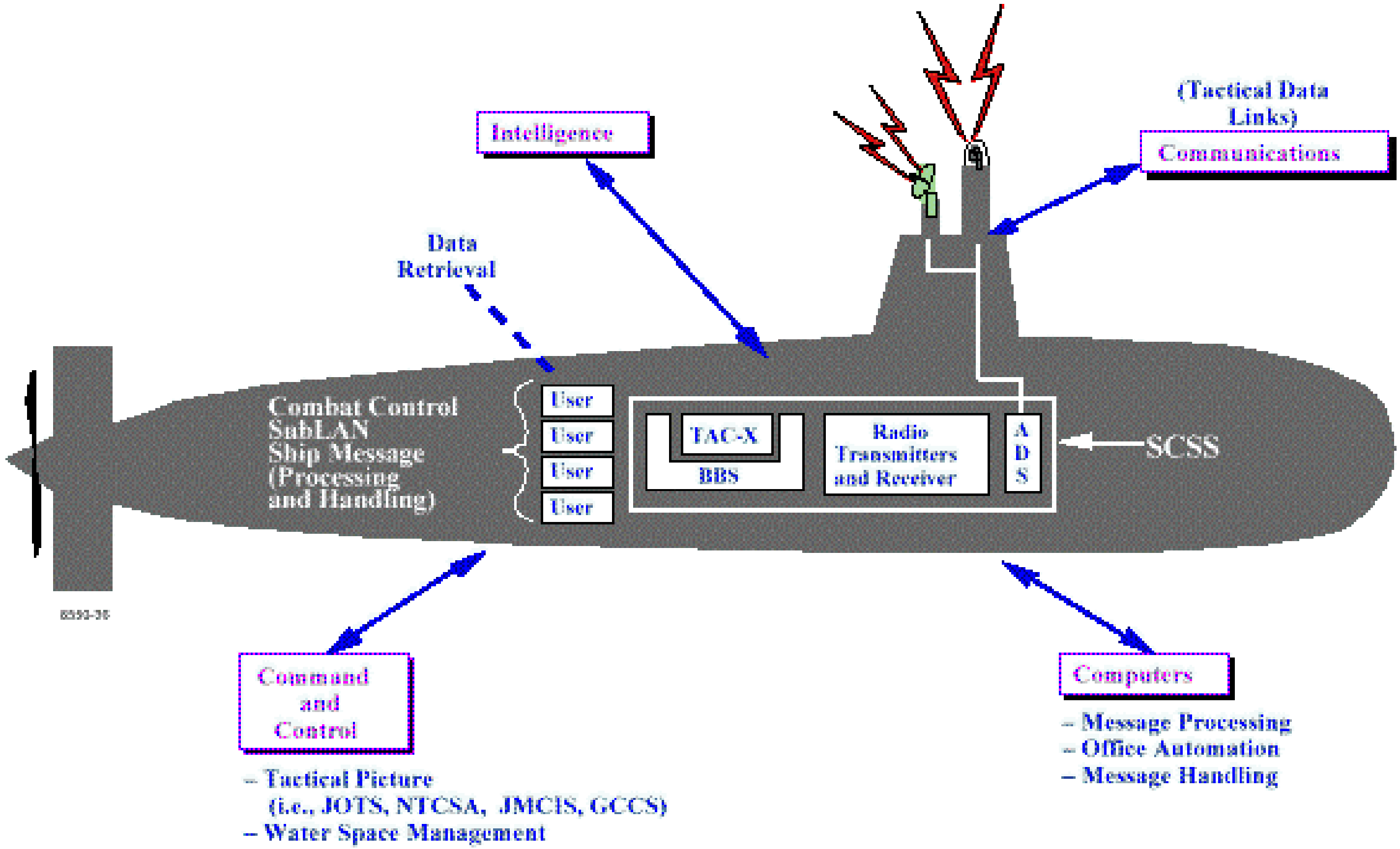

Figure 2-1. Integrated Submarine C^4I

It is important to understand the following aspects of JMCIS:

- JMCIS is not the same as Unified Build, NTCS-A, or Operational Support System (OSS), but each of these have contributed software to the JMCIS superset.
- JMCIS is not a solution for all command and control problems. However, the number of applications, whether or not related to C 2 , which share common requirements with JMCIS is large.
- JMCIS is not government modified commercial off-the-shelf (COTS) products. Commercial software is used whenever practical, but the executable code and data files are not modified except to customize the COTS products.
- JMCIS is not a deviation from accepted industry standards (e.g., Motif Style Guide).
- JMCIS is not vendor proprietary.

JMCIS is managed Navy-wide by SPAWAR (PD 70 and PMW 171).

The submarine implementation of JMCIS will consist of loading a COMSUBLANT/ COMSUBPAC-approved selection of JMCIS software modules on JMCIS compliant computers and is the responsibility of Naval Sea Systems Command (NAVSEA).

2.3.2 Submarine Communications Support System Interface with the Defense Messaging System

The Defense Message System (DMS) is a joint DOD program created to improve DOD's electronic messaging and interpersonal electronic mail (e-mail) capabilities, while reducing cost.

The DMS will replace the baseline Automatic Digital Network (AUTODIN) messaging and Simple Mail Transfer Protocol (SMTP) e-mail with a system based on the International Telecommunications Union (ITU) recommendations for Automatic Message handling, X.400, and Directory Services, X.500. The DISA DMS Program management has planned an evolutionary program in which the DOD DMS architecture will be implemented through a series of phases over time. Within the Navy, SPAWAR PMW 172 manages the DMS program for shore and afloat implementation. The two major infrastructure programs that will be used to incorporate automatic message handling is the Naval Modular Automated Communications System (NAVMACS) for Surface afloat units and the Naval Communications Processing and Routing System (NAVCOMPARS) for activities ashore.

The SCSS Exterior Communications System will be fully DMS compliant. In the near-term, submarine SCSS DMS implementation is planned to provide DMS services while the submarine is pierside. In this planned architecture, the UNIX-based SMB will host DMS applications supporting communications front end processing and message routing functions based on classification (SECRET and below message will be routed via a submarine LAN). Multi-Level Information System Security Initiative (MISSI) products (FORTEZZA with Assure) will be used for information security (INFOSEC), and Lotus Notes will be used for message profiling, storage, and routing to individual users. Messages from the submarine can be transferred into the Defense Information System Network (DISN) through landline connectivity or by transferring DMS messages onto a floppy disk for hand delivery to an appropriate shore activity that provides a DISN interface.

In the long term, as the DMS is incrementally implemented into the fleet for tactical DMS message delivery while underway, the submarine SCSS ECS architecture will support the receipt of tactical messages via X.400/X.500 messaging.

2.3.3 Submarine Communications Support System Interface with the Submarine Local Area Network

Automated distribution of data is required on submarines and will be implemented in accordance with the Submarine Afloat Information Systems Strategic Plan (CSLNOTE 5230 of 31 Jun 94). SPAWAR PMW 174 is working with NAVSEA and PMW 173 to field the Standard Non-Tactical Automated Data Processing Program (SNAP III) LAN on submarines. This element of the submarine integrated C 4 I is described by the SCSS Security Concept of Operations (SCONOP).

2.3.4 Submarine Communications Support System Interface with the Submarine Combat Control System

The SCSS is the ECS through which the CCS sends and receives data to and from the telesphere. This element of the submarine integrated C 4 I is the responsibility of NAVSEA.

2.4 Polar Coverage Requirements

Submarines require polar communications capability. This requirement is being addressed by Navy/Joint Systems under direction of the Joint Staff (J61).

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SECTION 3 SUBMARINE COMMUNICATIONS SUPPORT SYSTEM

3.1 SUMMARY OF PROGRAM STRATEGY

The transition of today's submarine radio room communication capabilities and stovepipe systems to the goal of an interoperable, OSA with reduced life cycle costs will take place incrementally over the next decade. A near-term, hybrid SCSS ECS, consisting of both new, OSA-based equipment, and legacy, closed architecture equipment, will be fielded near the mid-point in this transition. To affordably capture the technologies needed to improve submarine communication capabilities, an economically and technically sound acquisition strategy is required. This strategy must support both transitioning existing ECS (SSN 688, SSN 21, TRIDENT) and fielding a 9-rack SCSS ECS implementation for the NSSN with the same functionality. The 9-rack NSSN SCSS variant provides an opportunity for a significant advance in ECS automation, operability, and miniaturization.

The Submarine Communications Program Manager (SPAWAR PMW 173) has been directed to develop and implement a shore and shipboard program plan that has the objective of being flexible and using open system architecture. The programmatic strategy will:

- Provide full interoperability at lower cost;
- Use the Navy's Copernicus Concept and CSS Architecture and overall systems engineering as a baseline;
- Use common Navy/Joint hardware, size permitting; if not possible, fully software compatible but smaller hardware will be employed;
- Use COTS/government off-the-shelf (GOTS) circuit cards and modules as available (environmental requirements such as shock, cooling, and noise will be met by using the appropriate chassis);
- Coordinate the radio room architecture with improvements in submarine CCSs;
- Use tailored software modules such as those being used for the JMCIS;
- Maximize use of automation for operation of radios, communication plan implementation, paperless message distribution, technical manuals, training, thereby reducing manning;
- Leverage commercial telecommunications technologies to the extent feasible, particularly in the areas of data compression and advanced antenna concepts;
- Influence Navy standards in the communication field by submarine force personnel actively participating on requirement and decision making boards;
- Coordinate shipboard equipment installation design, planning, and fielding; and
- Provide for seamless insertion of new technology through the use of OSA.

3.2 SUBMARINE COMMUNICATIONS SUPPORT SYSTEM TRANSITION (FY94–FY04)

To transition the entire Submarine Force to the SCSS, the implementation plan calls for the installation of various communication building blocks in the submarine hybrid ECS. The building blocks are:

- SMB Phase (FY94 – FY96)
  - Automated Internal Message Preparation
- BBS Phase (FY97 – FY98)
  - Automated Internal Message Preparation (SMB)
  - Automated Internal Signal Routing (BBS)
  - Automated Internal Message Routing (SMB + SNAP III)
- SARR (FY99+)
  - - All BBS Phase Functionality
  - Enhanced automation through remote control of communications equipment
  - Higher Throughput Antennas (Improved BRA-34, SUB HDR, GBS)
  - Higher Overall Data Rate by using Shipboard Automated Communications Control System (SACCS) Multicast Capability (when implemented Navy-wide)

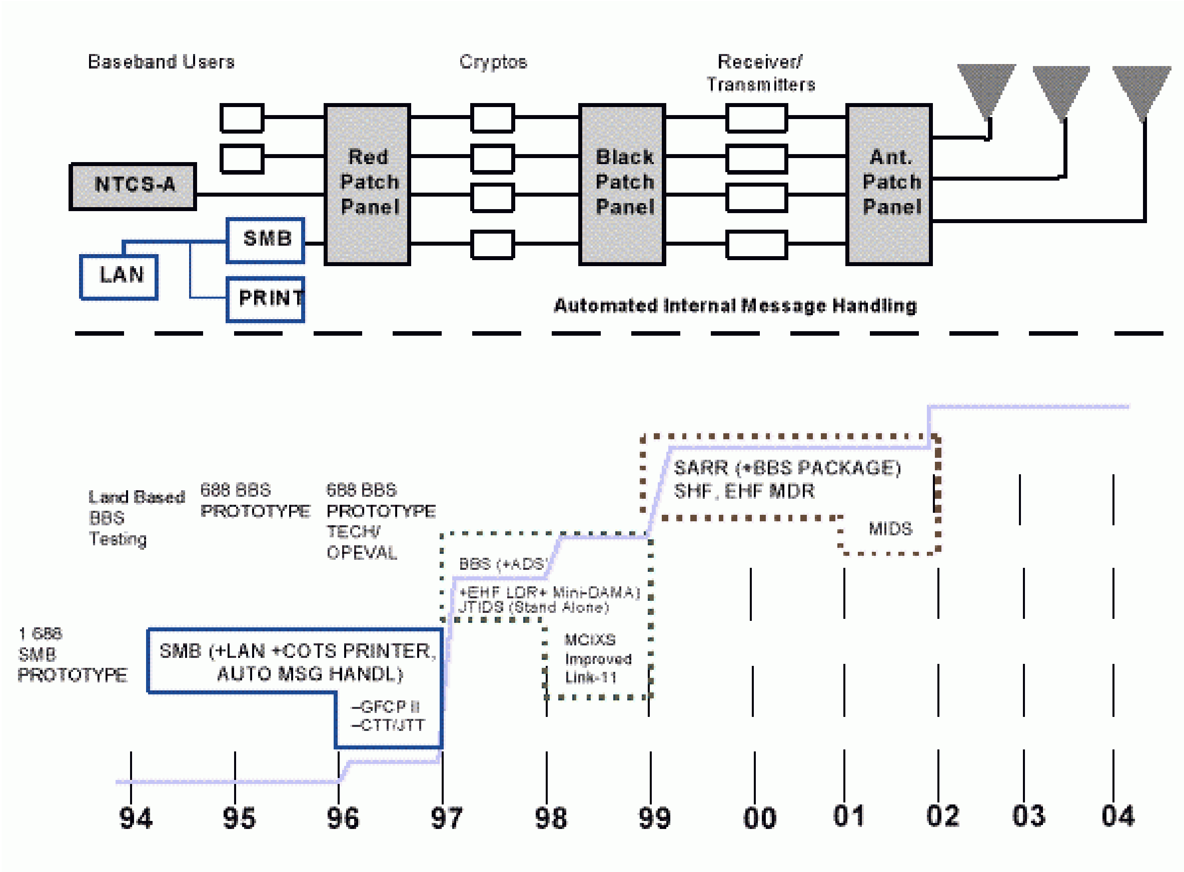
Baseline SCSS is 688 class which will be the development platform for all other classes. The transition to the near-term, hybrid ECS will make use of existing programmatic schedules to phase the introduction of new equipment through a cost effective, integrated installation plan. PMW 173 will coordinate with NAVSEA, PMS 396 and PMS 393, to investigate possible efficiencies in combining the EHF Low Data Rate (LDR) SHIPALT with one or more of the following SHIPALTs: Mini-DAMA, BBS, ADS. Installation of EHF LDR will not be delayed to support this synergistic installation effort.

Technical concepts will be demonstrated and evaluated through a series of prototype SCSS installations prior to selection of a specific implementation for full production and introduction into the fleet. For example, during the SMB Phase, a series of candidate BBS are being evaluated, via prototyping, to select the production BBS, which will be installed during the follow-on, BBS Phase. Installations supporting these evaluations will be coordinated with the TYCOMs such that the submarine evaluating the SCSS prototype BBS receives a comprehensive package of all available upgrades. This coordination of prototype installations will allow a synergistic evaluation of the prototype systems operating together and will reduce test and evaluation costs.

The following sections briefly summarize the programmatic efforts which affect the SCSS during this near-term transition. Submarine antennas, because of their unique requirements and significant impact on submarine communications capabilities, are discussed separately in Section 4. More detailed information concerning this transition, new equipment, and schedules, is contained in Appendix A (Shipboard Communications Equipment).

3.2.1 Submarine Message Buffer Phase (FY94–FY96)

The SMB Phase is the first step toward the hybrid SCSS. This phased transition is depicted in Figure 3-1. The most significant installation of production equipment during this time period is the SMB program, in which a commercial personal computer (PC) is truly integrated into the submarine radio room automated internal message storage, generation, and processing. The SMB phase makes use of Non-Development Item (NDI) hardware and existing commercial and military software. All SSN 688 and SSN 21 class submarines will receive the SMB during this phase. Additionally, a BBS prototype will be evaluated on a SSN 688 class submarine. This prototype will be used to validate production BBS concepts prior to a full rate production decision in FY97. Figure 3-2 describes the revised ECS architecture for this BBS Prototype and Figures 3-3 and 3-4 present the rack layout of the BBS Prototype SCSS ECS. Related production and prototyping efforts, applicable to the SSN 688 class only, during the SMB phase will include: introduction of quiet and reliable commercial printers, an internal radio room LAN, production installations of EHF LDR capability, installation of Mini-DAMA Engineering Development Models (EDMs) and initial production units, Joint Tactical Information Distribution System (JTIDS) capability for submarines deploying with the Battle Group, and a prototype automated ADS. Each of these systems is discussed in the following sub-sections. During the SMB phase, TRIDENT class submarines will be frozen at Integrated Radio Room (IRR) Revision 5.3.1, with the exception of TRIDENT EHF LDR installations and the requirement for multiple HIDAR receivers to be installed prior to January 2000. The potential for installation of DAMA capability prior to the planned FY01 SCSS implementation for TRIDENT is being assessed.


Baseband Users
Cryptos
Receiver/ Transmitters
NTCS-A
Red Patch Panel
Black Patch Panel
Ant. Patch Panel
SMB
LAN
PRINT
Automated Internal Message Handling
Land Based BBS Testing
688 BBS PROTOTYPE
688 BBS PROTOTYPE TECH/ OPEVAL
SARR (+BBS PACKAGE) SHF, EHF MDR
MIDS
BBS (+ADS)
+EHF LDR+ Mini-DAMA) JTIDS (Stand Alone)
MCIXS Improved Link-11
1 688 SMB PROTOTYPE
SMB (+LAN +COTS PRINTER, AUTO MSG HANDL)
–GFCP II
–CTT/JTT
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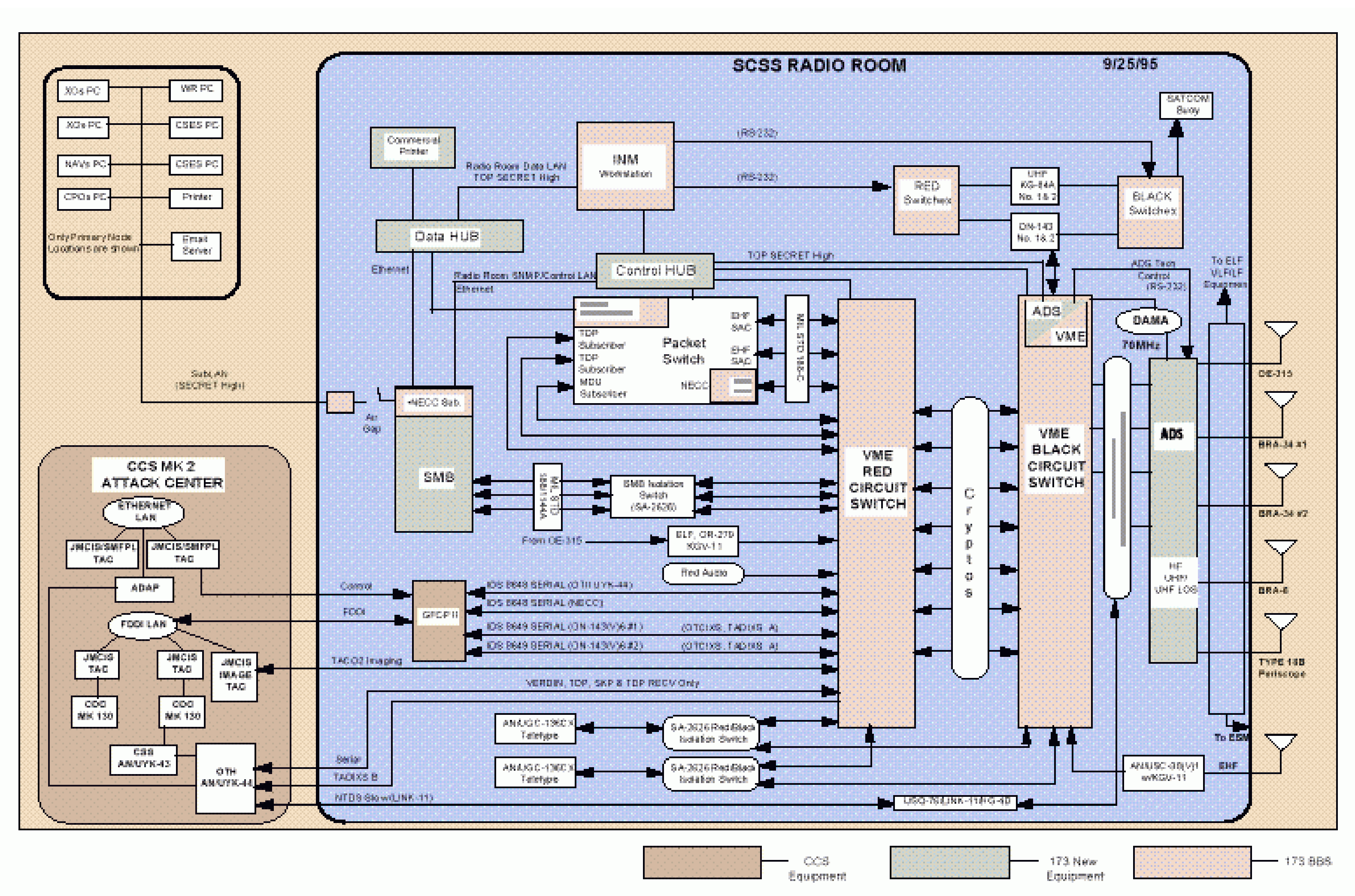
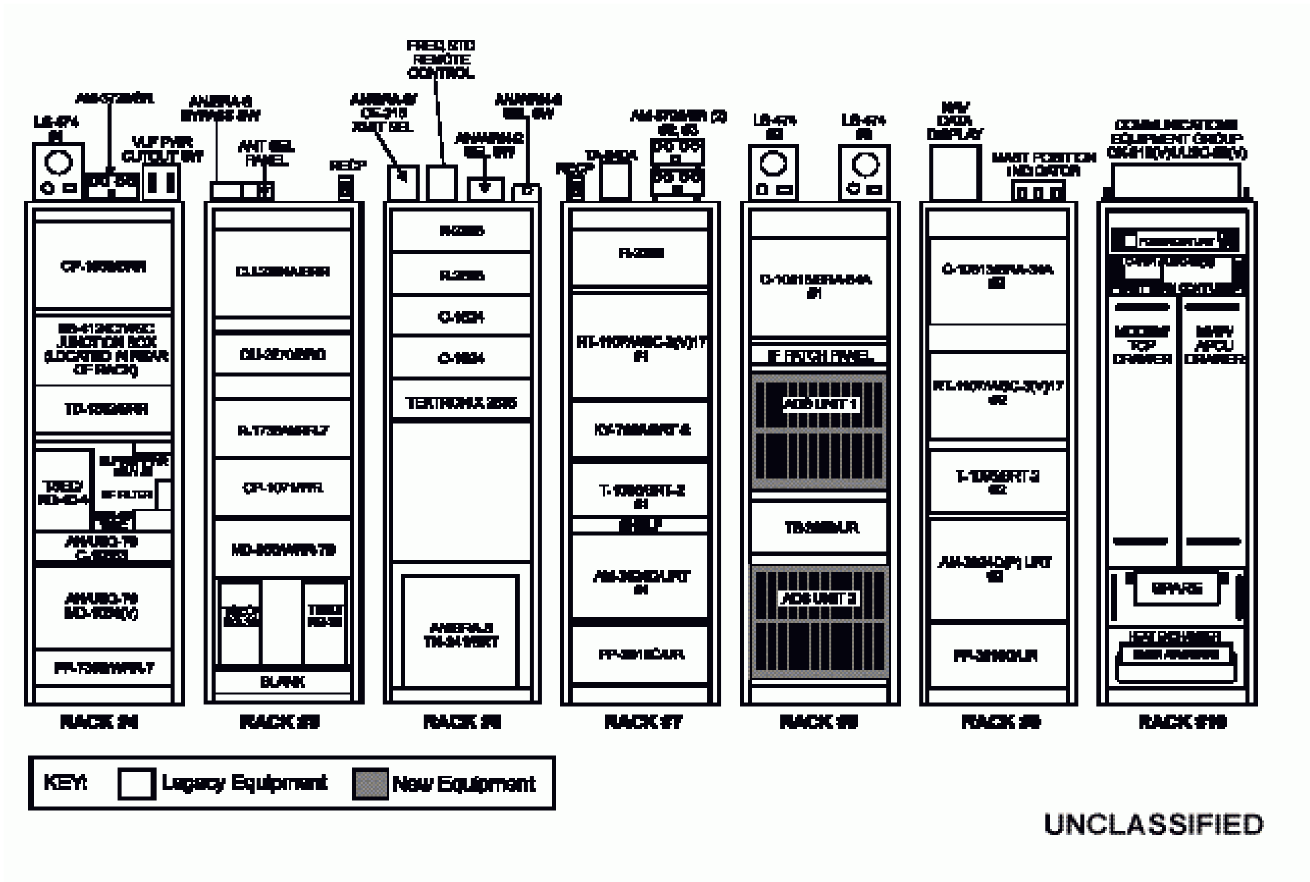
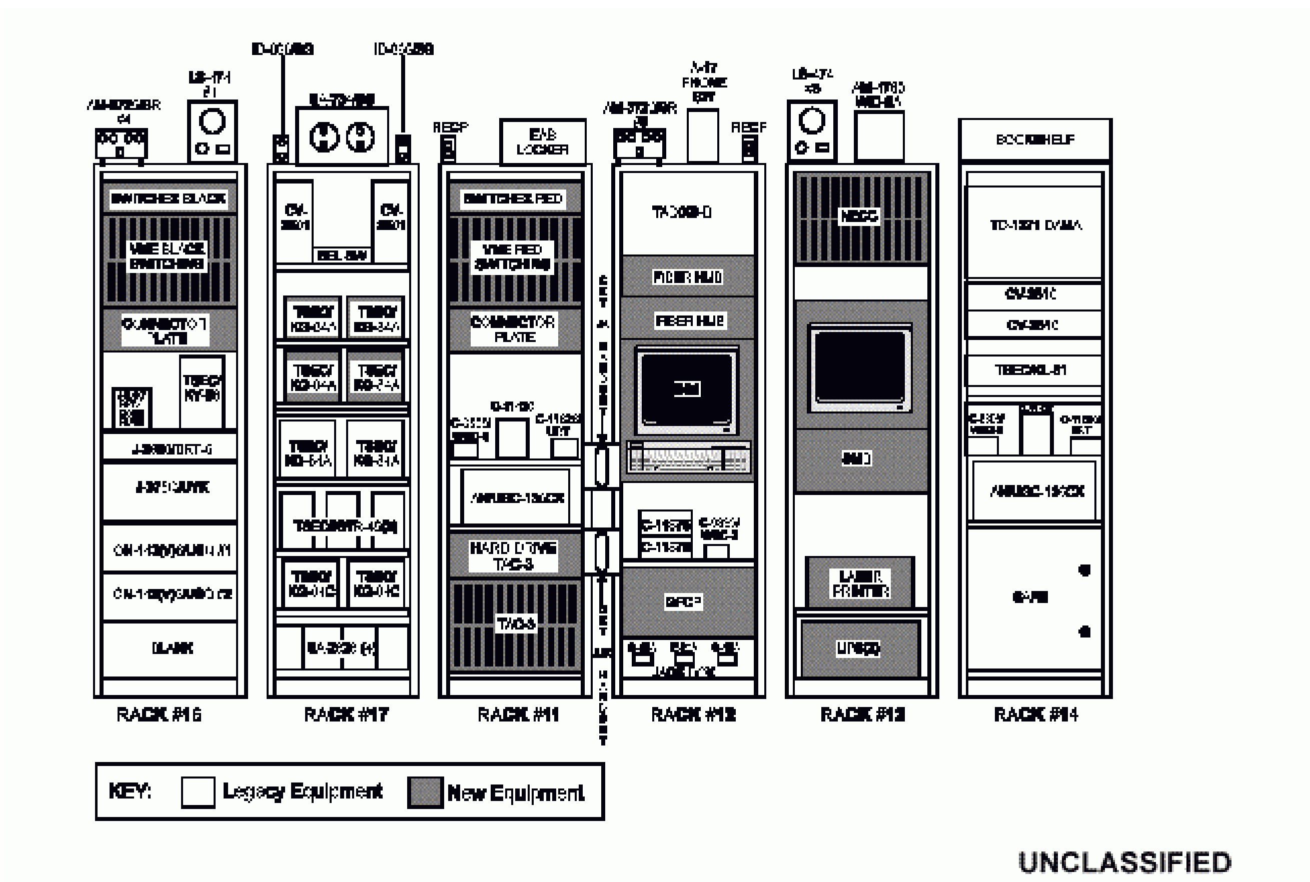

SCSS RADIO ROOM
9/25/95
XOs PC
WR PC
XOs PC
CSES PC
NAVs PC
CSES PC
CPOs PC
Printer
Email Server
Only Primary Node Locations are shown
Commercial Printer
INM Workstation
Radio Room Data LAN TOP SECRET High
Data HUB
Control HUB
TOP SECRET High
RED Switches
BLACK Switches
SATCOM Buoy
Packet Switch
ADS
VME
DAMA
70MHz
SMB
VME RED CIRCUIT SWITCH
VME BLACK CIRCUIT SWITCH
Cryptos
ADS
CCS MK 2 ATTACK CENTER
ETHERNET LAN
ADAP
FDDI LAN
GFCP II
OE-315
BRA-34 #1
BRA-34 #2
BRA-6
TYPE 18B Periscope
To ESM
EHF
173 BBS
CCS Equipment
173 New Equipment
173 BBS



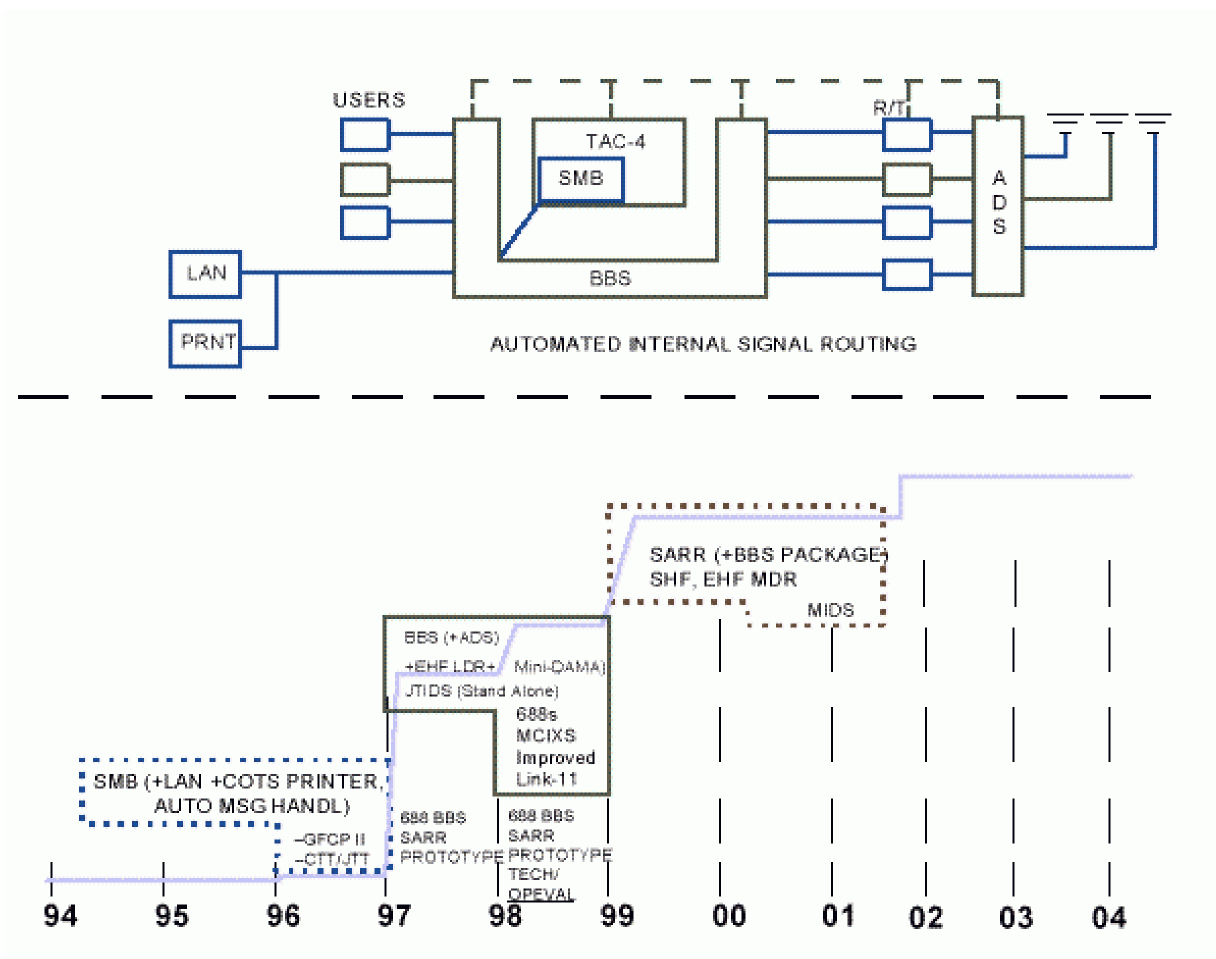


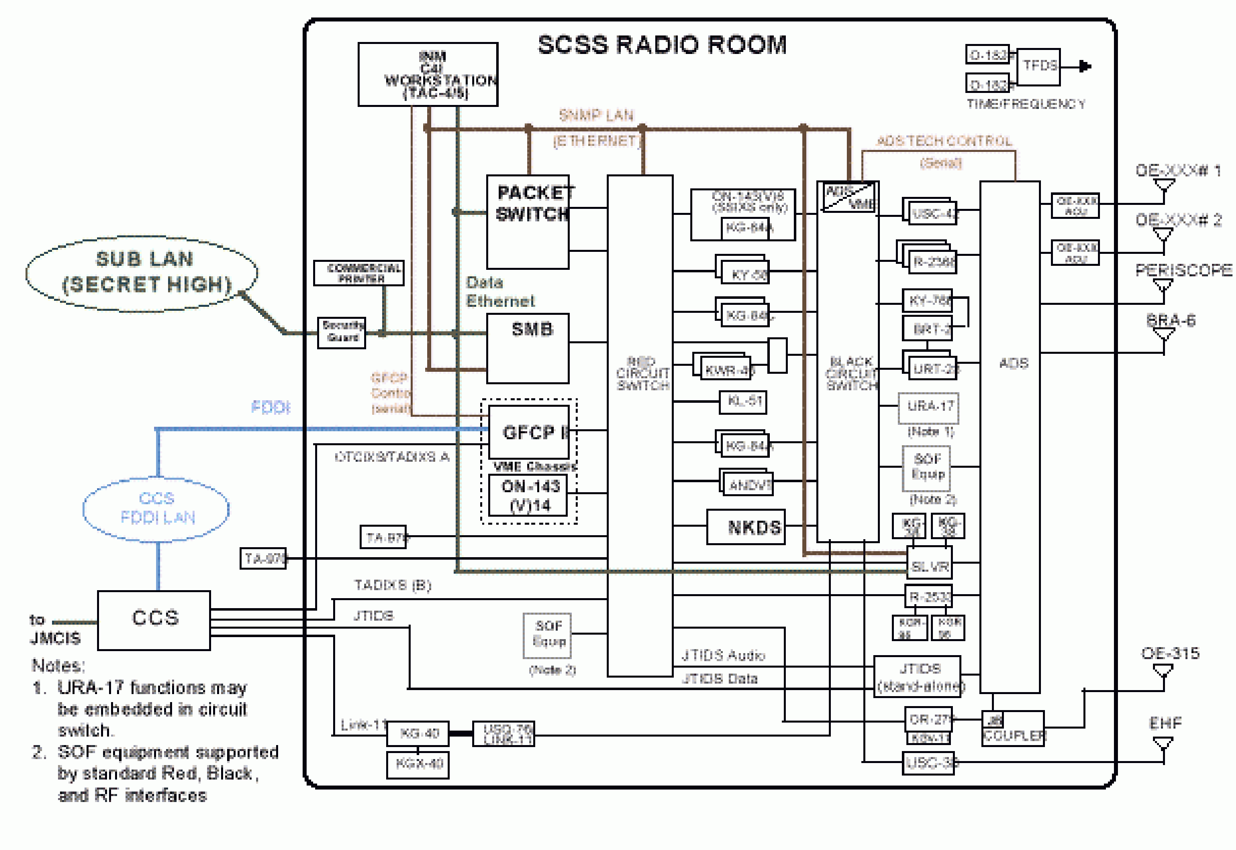
3.2.2 Baseband System Phase (FY97–FY98)

During the BBS Phase, the SSN ECS will begin transitioning to an automated system of OSA components. A fully automated and integrated ECS will not be achieved in the BBS Phase because of the retention of significant amounts of legacy equipment. This transition, depicted in Figure 3-5, will continue into the follow-on SARR Phase. Installations during this phase (BBS, Mini-DAMA, GFCP II) will support the SCSS ECS architecture and standard interfaces. These OSA-based equipment will also support data I/O via both legacy interfaces (e.g., MIL-STD 188-144) and an Ethernet (IEEE 802.3) data LAN. New equipment will be remotely controlled via the INM, using SNMP and a radio room control LAN. During this time period, the SCSS ECS will also integrate the message processing function performed by the SMB into a Tactical Advanced Computer (TAC)-4 or TAC-5. Figure 3-6 depicts the FY98 SCSS Architecture, which uses both modern, OSA-based equipment and legacy radio room equipment.

3.2.2.1 Baseband System Prototype Multi-Level Security Implementation

A major feature of the BBS prototype will be electronic message dissemination. This will be accomplished over the confidential SNAP III/ Automated Technical Information System (ATIS) LAN using ASSURE software with FORTEZZA Personal Computer Memory Card International Association (PCMCIA) security cards and Lotus Notes (client-server). ASSURE with FORTEZZA provides capabilities of user identification and authentication (I&A), network configuration control, network layer encryption and data storage encryption for Novell NetWare and Windows O/S. It also provides hardware/software protection for the end-user PC and central management of user profiles. All encryption is MISSI compliant, using the FORTEZZA card for I&A and for encryption of data at the SECRET level and below. Lotus Notes v.3 provides access control for multiple operating systems (e.g., Windows, HP-UX, Macintosh, Solaris, NetWare for the server only). ASSURE with FORTEZZA will provide protection for the Secret data running over the confidential SNAP/ATIS LAN.



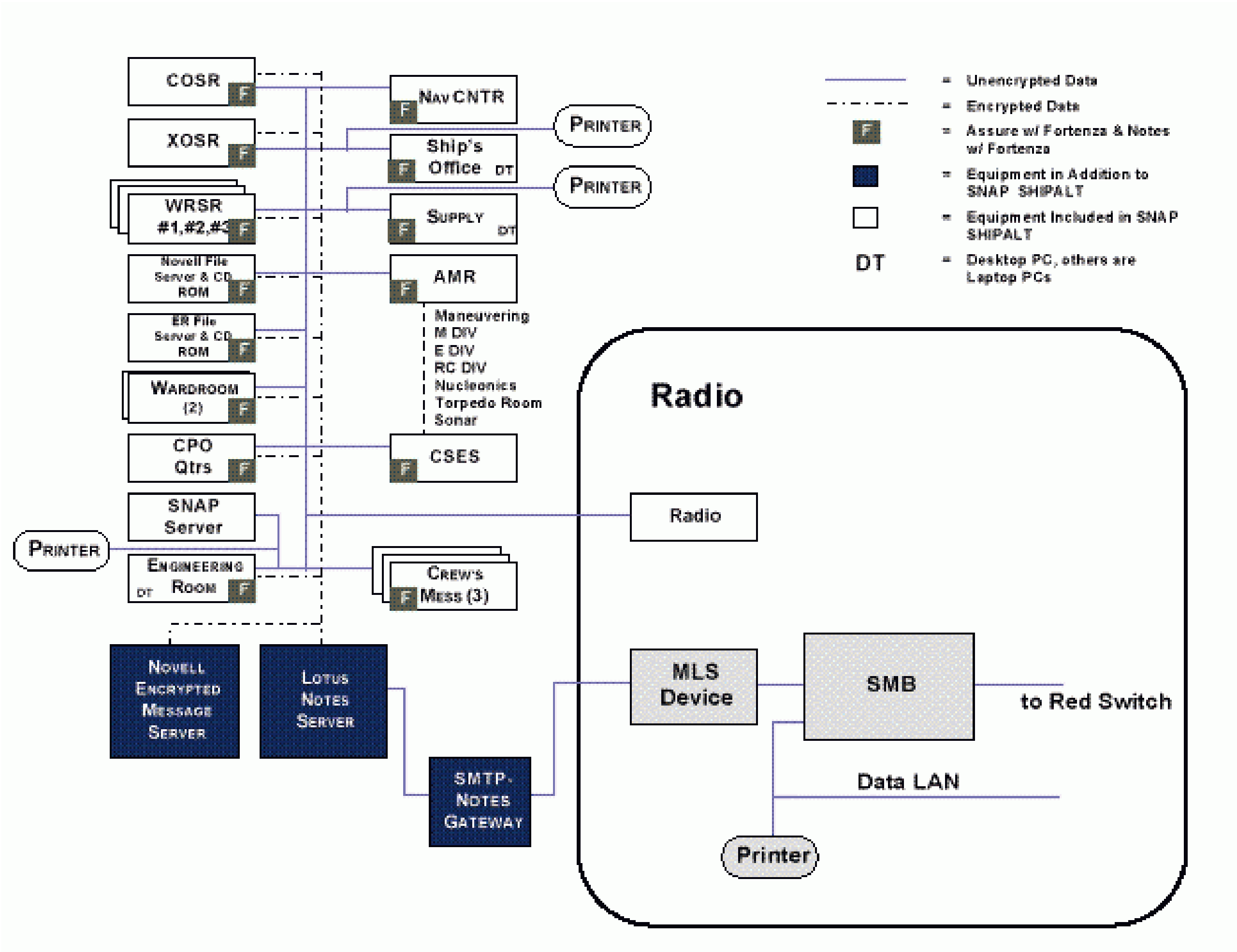


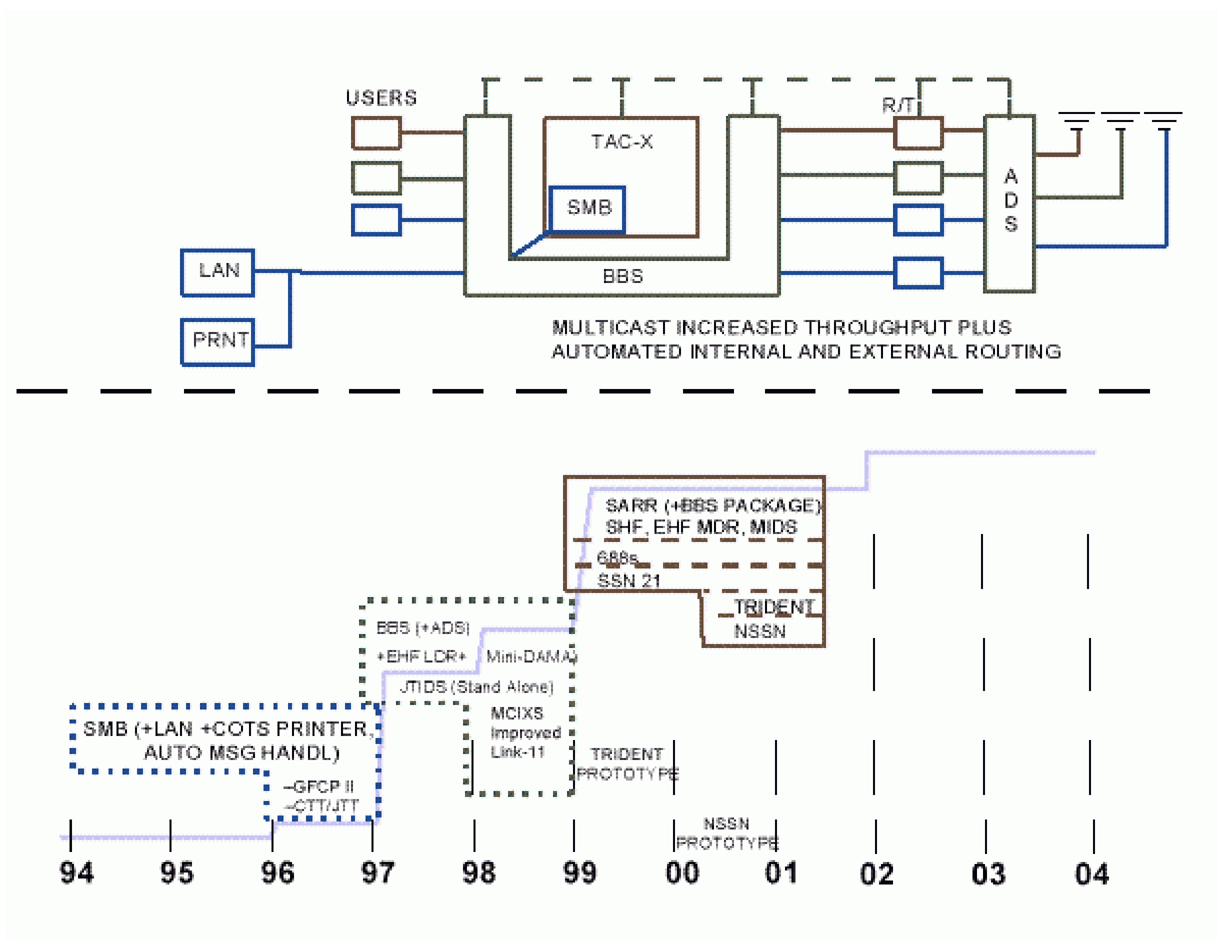
The SMB will interface with the Red BBS to receive and transmit over-the-air message traffic, as in the current baseline. The SMB parses and profiles the messages, queuing the SECRET and below messages for operator review and release to the classified message server (running Lotus Notes and ASSURE). The SMB will transmit messages using SMTP-based e-mail to the Lotus Notes Server, via the Lotus Notes Gateway. The server will automatically address e-mail to the appropriate recipient(s), encrypting with FORTEZZA for FORTEZZA-capable LAN workstations. Figure 3-7 illustrates the recommended configuration of ASSURE and Notes with the SCSS and the SNAP-III/ATIS LAN, with the exception that, for the BBS Prototype, Notes will not be FORTEZZA-capable.

The Multi-Level Security (MLS) implementation for the BBS Prototype will be functionally identical to the FY96 Production implementation, discussed in Section 3.3. The differences are: Lotus Notes v.3 will be used instead of the Notes Data Management System (DMS) v.4 (encryption provided by ASSURE with FORTEZZA rather than Notes with FORTEZZA (DMS v.4)) and the MLS device will be a simple A/B type switch instead of a MISSI Guard with filters.

3.2.3 Submarine Automated Radio Room (FY99–FY04+)

During the SARR Phase, depicted in Figure 3-8, the SCSS ECS will be increasingly automated and integrated. The hybrid (part OSA, part legacy) SCSS ECS will be fielded by FY00. Additional efforts include further SCSS prototyping on-board an SSN 688 class submarine. The goal of this prototype effort will be to more fully automate and miniaturize the SCSS ECS, in preparation for the 9-rack NSSN-variant of the SCSS ECS (the NSSN ECS). The NSSN ECS is required in early FY01 to support new construction platform integration testing. SARR phase efforts will apply to all submarine classes, including TRIDENTs. TRIDENT IRR is currently planned to remain frozen until FY01, with the exception of TRIDENT EHF installations and the requirement for multiple HIDAR receivers to be installed prior to FY00. The planned Initial Operational Capability (IOC) for the TRIDENT ECS is FY01; Full Operational Capability (FOC) is scheduled for FY06. Potential exists for the conversion of non-D-5 TRIDENT submarines to SSGN or dry deck shelter/advanced swimmer delivery system platforms. If converted, SSN variant SCSS ECS upgrades will be required.


COSR
XOSR
WRSR #1,#2,#3
Novell File Server & CD ROM
ER File Server & CD ROM
Wardroom (2)
CPO Qtrs
SNAP Server
Printer
Engineering Room DT
Nav CNTR
Ship's Office DT
Supply DT
AMR
Maneuvering
M DIV
E DIV
RC DIV
Nucleonics
Torpedo Room
Sonar
CSES
Crew's Mess (3)
Printer
Printer
Novell Encrypted Message Server
Lotus Notes Server
SMTP-Notes Gateway
= Unencrypted Data
= Encrypted Data
= Assure w/ Fortenza & Notes w/ Fortenza
= Equipment in Addition to SNAP SHIPALT
= Equipment Included in SNAP SHIPALT
DT = Desktop PC, others are Laptop PCs
Radio
Radio
MLS Device
SMB
to Red Switch
Data LAN
Printer


USERS
TAC-X
SMB
R/T
A D S
LAN
PRNT
BBS
MULTICAST INCREASED THROUGHPUT PLUS
AUTOMATED INTERNAL AND EXTERNAL ROUTING
SARR (+BBS PACKAGE)
SHF, EHF MDR, MIDS
688s
SSN 21
TRIDENT
NSSN
BBS (+ADS)
+EHF LDR+
Mini-DAMA
JTIDS (Stand Alone)
MCIXS
Improved
Link-11
SMB (+LAN +COTS PRINTER,
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-GFCP II
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3.2.4 Submarine Communications Support System Goal Architecture

In the SCSS goal signal environment, the analog output of all RF sensors will be converted to a digital format before any signal processing steps are encountered in the signal flow path. These digitally formatted signals will be packetized and then transported over a diffuse Asynchronous Transfer Mode (ATM)-based backplane. Signal processing will then be performed by ‘virtual components’ formed by ‘virtual connection’ of cards/electronic units housed in common VME/VMEbus Extension for Instrumentation (VXI) racks. This results in a localized fibersphere whereby an interface with a sensor can be established at any port of the diffuse mesh constituting the fibersphere. The high-bandwidth generic information-transport infrastructure will support all information interchange and provide a means to incorporate high-bandwidth satellite links to furnish a seamless bridge between the on-board infrastructure and a global grid, i.e., all on-board systems and data sources can have worldwide connectivity. Additionally, the space and weight requirements for the communications system should decrease dramatically.

3.3 INFORMATION SECURITY CONSIDERATIONS

3.3.1 Information Security Requirements

The current trend in system security certification and accreditation is away from evaluation of stand alone systems by National Security Agency (NSA) and towards accreditation of systems in their use environment. Therefore, the system shall be designed and developed such that it will be certifiable and accreditable by the Designated Approval Authority (DAA at the lowest possible cost. System security features will include:

- I&A,
- Access Control,
- Audit,
- System Integrity,
- Data Integrity,
- Assurance,
- Classification Bannering,
- TEMPEST,
- Compatibility with DMS, JMCIS, SNAP-III and other installed systems, and
- Security Labeling.

3.3.2 Future Goal

The ultimate future goal for SCSS is to provide an automated ECS which will be: paperless and at the discretion of the ship, unmanned and remotely operated from the ship’s control room. Automation will be accomplished by computers performing most, if not all, of the processing and internal electronic routing of messages. The paperless ECS will make hand routing of messages via message clipboards obsolete by making maximum use of the electronic message routing afforded by automation. The remote operation feature of the ECS ideally allows the use of personnel from computer-based technical ratings as remote system operators thus reducing shipboard manning requirements. The key to meeting this goal, however, lies in satisfying fundamental security requirements such as secure transmission or encryption methods. System operation without operator intervention implies the use of Multi-level Security (MLS) trusted operating systems or processes.

3.3.3 Implementation

The SCSS will evolve from System High Mode of operations with Periods Processing to an MLS Mode of operations. This will be accomplished through “evolutionary production,” introducing MLS products as they become available. As the system requirements change, the security architecture will change also.

3.3.3.1 FY96 Submarine Communications Support System

The SMB will interface with the red BBS to receive and transmit over-the-air message traffic, as in the current baseline. The SMB parses and profiles the messages, queuing the Secret and below messages for operator review and release to the classified message server (Lotus Notes). The SMB will transmit messages using DMS X.400 e-mail or SMTP-based e-mail through the DMS Multifunction Interpreter

(MFI), to the Lotus Notes Server via the Lotus Notes Gateway. The server will automatically address e-mail to the appropriate recipient (s), encrypting with FORTEZZA for FORTEZZA capable LAN workstations. A MISSI Guard with filters for Navy Message formats will be used to automatically read the classification of the incoming messages, ensuring that the SMB, or operator, does not accidentally pass a message classified higher than Secret.

3.3.3.2 FY98 Submarine Communications Support System

A major feature of the FY98 production will be electronic message dissemination. This will be accomplished over the Confidential SNAP III/ATIS LAN using ASSURE with FORTEZZA and Lotus Notes with FORTEZZA (client-server). ASSURE with FORTEZZA provides capabilities of user I&A, network configuration control, network layer encryption and data storage encryption for Novell NetWare and Windows O/S, and hardware/software protection for the end-user PC. All encryption is MISSI compliant, using the FORTEZZA card for I&A and for encryption of data at the SECRET level and below. FORTEZZA is currently authorized for classification levels up to Secret, with future versions capable of TS or TS/SCI. Lotus Notes DMS v.4 provides capabilities of user I&A, access control, network layer encryption and file/field/document encryption for multiple operating systems (e.g., Windows, HP-UX, Macintosh, Solaris, NetWare for the server only). Encryption is MISSI compliant, using the FORTEZZA card for I&A and for encryption of data at the level of SECRET and below. All e-mail functions are DMS compliant. A combination of the security mechanisms of ASSURE and Lotus Notes provides protection for the SECRET data running over the Confidential SNAP/ATIS LAN. 3.3.3.3 Goal Submarine Communications Support System Multi-Level Security The Goal SCSS will implement MLS through the use of several MLS products in order to support the transition to complete automation. In addition, it will use Embedded (programmable) INFOSEC Products (EIP/PEIP) to replace the existing crypto systems with much smaller crypto devices. Figure 3-9 shows a functional block diagram of the future SARR. The Trusted Labeler will assign classification labels to all incoming messages and pass the data to an Automated Message Handling System (AMHS). The AMHS function, combined with Type 1 encryption hardware/software, provides protection for classified data running over the ship's LAN (SubLAN). There may need to be multiple copies of the Labeler or AMHS, running at single or multiple classification levels, depending on the level of trusted software available. Some of these functions may be incorporated into DMS components or may be separate, but all must be DMS compliant. To automate the process, the Labeler and AMHS functions must be trusted.

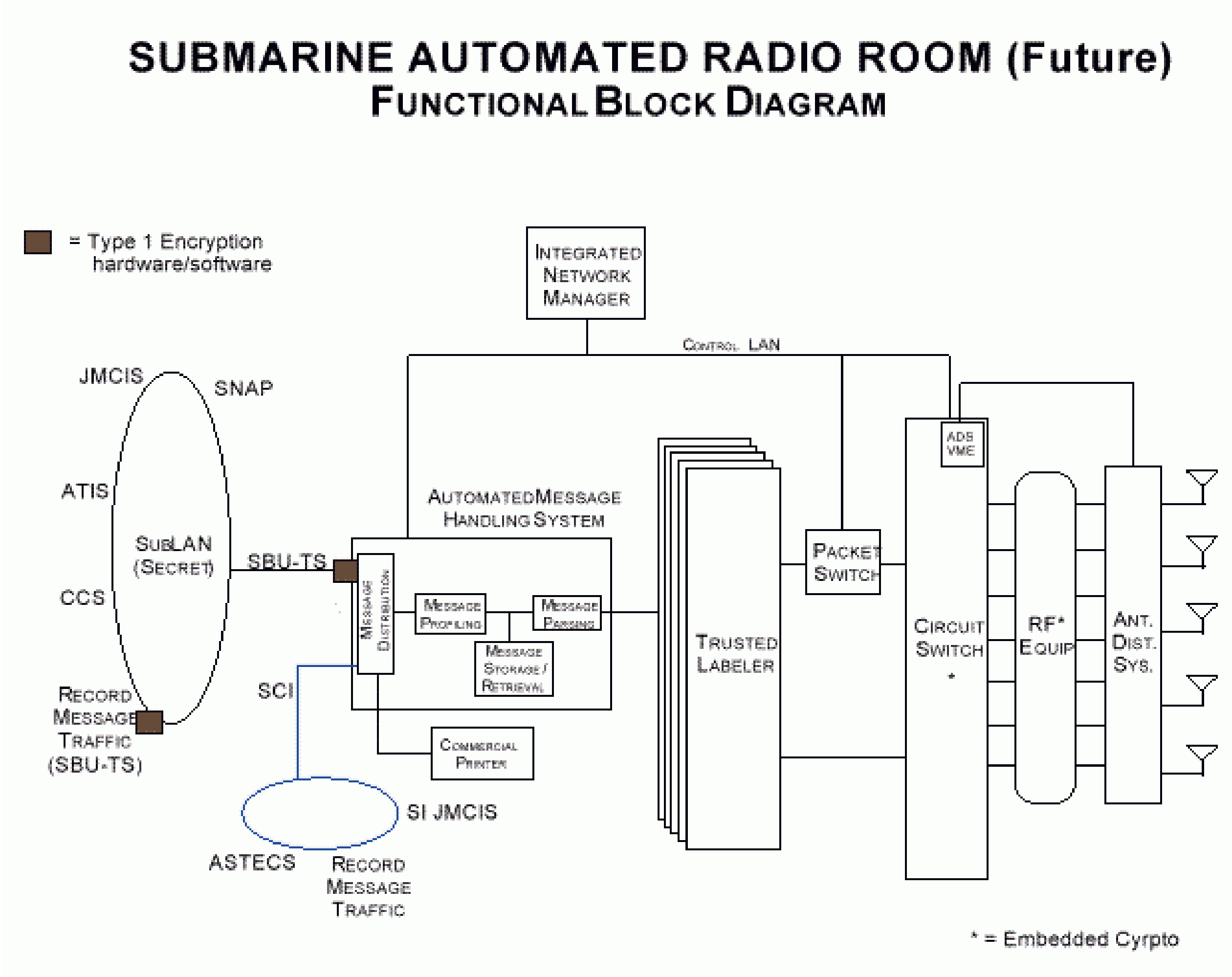
3.4 FIXED SUBMARINE BROADCAST SYSTEM

3.4.1 Fixed Submarine Broadcast System

Efforts and analysis are being performed to automate and consolidate the submarine shore communications infrastructure, particularly the VLF and LF shore systems in an effort to improve operational efficiency while reducing operating costs. Initiatives in progress or being analyzed are summarized below. For a more detailed explanation, refer to Appendix B.

For the VLF/LF shore broadcast systems, programs are in place to maintain existing systems and to replace vacuum tube type amplifiers with solid state technology. Implementation of more cost-effective connectivity to the Broadcast Keying Stations (BKSs) from the Broadcast Control Authorities (BCAs) is being addressed. The Office of Chief of Naval Operations (OPNAV) has approved a plan to consolidate the 11 worldwide BKSs to four BKSs, two for the Atlantic fleet and two for the Pacific fleet. Cost saving initiatives associated with remote transmitter operation and power management of the VLF and LF shore transmitting facilities are being tested and are planned to be fielded. Other VLF/LF program initiatives being evaluated include use of Range Extension, Dynamic Channelization, and Split Array operation of the VLF sites.

Lastly, SPAWAR PMW 173 has been directed to develop a plan to modernize and maintain the submarine BCAs, based on TYCOM requirements submitted to N87. N87 will sponsor these needed upgrades. The purpose of this plan is to document how the communications equipment at the BCAs will be modernized to remain fully interoperable with SCSS, JMCIS, and GCCS as these systems and architectures evolve. This plan and the resulting efforts will also ensure that BCA equipment is fully supported logistically and all new equipment is integrated into the existing BCA suite.

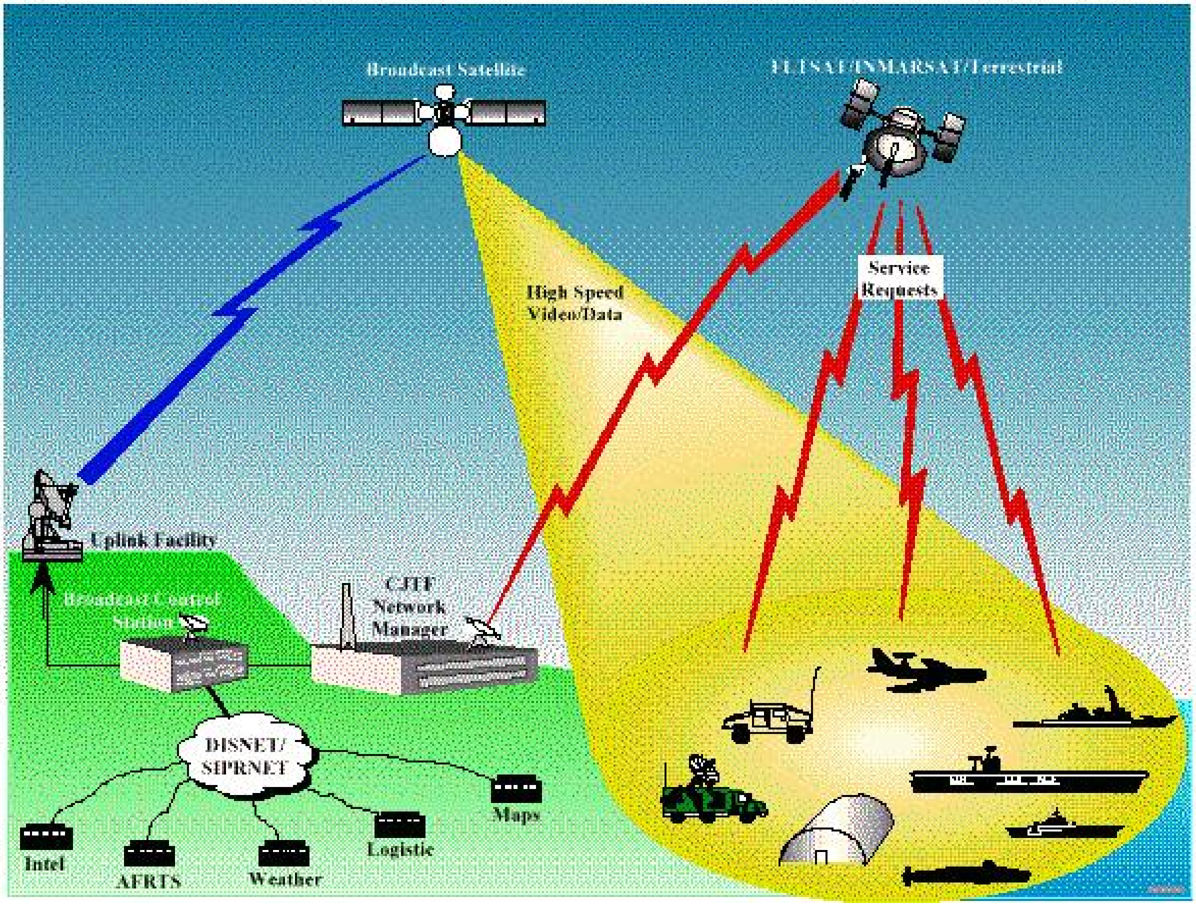


3.4.2 Global Broadcast Service

The MNS for a GBS has been given validation approval by the Joint Staff. This MNS outlines the need for asymmetric flow of information to deployed units to cover products tailored to their operating areas. This data includes local weather forecasts, environmental updates, intelligence data, imagery, high-speed computer updates, battle damage assessments, news updates, and TOMAHAWK Mission Data Updates and composites. This system is envisioned to be a militarized version of the commercial direct broadcast system (currently providing up to 500 channels via an 18-inch dish antenna) which will provide a global dissemination of large volumes of information in a timely fashion by providing standardized products to a large group of users and on-demand products to specific groups of users. GBS has the capability of providing very high data rates (up to 20 Mbps) into small receive antennas. A TOMAHAWK Mission Data Update (MDU) can be received in approximately 2 seconds. The GBS system is envisioned to use COTS receivers.

The concept is depicted in Figure 3-10. The Joint Staff is the lead in developing the GBS system concept and consolidating GBS requirements. As the Joint Staff moves forward with this system, NUWC will begin investigating antenna technology solutions compatible with the GBS system.

The SCMP will be the one document promulgating these requirements and stating the acquisition strategy.



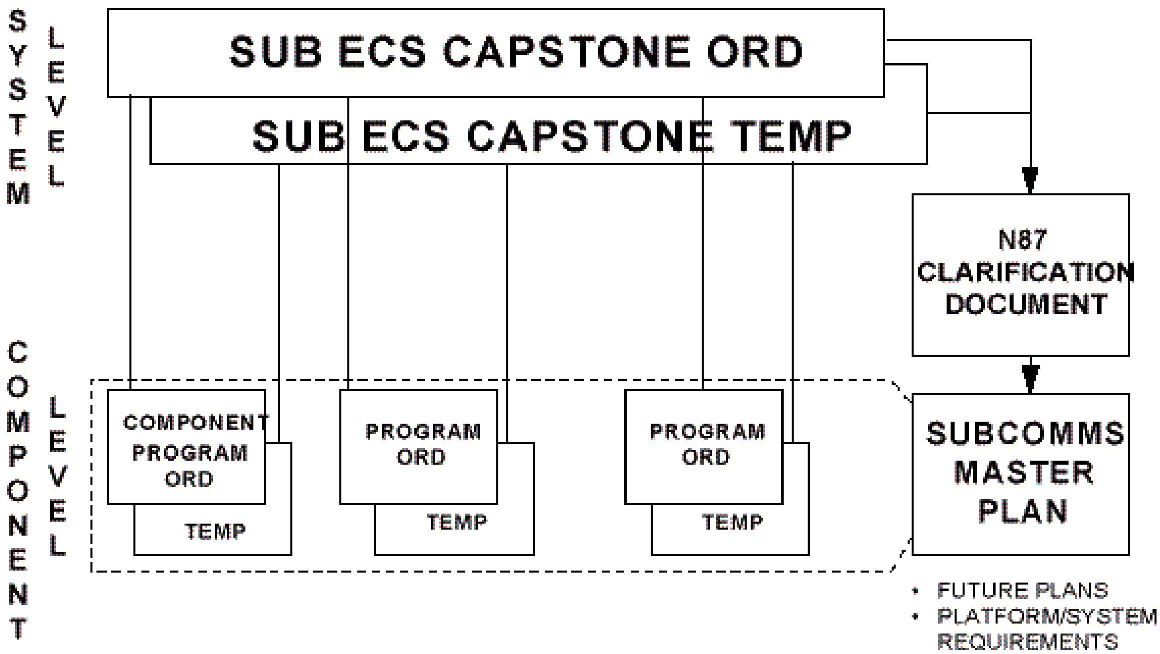
3.6 Submarine Communications Support System Training and Logistics Support Concepts

3.6.1 Transition to Onboard Training

The training goal for the SCSS ECS is to maximize the use of Computer-Based Training (CBT), Interactive Electronic Technical Manuals (IETMs) and other performance support tools to reduce duplicative based training requirements and provide single media training supporting both maintenance and operational training requirements. The move towards total On-Board Training (OBT) will be an evolutionary process. The process will progress from a combination of OBT, CBT, IETMs, and formal school house training toward the goal of total OBT, where appropriate. The CBT will be unique because the supporting IETM will be linked to the training program software and vice versa. The equipment level CBT modules will become a part of the larger SCSS System Level Training System. The SCSS System Level Training System and equipment level CBT, along with the IETMs will be available via the SNAP III/ATIS LAN. The CBT and IETMs will comply with the Navy's portability standards and therefore, can be hosted on a variety of platforms such as laptops, operational workstations, and PCs. All SCSS training products will be coordinated through COMSUBGRU TWO, New London.

3.6.2 Logistics Support

In all phases of the transition to the goal architecture, the existing Navy supply system will be used to support the supply needs of the SCSS ECS. As this transition proceeds, however, the support methodology will change from one based on in-depth stocking of repair parts and government depot repair to logistic support based on higher level (e.g., VMEbus board) lowest field replaceable units (LFRUs). Repair parts will be covered by manufacturer warranties and commercial market place driven upgrade paths with approximately 2 year life cycles. In many cases, one or more VMEbus boards may be replaced by a single upgraded processor board before the boards being replaced approach their Mean Time Between Operational Mission Failures (MTBOMF). As OSA-based systems such as Mini-DAMA, GFCP II, and SLVR are installed in the SCSS ECS, the number of on-board repair parts will reflect the significant number of VMEbus boards common to all these systems. The Naval Inventory Control Point (NAVICP), Mechanicsburg, PA will become the Supply Support Logistics Element Manager (SSLEM) and will establish Basic Ordering Agreements (BOAs) with the Original Equipment Manufacturers (OEMs) to obtain new parts.


SYSTEM LEVEL
SUB ECS CAPSTONE ORD
SUB ECS CAPSTONE TEMP
N87 CLARIFICATION DOCUMENT
COMPONENT LEVEL
COMPONENT PROGRAM ORD
TEMP
PROGRAM ORD
TEMP
PROGRAM ORD
TEMP
SUBCOMMS MASTER PLAN
• FUTURE PLANS
• PLATFORM/SYSTEM REQUIREMENTS

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SECTION 4 SUBMARINE ANTENNAS

4.1 SUBMARINE ANTENNA INTRODUCTION

Submarines require a suite of antennas to provide the necessary communications, navigation, and Identification, Friend or Foe (IFF) capabilities. Submarine antennas, as compared to surface ship antennas, are unique in design, shape, materials, and performance due to a submarine's space and weight limitations, extreme environmental conditions, and stealth considerations. The NUWC Division Newport, under the Submarine Integrated Antenna System (SIAS) program, is the primary design agent for submarine antennas. The following sections summarize the current SIAS program and future antenna concepts. Appendix A provides a detailed Submarine Antenna Program Plan, listing both existing capabilities and current and planned SIAS acquisition and research and development programs.

4.2 OVERVIEW OF CURRENT SUBMARINE INTEGRATED ANTENNA SYSTEM

The current antenna development efforts include: the Submarine SHF/EHF HDR SATCOM antenna, an Improved AN/BRA-34 antenna, the upgrade to the AN/BST-1 SSBN emergency buoy, the ADS, and antenna systems engineering. Ongoing antenna systems engineering include: GBS, SOF connectivity, Global Maritime Distress and Safety System (GMDSS), JTIDS, and a Maritime Cellular Information Exchange System (MCIXS) cellular telephone capability. Table 4-1 and the following sections summarize the capabilities provided by each program.

Table 4-1. Core Program Impact On Operational Capability

Program	Operational Capability
High Data Rate Antenna	High Data Rate, Interoperable Communications via SHF DSCS, Commercial SATCOM, and EHF MDR SATCOM
Improved AN/BRA-34	Improved DAMA capability Added MF/HF capability (wideband modes) Added low band VHF (30 - 88 MHz) Improved Reliability Rapid Tune Coupler for ALE Pre-Planned Product Improvements (P^3I) Add high band VHF (116-174 MHz)
Antenna Distribution System	Open Systems Architecture (VME/VXI) Rapid Interconnect to Radio Equipment Reduced Operator Workload; Improved Operability
AN/BST-1 Upgrade	Improved electronics, batteries, and test equipment
Systems Engineering • GBS • GMDSS • JTIDS • SOF • MCIXS	New developments to support fleet requirements: High data rate, receive-only comms; Joint interoperability Navy and Commercial Safety Warnings Joint interoperability, improved tactical warfighting Access to submarine antennas for SOF equipment Improved coordination with BG

4.2.1 SHF/EHF High Data Rate Satellite Communications Antennas

The Submarine HDR antenna effort is focused on providing submarines with antennas that have the bandwidth, gain, and flexibility to meet the stated COMSUBLANT/COMSUBPAC requirements for HDR communications in the SHF and EHF frequency bands. Antenna development is concentrating on multiband antennas which support military SHF (Defense Satellite Communications System

[DSCS]), commercial SHF, and EHF MDR communications at data rates up to 1544 kbps (T1). A near-term SHF capability at 128 kbps and a minimum EHF MDR capability of 64 kbps is required. These capabilities will be achieved using existing technology and a COTS/GOTS/NDI approach. The far-term (FY06) requirement is to achieve data rates up to T-1 as antenna and satellite technology matures. Anticipated technologies include multi-band antennas and the use of conformal arrays. Ongoing submarine technology base efforts sponsored by the Office of Naval Research will be leveraged and transitioned into the SIAS program at the appropriate time.

4.2.2 Improved AN/BRA-34

The Improved AN/BRA-34 (or AN/OE-XXX) program began in June 1989 to increase reliability and improve the antenna's multifunction (communications, navigation, and IFF) capabilities while retaining the existing radome. The program has since been restructured to optimize support for Fleet UHF DAMA requirements. A low band very high frequency (VHF) capability (30-88 MHz) has been added to support interoperability with SOF. Technical and Operational Evaluation (TECHEVAL/OPEVAL) is to be conducted in FY96 with a Milestone III decision expected in late FY96.

4.2.3 Antenna Distribution System

The objective of the ADS program is to replace the existing manually operated antenna RF patch panels. Manual patching prevents the rapid reconfiguration of communications circuits required to support submarine operations in a Joint or Battle Group environment. The ADS will allow highly flexible and automated routing of signals and information between the radio room and various antenna systems. The ADS will be under the technical control of the SCSS INM, using an industry standard SNMP running on a single TAC-X based operator workstation. The ADS will replace the point-to-point wiring of radio frequency (RF) and control lines that exist on current submarines. As discussed in Section 3.2.1, a prototype version of the ADS, supporting RF switching in the high frequency (HF) and ultra high frequency (UHF) bands, is being fielded as part of the SCSS BBS Phase Prototype and will be demonstrated and evaluated at sea in FY96. Following IOC in FY98, ADS installations will continue during the SCSS SARR phase. Production ADS units will be OSA-based, using the VXI standard and, wherever possible, COTS components. All future antennas will be designed with an ADS interface to provide for automatic control and operation. The antenna designer will be required to provide a plug-in card for the ADS controller that will contain all information regarding the capabilities and operation of the antenna. The antenna system design will require an RF plug-in unit that conforms to the ADS interface standard. The ADS will provide RF and Intermediate Frequency (IF) interfaces for SOF communications equipment.

4.2.4 AN/BST-1 Upgrade

The AN/BST-1, a submarine emergency communications transmitter (SECT) system, has been deployed on SSBNs since 1972. A system upgrade providing a long-life battery, increased reliability, and reduced operating costs is under consideration. The upgrade program would be applicable to TRIDENT class submarines and consists of a launch control system (LCS), launcher subsystem, buoy subsystem, and test set subsystem. The LCS would upgrade the launch control unit, release unit, depth sensing unit, and signal unit while using existing cables and hull penetrators, as well as add Built-in Test/Built-in Test Equipment (BIT/BITE) circuitry.

CJCSI 3150.3, Joint Reporting Structure Event and Incident Reports require a system be in place for immediate notification to the National Military Command Center (NMCC) and CINCs of any incident or event where national level interest is indicated. Without notification, the loss or destruction of a TRIDENT submarine would significantly degrade the ability of the CINC to manage strategic forces in a crisis. The AN/BST-1 system currently provides for immediate and reliable loss reporting capability. Until a new system that meets the current requirements is developed, the AN/BST-1 should be maintained and remain reliable.

4.3 ANTENNA SYSTEMS ENGINEERING

The SIAS program will continue to concentrate on the development of a system of antennas, new SHF/EHF HDR antennas, and technology enhancements to meet the evolving needs identified by the submarine force. In particular, the SIAS program will continue to concentrate on addressing the specific antenna requirements identified in the COMSUBLANT/COMSUBPAC requirements letter (see Appendix E). Figure 4-1 describes the future transitions in submarine antennas and antenna switching. The related programs, commencing in FY96 and discussed in detail in Appendix A, include:

- A GBS capable antenna to support the Joint GBS program and its planned capability to provide high data rate (up to 23 Mbps), receive only satellite communications.

- VHF antennas to support current and future SOF communications requirements.
- Backup UHF DAMA antennas to support removal of AN/BRA-34 on SSN 688 class submarines with the introduction of the SHF/EHF multiband antenna.
- Continuing antenna investigations to evaluate alternative approaches to meet the joint COMSUBLANT/COMSUBPAC requirements for GMDSS, JTIDS, and MCIXS.

CURRENT SYSTEMS		FUTURE REQUIREMENTS	FUTURE SYSTEMS
EHF T-R	Type 8 Mod 3 Periscope Mast Antenna (5.25 Inch) LDR	EHF MDR Joint Imagery	SHF/EHF Multiband Antenna; Snorkel Antennas
SHF T-R	No Capability	SHF for JTF Interoperability Joint Imagery INMARSAT-C JTIDS MCIXS	Antennas being Evaluated (Conventional, Unfurlable, Phased Arrays) 21-Inch Multiband Antenna
UHF T-R	AN/BRA-34 OE-207/BR AN/BRT-1(T) TYPE 18 Periscope (R)*	Improved DAMA JTIDS	AN/BRA-34 Upgrade (OE-XXX) OE-207 Upgrade Standard Multifunction Antenna Snorkel Antennas
VHF T-R	No Visible T/R Capability AN/BRT-1(T) TYPE 18 Periscope*	SOF Connectivity	Antennas being Evaluated (AN/BRA-34 Upgrade (OE-XXX), Snorkel, Periscope)
HF T-R	AN/BRA-6B AN/BRA-34 OE-207/BR AN/BST-1(T) OE-315(V)* AN/BRR-6 (R) TYPE 18 Periscope (R)*	HF Wideband	AN/BRA-34 Upgrade (OE-XXX) OE-207 Upgrade OE-315(V) HSBCA AN/BRR-6( ) AN/BST-1 Upgrade
LF R VLF R	OE-315(V)/BRC An/BRA-34 OE-207/BR AN/BRR-6 TYPE 18 Periscope	NAVTEX Stealth	OE-315(V)/BRC HSBCA AN/BRA-34 Upgrade (OE-XXX) AN/BRR-6( ) Sail-Mounted VLF/LF Antenna OE-207 Upgrade
ELF R	OE-315(V)/BRC	Continued 2-Site ELF, Assured Connectivity	OE-315(V)/BRC HSBCA On-Hull ELF
ADS	MANUAL SWITCHING	CSS Compatibility	Fully Automated Copernicus/CSS Compatible OSA Design COTS/GOTS Approach

* Indicates Limited Capability

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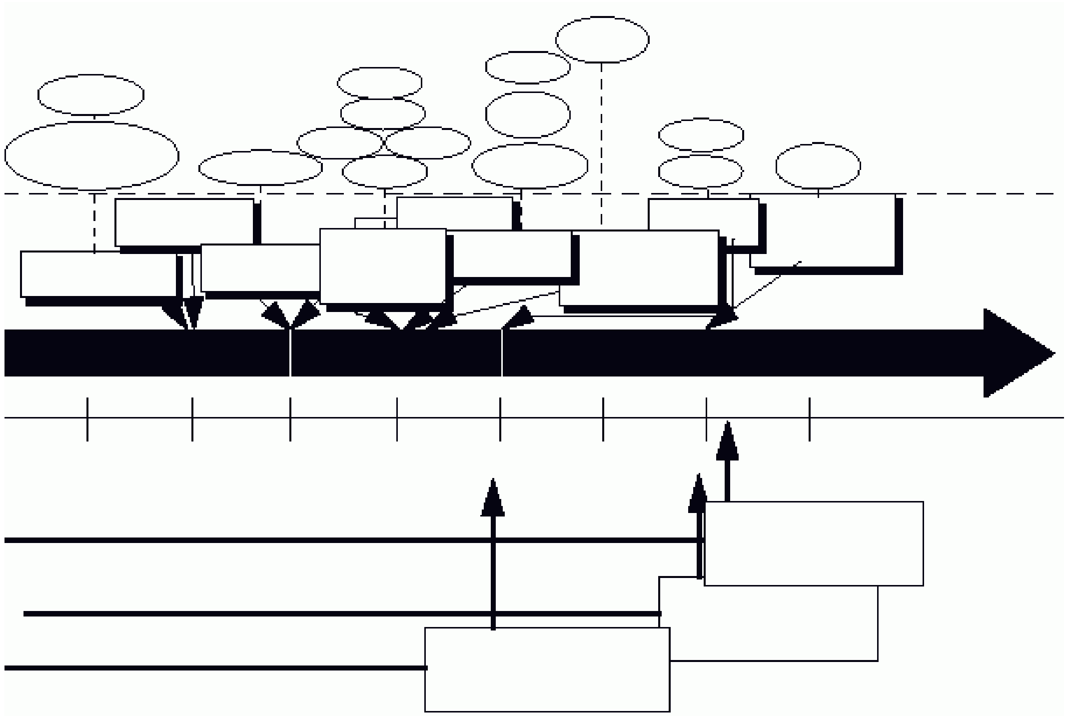
SECTION 5 SUBMARINE COMMUNICATIONS SUPPORT SYSTEM ACQUISITION/IMPLEMENTATION STRATEGY

5.1 ACQUISITION STRATEGY

Procuring the SCSS will be an evolutionary process, transitioning from multiple suites of class-specific, closed system equipment to a common (standard) submarine suite incorporating OSA communications equipment. The Navy cannot execute a wholesale replacement of submarine radio rooms, and a replacement radio room with the required features and functionality is currently neither available nor affordable. The transition from today's existing submarine radio rooms to a hybrid SCSS is planned to be completed within a 10 year period. Figure 5-1 provides a notional diagram of this transition strategy. The strategy makes use of common OSA and NDI acquisitions while actively seeking industry participation during the requirements definition and procurement processes.



Through commonality, submarine communications systems will be interoperable with Joint/Navy forces. The SCSS will use standard communications software and hardware where feasible, standard interfaces, and will be JMCIS compliant when required. Submarine unique hardware and/or software will only be used when it is not possible (e.g., physically too large or too expensive) to use the Navy's standard system or system components. Commonality will provide several life cycle cost (LCC) advantages in addition to improved interoperability. These advantages are: (1) reduced program costs through sharing of development costs with all Navy platforms; and (2) reduced logistics support costs due to a common logistics pipeline for standard Navy repair parts, software maintenance, and training. Because the SCSS will use Navy standard system components, as well as commercial items whenever possible, the submarine force will actively participate in Navy/DOD standards setting forums to ensure the submarine requirements such as size, space, weight, electromagnetic interference (EMI), and electromagnetic compatibility (EMC) are considered in new equipment procurements and standards. To ensure commonality, the submarine force will actively participate in new, Navy-wide development programs to ensure submarine requirements are being met. To promote Allied Navy C 4 I interoperability and cost savings with the SCSS, efforts will be made to cooperatively share technology through the Foreign Military Sales (FMS) program whenever feasible. Through this process, the benefits of using better C 4 I technology for both the U.S. Navy and Allied Navies may be realized while achieving interoperability at reduced cost.

To deliver improved system functionality to submarine communications systems as soon as possible, the SCSS procurement strategy will maximize the use of OSA procurements. OSA is defined in

Secretary of the Navy Instruction (SECNAVINST) 5200.32 as:

> “A system that implements sufficient open specifications for interfaces, services, and supporting formats to enable properly engineered components to be used 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 which facilitates portability.”

Additionally, the SCSS will make use of NDI procurements where it is consistent with operational requirements. NDI can be either a commercially available COTS product or the product of a previous GOTS procurement. Minor modifications to either COTS or GOTS products are also allowed as NDI.

The SCSS acquisition strategy will be streamlined in accordance with DOD Instruction (DODI) 5000.2 and in compliance with the Federal Acquisition Regulations (FAR). It will make use of new innovative procurement methodologies such as “Rapid Development” being employed by the GCCS. Equipment installations will be accomplished using the “turn-key” concept or equipment “block” upgrades in which multiple, coordinated equipment installations take place at one time to save installation funding costs and minimize the total ship availability time required. From a programmatic perspective, the critical path is controlled by Navy acquisition of systems which the submarine must be interoperable with: EHF, DAMA, Link 16, GBS, SACCS, and JMCIS.

To reduce the LCCs of the SCSS and to aid interoperability, the SCSS will make maximum use of commonality with Navy and Joint forces. There will, however, be instances when non-standard components and equipment will be required, e.g., the submarine ELF, VLF, LF, and submarine antenna programs. These programs, for both shore and shipboard, do not have a Navy air or surface counterpart or standard. These requirements will remain unique and will need to be managed and supported.

The SCSS is being designed as an integrated system and will be installed and maintained as an integrated system. PMW 173 has primary responsibility for executing this program and will ensure that all communications equipment is integrated and installed as a system. The System In-Service Engineering Manager (SISEM) (located at NISE East) has been tasked by PMW 173 to manage all installation and life cycle support. The SISEM is the single point of contact between the fleet and the support infrastructure.

In summary, the “Business Plan” SPAWAR PMW 173 will execute to implement the SCSS Exterior Communications System (ECS) aboard all classes of submarines will:

- Apply a systems approach to design and implementation of the SARR;
- Maximize the use of COTS products;
- Use existing Software modules as feasible (i.e., JMCIS);
- Provide early establishment of the Government/Industry team and assign the systems integration function responsibilities to industry;
- Employ aggressive use of acquisition streamlining regarding COTS; and
- Leverage the FMS program whenever possible.

5.2 PLATFORM IMPLEMENTATION STRATEGIES

The goal of the SCSS architecture is a common, flexible suite of COTS, OSA-based equipment, providing enhanced capability at a reduced life cycle cost. To reduce life cycle cost, equipment commonality is needed. Each platform’s communications requirements will be met using a standard SCSS, with enhancements or additional numbers of individual equipment as needed. For example, when the TRIDENT SCSS is implemented in FY01, it will support a greater number of VLF/LF channels and a smaller number of UHF channels than is required for the SSN SCSS. These variations are required by the different missions and mission emphasis of the TRIDENT Submarine-Launched Ballistic Missile (SLBM) force. However, these additional VLF/LF capabilities will be provided using the standard SLVR, and not a TRIDENT-unique receiver. Similarly, although there will likely be only one UHF transceiver in the TRIDENT variant of the SCSS, this transceiver will be common with the SSN 688, SEAWOLF, and NSSN class transceiver (Mini-DAMA). Additional, TRIDENT-unique features, including EAM alerting, will be supported via software modules in the SCSS INM.

Due to the differing operating schedules and availability of the four classes of submarines (SSN 688, SEAWOLF, NSSN, and TRIDENT), the means by which the SCSS is fielded will differ. For example, SSN 688 class submarines scheduled for extended availability will receive a complete SCSS installation, consisting of BBS, ADS, GFCP, Mini-DAMA, TFDS, EHF LDR, and CTT/JTT. SSN 688 class submarines scheduled for moderate length (4–6 week) availabilities will receive BBS, ADS and selected additional elements of the SCSS. Other SSN 688 class submarines not scheduled for long availabilities will receive one or more SCSS sub-systems via SHIPALTs during upkeep periods. Similarly, the NSSN new construction and SEAWOLF schedules will require differing implementation strategies. Detailed implementation strategies, for each class of submarine, are presented in Sections 5.3 through 5.6.

5.3 SSN 688 IMPLEMENTATION PLAN

The planned installation and integration of SCSS equipment aboard SSN 688 class submarines will occur using one of three implementation strategies. The first installation strategy will make use of the submarine’s extended availability time frames such as a ship’s Overhaul, Depot Modernization Period (DMP), or Selected Restricted Availability (SRA). This is the optimum installation time frame for SCSS equipment installation because of the length of time required to complete the SCSS install. When a period such as this is not scheduled or is delayed, a second installation strategy encompassing the submarine BBS installation with additional communication ship-alterations as feasible, such as Mini-DAMA, SLVR, etc., will be scheduled based on the a ship's inport pierside availability. The last installation strategy will be used when pierside periods are severely limited; planning will be done on a case by case basis. It will provide a limited "mixture" of SCSS equipment installations (BBS, Mini-DAMA, EHF, ADS, etc.) based on a ship's upcoming deployment and in port availability schedule.

5.4 SEAWOLF (SSN 21) IMPLEMENTATION PLAN

The existing SSN 21 ECS is capable of supporting all current platform communications requirements. It is comprised of legacy, closed system architecture based equipment inter-connected via automated baseband and RF switching systems. The transition of the SSN 21 ECS to the SCSS is driven by the cost reductions and flexible interoperability achievable via ECS commonality, NDI, and OSA. Due to the existing ECS capabilities, the transition to the SCSS will be deferred until a major availability following PSA. Selected SCSS elements, such as SLVR (with ELF and HF P 3 I) or JTIDS/Multi-functional Information Distribution System (MIDS), will be considered for early introduction, as operational requirements and funding support dictate. Existing acquisition programs (SMB, Mini-DAMA, Navy EHF SATCOM Program (NESP)) are also scheduled to be installed in the SSN 21 ECS. These installations will continue as currently planned, but will be coordinated, where feasible, to minimize the disruption to the radio room and submarine schedule.

5.5 TRIDENT IMPLEMENTATION PLAN

To date, the TRIDENT IRR has successfully met all of its original operational requirements, which include: maintaining connectivity with the National Command Authorities (NCA); maintaining a high degree of availability; and maintaining interoperablity with joint strategic communication systems. The current configuration of the IRR is, however, expensive to maintain, is not OSA-based, and does not facilitate rapid technology insertion. The TRIDENT SCSS variant will be introduced to support and exceed existing IRR performance parameters, allow for cost savings, rapid technology insertion via an OSA approach, and assure future interoperability with a modernized C 4 I network.

The TRIDENT IRR will transition into the TRIDENT SCSS, with IOC in FY01 and FOC planned for FY06. The SCSS development was initiated in 1993 and will progress through a series of design analyses and prototype revisions to effect a fully automated system radio room on-board TRIDENTs. However, because of noted operational and platform differences between SSNs and TRIDENTs, the TRIDENT SCSS will be considered an SCSS variant to that installed on SSNs. The TRIDENT SCSS variant will be the result of modifications to the SSN SCSS to accommodate: operational requirements (specified system availability, connectivity and RF links to support strategic communications); and environmental (e.g., noise requirements), human machine interface (HMI), and electrical/ mechanical interfaces unique to the TRIDENT platform. Moving today's IRR into a modern architecture presents unique challenges for program management, logistics (particularly supply support and training), and integration engineering to support the TRIDENT communications requisites for strategic connectivity and high availability.

The TRIDENT SCSS implementation will assume those design change, test, and support processes used to develop the overall SCSS implementation. Specific to the TRIDENT SCSS implementation, attention will be directed within supporting IPTs and working groups (WGs) to ensure that validated strategic communication requirements, acquisition mandates, and unique TRIDENT platform requirements are satisfied.

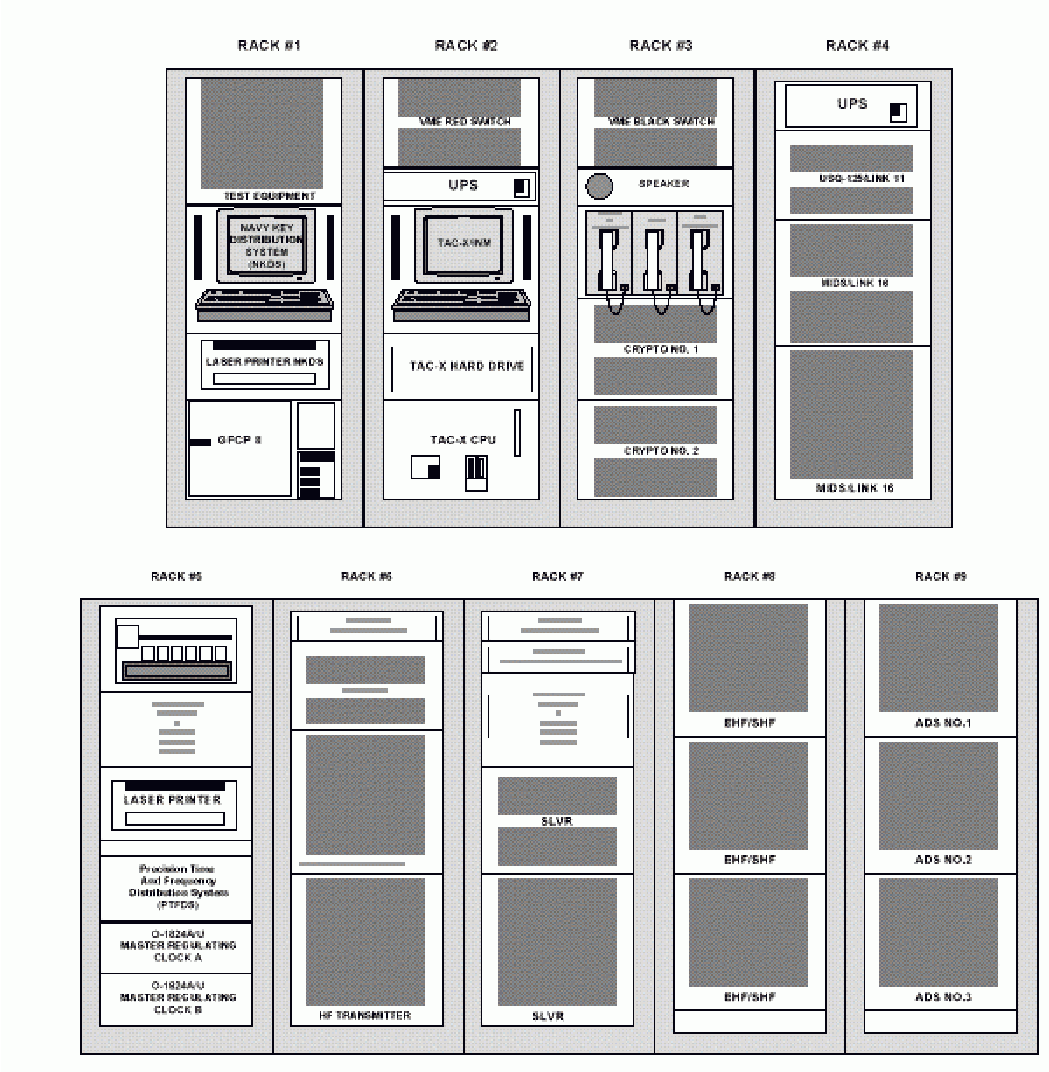
Unlike the phased acquisition and implementation approach described for the SSN SCSS, the acquisition and implementation of the TRIDENT SCSS is expected to be via a turn-key installation. The turn-key concept has been endorsed to accommodate design flexibility and allow insertion of new and state-of-the-art technologies as they evolve. The TRIDENT SCSS variant will be developed and acquired in the same manner as the attack submarine variants. The TRIDENT SCSS prototype will be a land based test site. The first TRIDENT SCSS radio room will be certified and acceptance tested. Subsequent shipsets will be acceptance tested but will not undergo the long certification testing that the existing IRR undergoes.

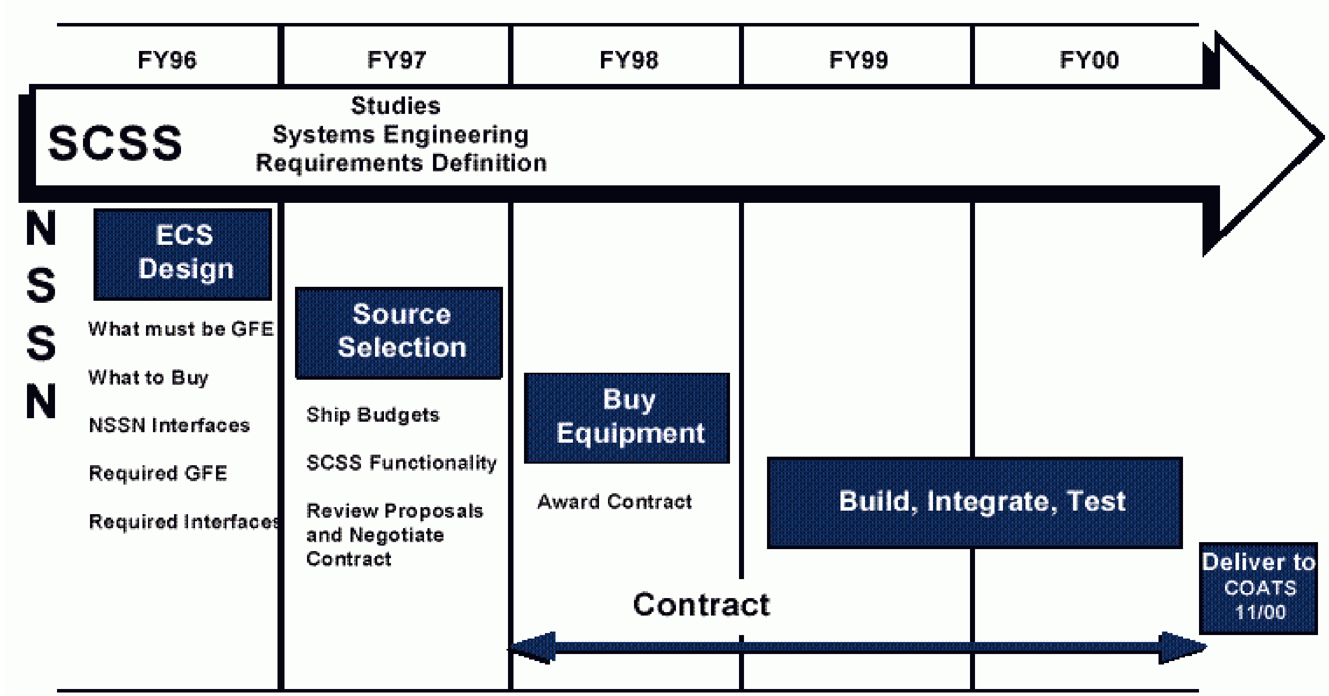
The TRIDENT SSGN, which is currently under consideration, is projected to consist of a TRIDENT SCSS radio room with dual Improved AN/BRA-34, dual Submarine HDR, and one GBS antenna.

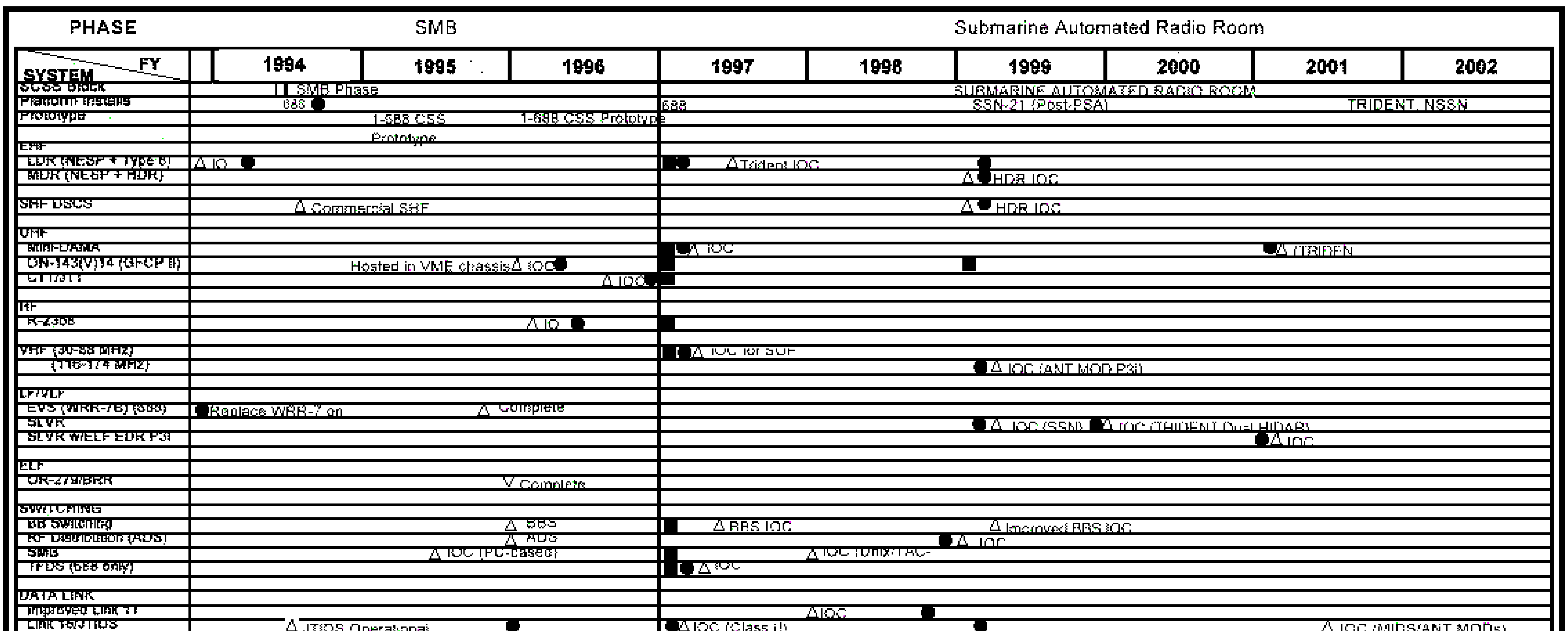
5.6 NEW ATTACK SUBMARINE

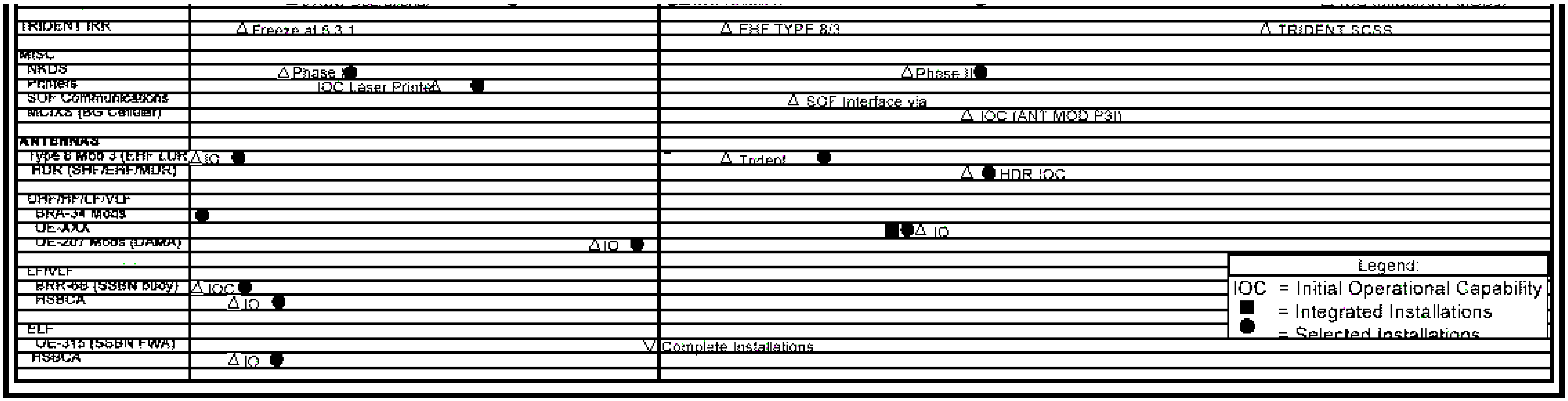
The NSSN variant of the SCSS will be optimized for cost effectiveness while fitting into a smaller footprint. PMW 173 will select the best ECS solutions from both existing legacy (Navy and/or Joint service) equipment and SCSS equipment prototyped during the SMB and SARR phases. The NSSN ECS will be delivered in early FY01 to support the Combat Control System Module (CCSM) Off-Hull Assembly Test Site (COATS) process. The size and space reductions needed for the 9-rack NSSN radio room will be achieved through ongoing advances in communication equipment technology. The NSSN ECS will leverage the prototyping, development, and design efforts of the SCSS through the SMB and SARR phases. During the SCSS radio room phases (SMB, SARR), the prototypes and proof of concepts will help identify realistic C 4 I capabilities and provide risk assessments which will be used in determining whether or not further development or procurement is warranted for various equipments planned to be procured as part of the SCSS and the NSSN ECS. A notional 9-rack radio room arrangement, based on both legacy and new equipment, is presented in Figure 5-2. The overall NSSN ECS Plan is presented in Figure 5-3.

As a separate approach, and for risk reduction purposes, consideration is being given for the design of the NSSN radio room in which complete OSA design and procurement is undertaken without using any legacy submarine communication equipment.


RACK #1
RACK #2
RACK #3
RACK #4
TEST EQUIPMENT
NAVY KEY DISTRIBUTION SYSTEM (NKDS)
LASER PRINTER NKDS
GFCP 8
VME RED SWITCH
UPS
TAC-X/NM
TAC-X HARD DRIVE
TAC-X CPU
VME BLACK SWITCH
SPEAKER
CRYPTO NO. 1
CRYPTO NO. 2
UPS
USQ-125/LINK 11
MIDS/LINK 16
MIDS/LINK 16
RACK #5
RACK #6
RACK #7
RACK #8
RACK #9
LASER PRINTER
Precision Time And Frequency Distribution System (PTFDS)
O-1824A/U MASTER REGULATING CLOCK A
O-1824A/U MASTER REGULATING CLOCK B
HF TRANSMITTER
SLVR
SLVR
EHF/SHF
EHF/SHF
EHF/SHF
ADS NO.1
ADS NO.2
ADS NO.3


FY96
FY97
FY98
FY99
FY00
SCSS
Studies
Systems Engineering
Requirements Definition
NSSN
ECS Design
What must be GFE
What to Buy
NSSN Interfaces
Required GFE
Required Interfaces
Source Selection
Ship Budgets
SCSS Functionality
Review Proposals and Negotiate Contract
Buy Equipment
Award Contract
Build, Integrate, Test
Deliver to COATS 11/00
Contract


PHASE
SMB
Submarine Automated Radio Room
SYSTEM
FY
1994
1995
1996
1997
1998
1999
2000
2001
2002
SCSS Block
SMB Phase
SUBMARINE AUTOMATED RADIO ROOM
Platform Installs
688
688
SSN-21 (Post-PSA)
TRIDENT, NSSN
Prototype
1-688 CSS Prototype
1-688 CSS Prototype
EHF
LDR (NESP + Type 6)
IO
Trident IOC
MDR (NESP + HDR)
HDR IOC
SHF DSCS
Commercial SHF
HDR IOC
UHF
Mini-DAMA
IOC
TRIDEN
ON-143(V)14 (GFCP II)
Hosted in VME chassis
IOC
CT7/STT
IOC
HF
R-2368
IO
VHF (30-88 MHz)
(116-174 MHz)
IOC for SOF
IOC (ANT MOD P3I)
LF/VLF
EVS (WRR-7B) (688)
Replace WRR-7 on
Complete
SLVR
IOC (SSN)
IOC (TRIDENT Dual HIDAR)
SLVR w/ELF EDR P3I
IOC
ELF
OR-279/BRR
Complete
SWITCHING
BB Switching
BBS
BBS IOC
Improved BBS IOC
RF Distribution (ADS)
ADS
IOC
SMB
IOC (PC-based)
TFDS (688 only)
IOC
DATA LINK
Improved Link 11
IOC
Link 16/JTIDS
JTIDS Operational
IOC (Class II)
IOC (MIDS/ANT MODs)



TAB A. SUBMARINE CSS IMPLEMENTATION STRATEGY

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APPENDIX A SHIPBOARD COMMUNICATIONS EQUIPMENT

A.1 SHIPBOARD COMMUNICATIONS EQUIPMENT

Submarine shipboard communications systems consist of RF antennas and radio room equipment, both RF transmitters/receivers and baseband suites. The following sections describe the current baseline submarine communications capabilities and list the current (POM 96) programs. This appendix is organized into five major sub-sections. Sub-section A.2 lists the current communications circuit capabilities of the submarine ECS and describes the rack arrangements for each submarine class. Sub-section A.3 describes the current submarine antenna program. A.4 provides an overview of the current Advanced Technology Demonstration (ATD) in the area of submarine antennas. In sub-section A.5, shipboard equipment procured for submarines by SPAWAR PMW 173 is listed. Lastly, sub-section A.6 describes shipboard equipment procured for submarines by other SPAWAR program offices and DOD organizations.

A.2 CURRENT SUBMARINE COMMUNICATIONS CAPABILITIES

Submarines communicate via multiple, complementary RF systems, covering nearly all the military communications frequencies. Figure A-1 lists the current submarine communications systems and their associated RF frequency band. Because of these limitations, no one communications system or frequency band can support all submarine communications requirements. For example, UHF SATCOM provides a relatively high data rate but requires the submarine to expose a detectable mast-mounted antenna, degrading its primary attribute — stealth. Conversely, extremely low frequency (ELF) and VLF broadcast communications provide submarines a high degree of stealth and flexibility in speed and depth, but are low data rate, submarine-unique and shore-to-submarine only. Table A-1 lists the unclassified characteristics of the communications circuits used by TRIDENT and LOS ANGELES class submarines. Figures A-2 through A-4 describe the SSN 688I, SSN 21, and TRIDENT SSBN radio room equipment rack layouts. Figure A-5 depicts the notional speed and depth limitations placed on the submarine by various communications circuits.

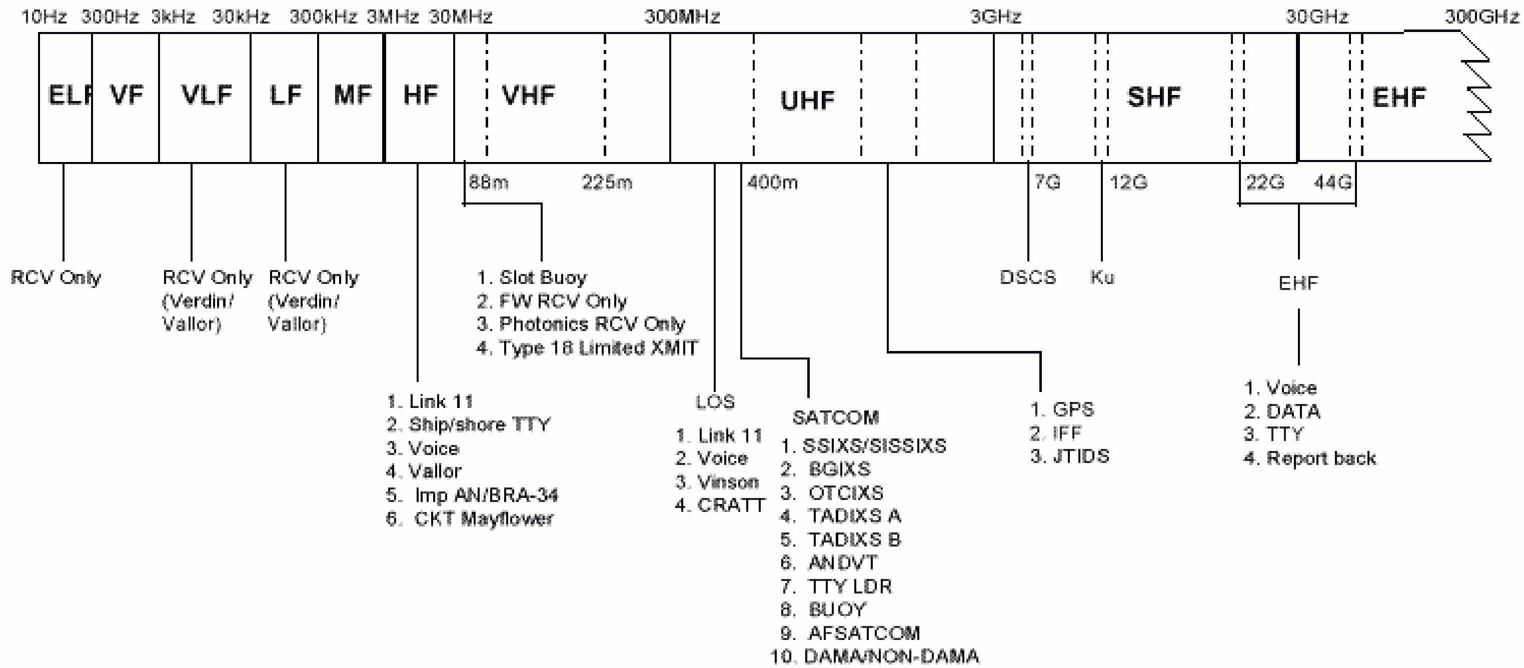


Table A-1. Submarine Communications Circuits

LINK	FREQUENCY	LINK TYPE	MODULATION	DATA RATE (bps)	CRYPTO	INFORMATION TYPE
ELF	40-80 Hz	R	MSK	LDR	KGV-11	Record
VLF/LF VERDIN (Tactical)	14-60 kHz	R	FSK/MSK/CW	50	KG-38	Record/Tactical
VLF/LF VERDIN (Strategic)	14-60 kHz	R	MSK	LDR	KG-38	Record
VLF/LF FSK (Verdin) (Strategic)	14-60 kHz	R	FSK	50	N/A	Record
VLF/LF VALLOR	14-150 kHz	R	FSK	50	KWR-46	Record/Tactical
VLF/LF VALLOR (NATO)	14-60 kHz	R	FSK/MSK/CW	50	KWR-46	Record
VLF/LF DOUBLE DECRYPT (Verdin)	14-60 kHz	R	MSK	50	KG-38/ KWR-46	Record
VLF/LF CW/FSK	14-60 kHz	R	CW/FSK	N/A	N/A	Audio (Morse)
HF SPECIAL COMMUNICATIONS	2-30 MHz	T	Special	Special	Off-Line	Record
HF SECURE TTY	2-30 MHz	HD T/R	FSK	75	KG-84C	Record/Tactical
HF VALLOR	2-30 MHz	R	FSK	50	KWR-46	Record/Tactical
HF LINK 11	2-30 MHz	HD T/R	ISB	2250	KG-40	Tactical
HF NARROWBAND	2-30 MHz	HD T/R	SSB	N/A	KYV-5	Voice

SECVOX						
HF CW	2-30 MHz	HD T/R	CW	N/A	N/A	Audio (Morse)
HF CLEAR VOICE	2-30 MHz	HD T/R	SSB	N/A	N/A	Voice
HF SCANNING	2-30 MHz	R	Multiple	N/A	N/A	Audio
SLOT BUOY	168-174 MHz	T	AM	N/A	Off-Line	Audio
LDR SATCOM	240-320 MHz	HD T	DPSK	75	KG-84C	Record/Tactical
UHF OTCIXS	240-320 MHz	HD T/R	DPSK	2400	KG-84A	Record/Tactical
UHF SSIXS	240-320 MHz	HD T/R	DPSK	2400/4800	KG-84A	Record/Tactical
UHF BGIXS	240-320 MHz	HD T/R	DPSK	2400/4800	KG-84A	Record/Tactical
UHF LINK 11	225-400 MHz	HD T/R	FM	2250	KG-40	Tactical
UHF TADIXS A	240-320 MHz	R	DPSK	2400	KG-84A	Tactical
UHF TADIXS B	240-320 MHz	R	QPSK	9600	KGR-96	Tactical
UHF SATCOM BUOY	290-320 MHz	T	DPSK	2400/4800	KG-84A	Record
UHF SATCOM SECVOX	240-320 MHz	HD T/R	DPSK	2400	KYV-5	Voice
UHF VINSON	225-400 MHz	HD T/R	AM or FM	N/A	KY-58	Voice
UHF CLEAR VOICE	225-400 MHz	HD T/R	AM	N/A	N/A	Voice
UHF SECURE TTY	225-400 MHz	HD T/R	AFTS AM/FSK	75-2400	KG-84A	Record/Tactical
UHF AFSATCOM	225-400 MHz	HD T/R	FSK	75	Off-Line	Record
EHF SECURE TTY	20.2-21.2 GHz R 43.5-45.5 GHz T	FD T/R	FSK/DPSK FSK	75-2400	KG-84A	Record/Tactical
EHF SPECIAL COMMUNICATIONS	20.2-21.2 GHz R 43.5-45.5 GHz T	FD T/R	FSK/DPSK FSK	75	Off-Line	Record
EHF SECVOX	20.2-21.2 GHz R 43.5-45.5 GHz T	FD T/R FD T/R	FSK/DPSK FSK	2400	KYV-5	Voice

R - Receive Only
T - Transmit Only
HD - Half Duplex
FD - Full Duplex
T/R - Transmit/Receive

bps - bits per second
MSK - Minimum Shift Keying
FSK - Frequency Shift Keying
CW - Continuous Wave
ISB - Independent Sideband
SSB - Single Sideband

DPSK - Differential Phase Shift Keying
FM - Frequency Modulation
AM - Amplitude Modulation
AFTS - Audio Frequency Tone Shift
N/A - Not Applicable
QPSK - Quadrature Phase Shift Keying

Figure A-2. SSN 688 I Radio Room Rack Arrangement

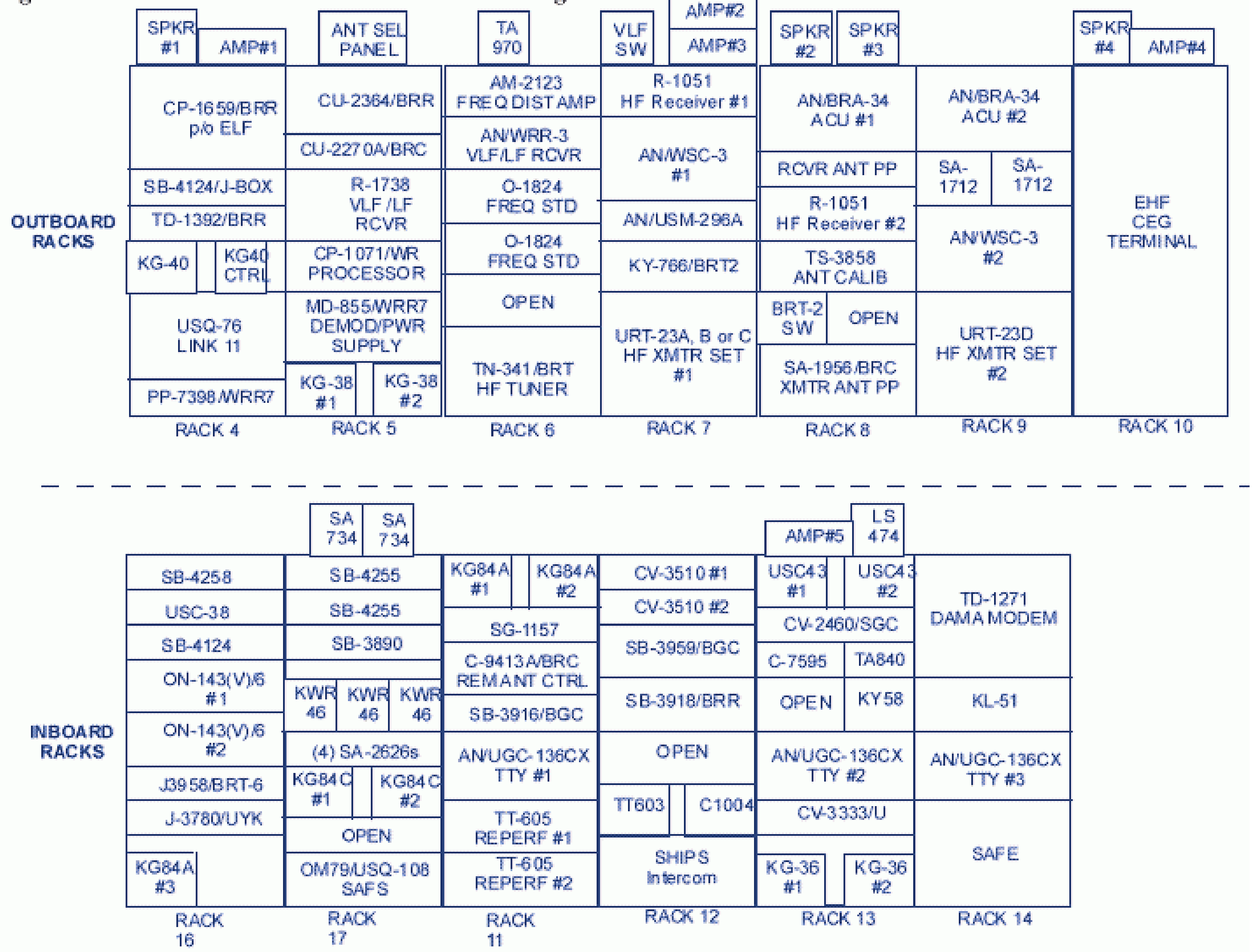


Figure A-3. SSN 21 Radio Room Rack Arrangement

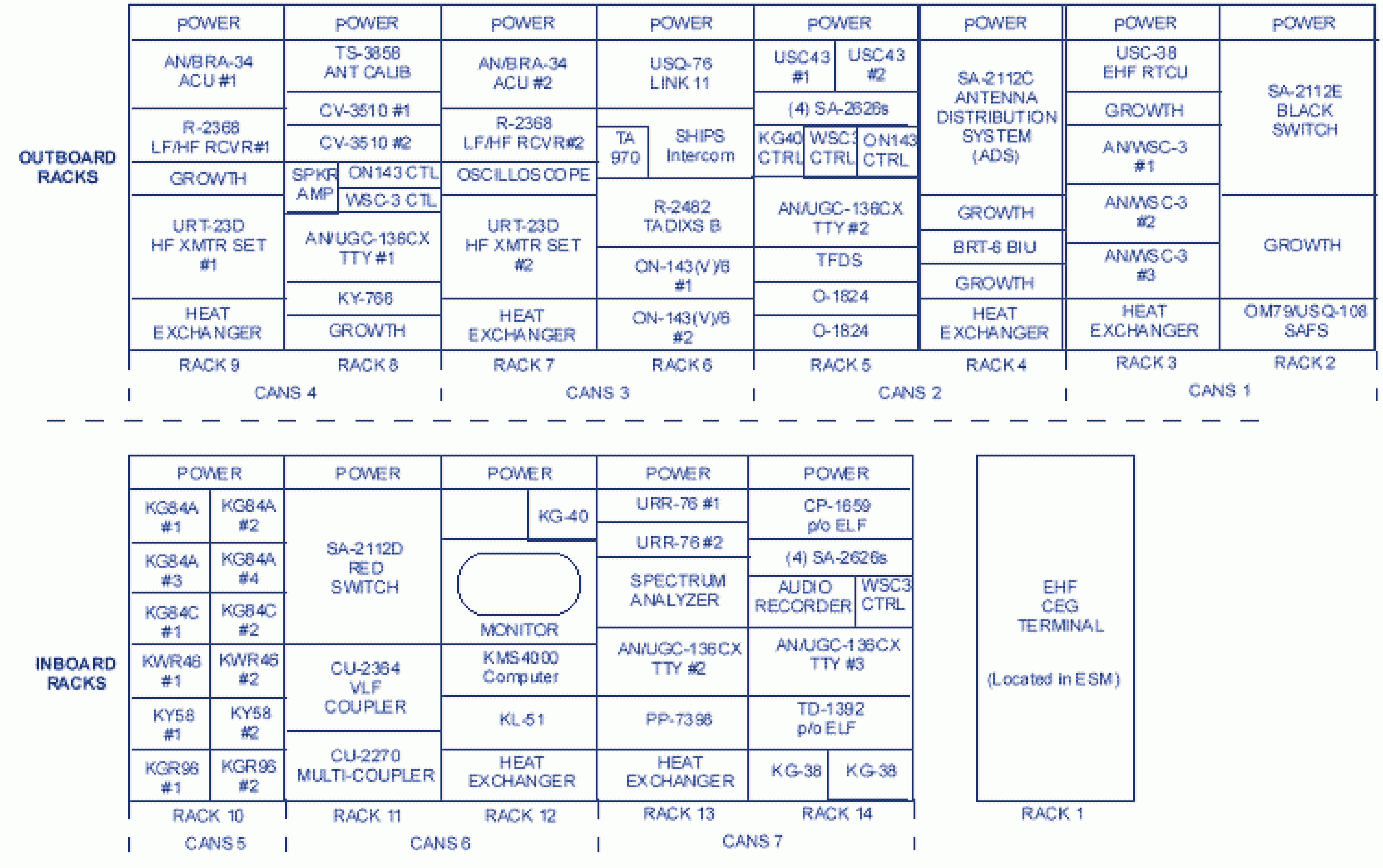
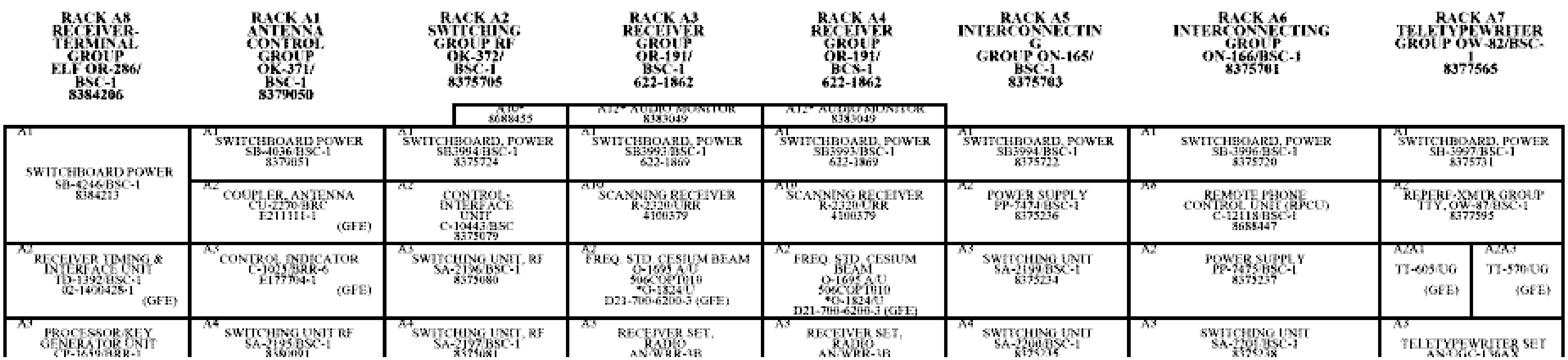
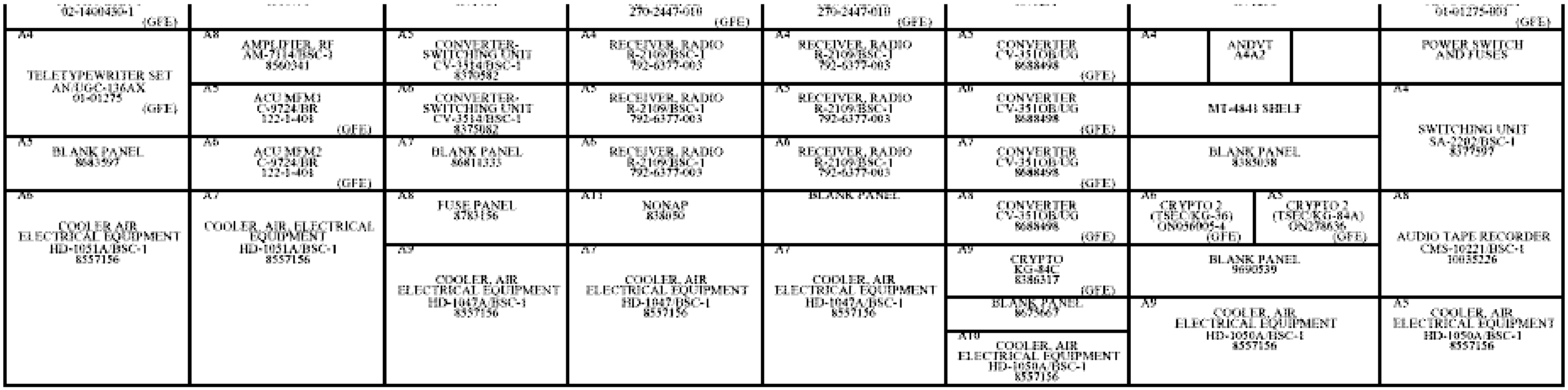


Figure A-4. TRIDENT Radio Room





SIGNAL DISTRIBUTION UNIT *ON SSBN 737 - 739

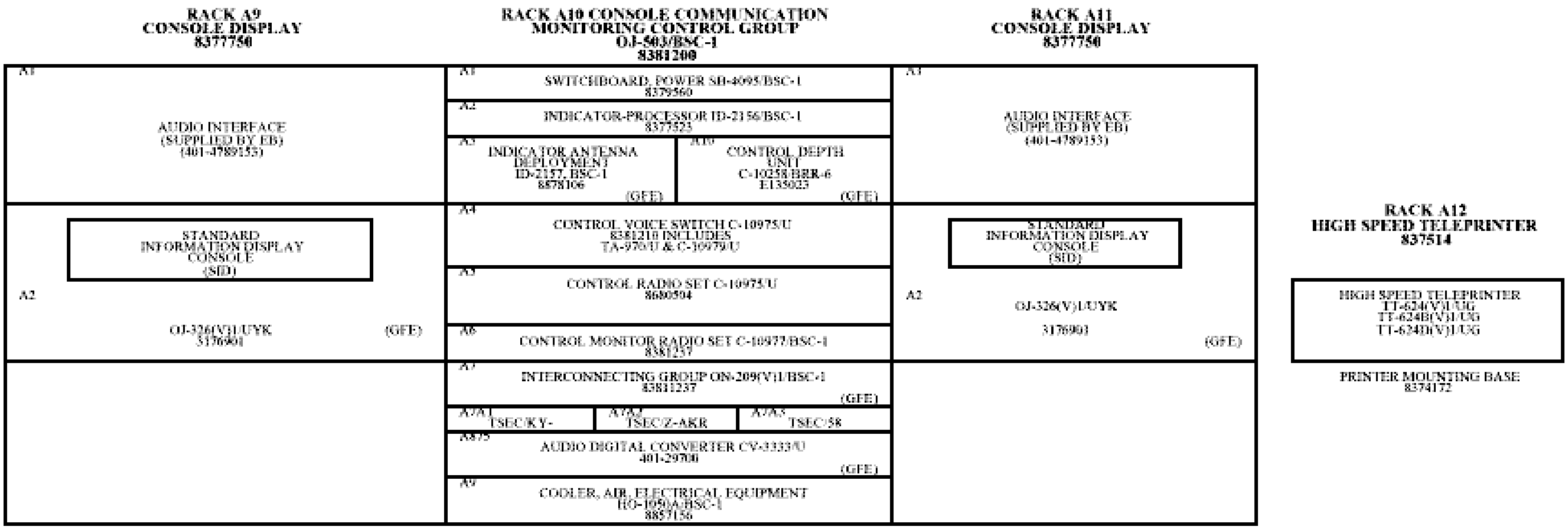
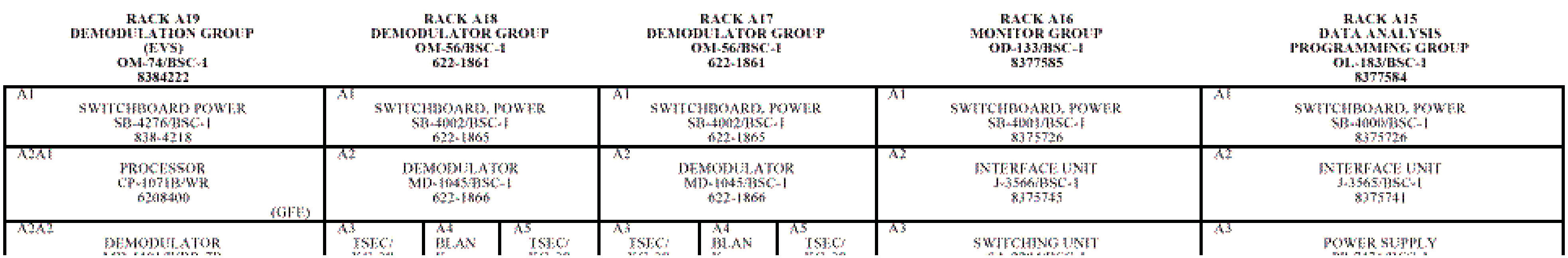


Figure A-4. TRIDENT Radio Room (continued)



622-6943 (GFE)		(V-2) (GFE)	K	(V-2) (GFE)	(V-2) (GFE)	K	(V-2) (GFE)	8375746	8377001
A3 TELETYPEWRITER SET AN/UGC-136AX 01-01273 (GFE)		A6 TSEC/ KG-38 (V-2) (GFE)	A7 POWER SUPPLY PP-7477/BSC-1 622-1867		A6 TSEC/ KG-38 (V-2) (GFE)	A7 POWER SUPPLY PP-7477/BSC-1 622-1867		A4 DATA PROCESSING SET AN/UYK-44 8154319 (GFE)	A4 DATA PROCESSING SET AN/UYK-44 8154319 (GFE)
A5 CRYPTO TSEC/ KG-38 ON056006 (GFE)	A4 POWER SUPPLY PP-8006/ BSC-1 8384243	A6 CRYPTO TSEC/ KG-38 OND56006 (GFE)	A8 DATA PROCESSING SET AN/UYK-20X(V) 8557765 (GFE)		A8 DATA PROCESSING SET AN/UYK-20X(V) 8557765 (GFE)			A6 CONTROLLER MEMORY UNIT C-10448/BSC-1 8678140	A6 CONTROLLER MEMORY UNIT C-10448/BSC-1 8678140
A7 APL RECORDER (MDC&R) 102260-102 (GFE)			A9 COOLER, AIR ELECTRICAL EQUIPMENT HD-1051A/BSC-1 8557156		A9 COOLER, AIR ELECTRICAL EQUIPMENT HD-1051A/BSC-1 8557156			A7 BLANK PANEL 86786188 A9 COOLER, AIR ELECTRICAL EQUIPMENT HD-1051A/BSC-1 8557166	A7 BLANK PANEL 86786188 A9 COOLER, AIR ELECTRICAL EQUIPMENT HD-1051A/BSC-1 8557156

RACK A20
COMMUNICATION GROUP
OA-9105/BSC-1
8378052

- A1 CONTROL UNIT, POWER C-10922/BSC-1 0102290
- A2 ANTENNA CALIB., SET TS-3858/UR 8788406 (GFE)
- A3 OSCILLOSCOPE AN/USM-296A 8562159 (GFE)
- A4 KEYER KY-766/BRT-2 8785574 (GFE)
- A5 BLANK PANEL 8787877
- A6 TRANSMITTER, RADIO T-1095/WRA-4 8785575 (GFE)
- A7 AMPLIFIER, RADIO FREQUENCY AM-3924B(P)/URT 0102305 (GFE)
- A8 COOLER, AIR ELECTRICAL EQUIPMENT HD-1087/BSC-1 0102030

RACK A21
RECEIVER-TRANSMITTER
OR-192/BSC-1 GROUP
8375706

- A1 SWITCHBOARD, POWER SB-4003/BSC-1 8375725
- A2 INTERFACE UNIT J-3567/BSC-1 8375075
- A3 BLANK PANEL 8675596
- A4 RECEIVER, RADIO R-2108/BSC-1, 8378067 INCLUDES (2) RT-1165/URC-88 8374652
- A5 UHF SATCOM SET RT-1107/(V)12/WSC-3(V) 8559368 (GFE)
- A6 RECEIVER-TRANSMITTER, RADIO RT-1278/BSC-1 8378068 INCLUDES RT-1165/URC-88 8374652 AND AM-6718/URC-88 8371860
- A7 COOLER, AIR ELECTRICAL EQUIPMENT HD-1052A/BSC-1 8375023

RACK A22
RECORDER-REPRODUCER GROUP
OA-8958/BSC-1
8375708

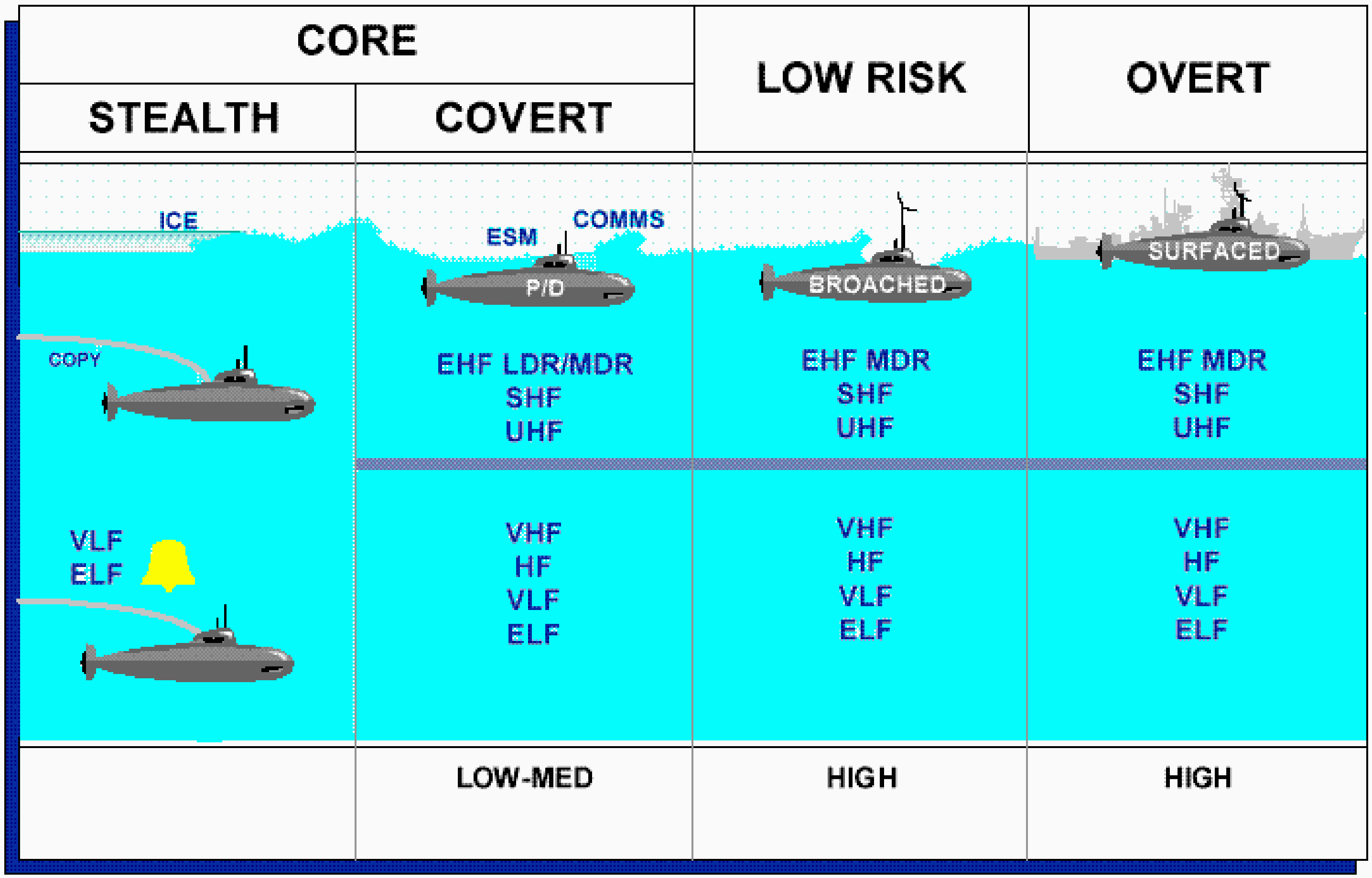
- A1 SWITCHBOARD, POWER SB-4004/BSC-1 8375727
- A2 INTERFACE UNIT J-3568/BSC-1 8375744
- A3 CARTRIDGE TAPE UNIT AN/USH-26(V) MOD 1 10035635
- A4 CARTRIDGE TAPE UNIT AN/USH-26(V) MOD 1 10035636
- A6 BUOY INTERFACE UNIT J-3958/BRT-6 8375744
- A7A1 TSEC/KWR-46 ON36081
- A7A2 TSEC/KWR-46 ON3681
- A7A3 SHELF ASSEMBLY 0126303
- A3 COOLER, AIR ELECTRICAL EQUIPMENT HD-1047A/BSC-1 8557156

RACK A23
POWER DISTRIBUTION GROUP
OP-118/BSC-1
8377575 (SSBN 726) or
8378060 (SSBN 727 - 739)

- A1 SWITCHBOARD, POWER SB-4005/BSC-1 8375733
- A3 GROUND FAULT INDICATOR 8688406
- A2 COOLER, AIR ELECTRICAL EQUIPMENT HD-1047A/BSC-1 8557156

RACK A24
RECORDER-REPRODUCER GROUP
OL-209/BSC-1
8378075

- A1 SWITCHBOARD, POWER SB-4006/BSC-1 8378076
- A2 COMPARATOR CM-507/BSC-1 8384231
- A6 INTERCONNECTING GROUP ON-143(V)6/USQ 0104160
- A6 TELETYPEWRITER SET AN/UGC-136AX 01-01275
- A3 DISK MEMORY UNIT MU-674/BSC-1 8678349
- A4 COOLER, AIR ELECTRICAL EQUIPMENT HD-1050A/BSC-1 8557156



Communication Capabilities for Submarine Operations

A.3 SHIPBOARD ANTENNAS

The SIAS Program provides SSN and SSBN submarines with new and improved antenna systems to support multifunction information exchange (including communications, navigation, and identification) capabilities with aircraft, ships, other submarines, and shore stations in support of submarine warfare operational doctrines. The SIAS Program also supports development of antenna distribution systems to permit optimum signal distribution. The NUWC Division Newport is the Technical Development Agent (TDA) for submarine antennas and acts as the Navy’s point of contact for submarine antenna programs. The following subsections provide detailed information on existing submarine antennas, the antenna suites of each submarine platform, and the antenna ATD program. Current antenna development programs are described in Section 4, these include the Submarine HDR SATCOM antenna, the Improved AN/BRA-34 antenna, the ADS, the upgrade to the AN/BST-1 SSBN emergency buoy, and the antenna systems engineering efforts.

A.3.1 Existing Submarine Communication Antenna Systems

Table A-2 provides a summary of the current and near-term submarine communication antennas.

Table A-2. Existing Submarine Communication Antenna Systems (Page 1 of 2)

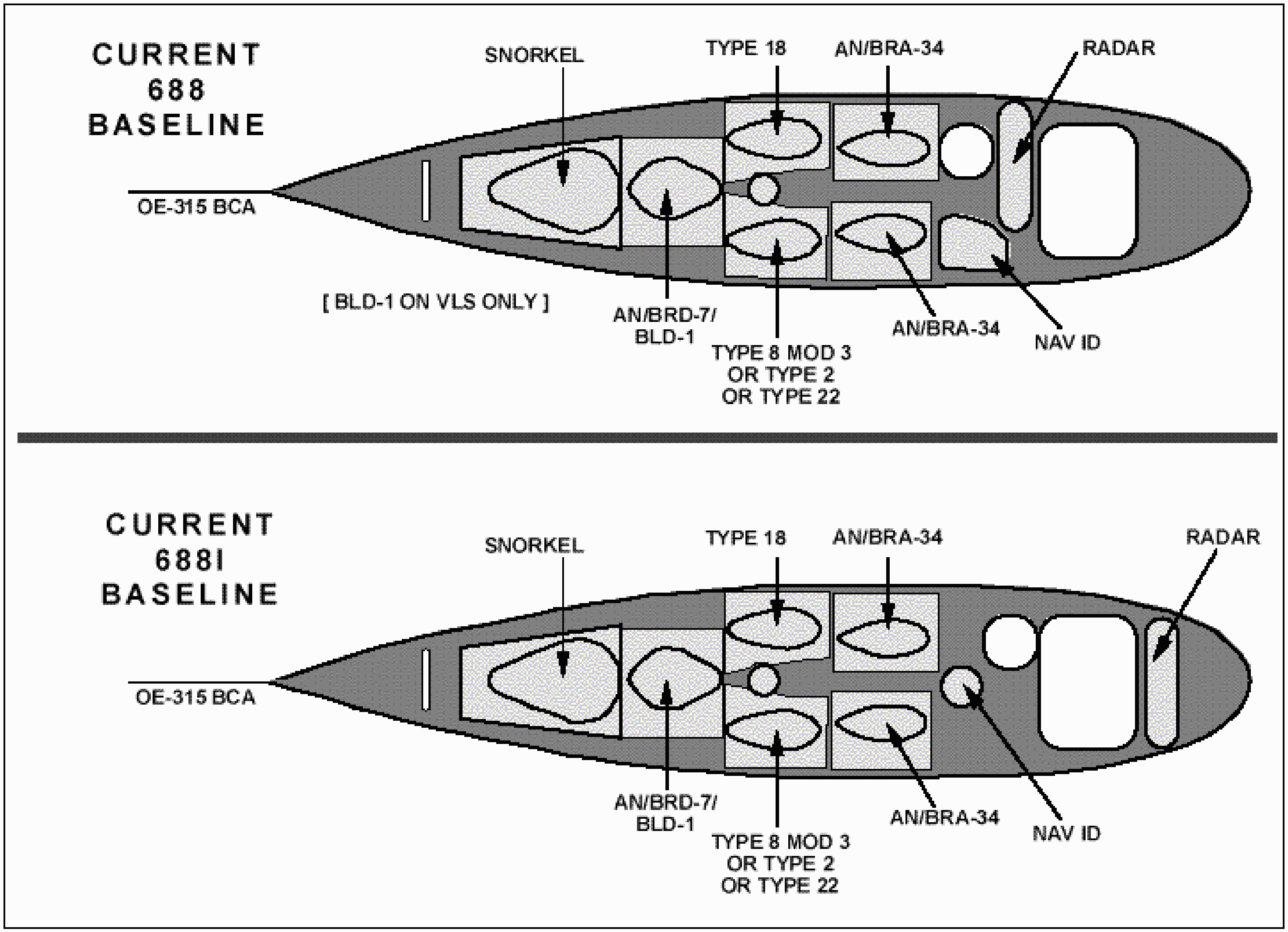
Antenna	Frequency Range	Mode/ Data Rate (bps)	Application		
			SSN 688	SSN 21	SSBN 726
OE-315(V)/BRC	10 Hz - 400 MHz	Data, Voice 50 - 75	X	X	X
AN/BRA-34	VLF/LF 5 kHz - 150 kHz	Data 50	X	X	
	MF/HF 2 MHz - 30 MHz	Data, Voice 50 - 2250	X	X	
	UHF 225 MHz - 400 MHz	Data, Voice 75 - 9600	X	X	
	UHF 240 MHz - 315 MHz	Data, Voice 75 - 9600	X	X	
	IFF 950 MHz - 1150 MHz	N/A	X	X	
	GPS 1227 MHz and 1575 MHz	N/A	X	X	
OE-207/BR	VLF/LF 10 kHz - 160 kHz	Data 50			X
	MF/HF 2 MHz - 30 MHz	Data, Voice 50 - 75			X
	UHF 225 MHz - 400 MHz	Data, Voice 75 - 2400			X

Table A-2. Existing Submarine Communication Antenna Systems (Page 2 of 2)

Antenna	Frequency Range	Mode/ Data Rate (bps)	Application		
			SSN 688	SSN 21	SSBN 726
OE-207/BR (Continued)	UHF 240 MHz - 320 MHz	Data, Voice 75 - 2400			X
	IFF 950 MHz - 1150 MHz	N/A			X
	GPS 1227 MHz and 1575 MHz	N/A			X
AT-441/MRC	MF/HF 2 MHz - 30 MHz	Data, Voice 50 - 75	X	X	X
AT-774/UR	MF/HF 2 MHz - 30 MHz	Data, Voice 50, 75	X	X	X
AN/BRR-6	VLF-HF 10 MHz - 160 MHz 2 MHz - 30 MHz	Data 50			X
Type 18 (RO)	MF-UHF 5 kHz-500 MHz	Data, Voice 75 - 9600	X	X	
	VHF-UHF 32 kHz - 500 MHz	Data, Voice 75 - 9600	X	X	
Type 15 (RO)	VLF-UHF 0.5 kHz - 500 MHz	Data, Voice 75 - 2400			X
Type 8 Mod 3 (RO)	VLF-UHF 12 kHz - 500 MHz	Data, Voice 75 - 2400			X
Type 8 Mod 3 EHF Antenna	EHF 43.5 - 45.5 GHz Uplink 20.2 - 21.2 GHz Downlink	Data, Voice 75 - 2400	X	X	X

A.3.1.1 SSN 688-Class Capabilities

SSN 688-Class submarines are currently equipped with two multifunction masts (AN/BRA-34) which provide a capability to communicate on two-way HF and UHF nets and a receive-only VLF/LF and Global Positioning System (GPS) capability. AN/BRA-34 DAMA modification kits are being installed to provide DAMA compatibility. This antenna also provides an IFF capability. The Type 18 periscope provides a limited VLF/LF/VHF/ UHF receive capability and a marginal transmit capability at VHF. In FY93, installations of AN/USC-38(V)1 EHF terminals began on this class of submarine. The first EHF terminals use an EHF antenna mounted on the top of the Type 8 Mod 3 periscope and are capable of operating with FLTSATCOM EHF Package (FEP) and Milstar I LDR satellites. The SHF/EHF HDR multiband antenna, when developed, will replace one AN/BRA-34. The SSN†688 has an OE-315(V)/BRR high speed buoyant cable antenna (HSBCA) system and carries AN/BRT-6 expendable UHF SATCOM buoys. Figure A-6 shows the layout of the current baseline SSN 688 and SSN 688I sail configurations.



A.3.1.2 SSN 21-Class Capabilities

The baseline SSN 21 communications antenna suite is the same as for the SSN 688-Class submarine; Figure A-7 shows the baseline sail configuration.

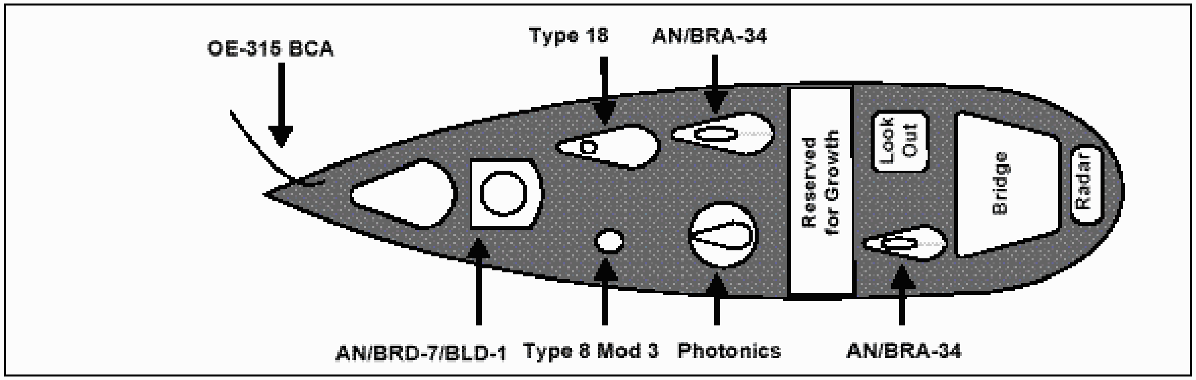


Figure A-7. SSN 21 Sail

A.3.1.3 SSBN 726-Class Capabilities

The current SSBN 726-Class antenna suite has two multifunction masts (OE-207/BR) for communications at periscope depth. The OE-207/BR multifunction mast provides the same communications capability as the AN/BRA-34. The difference in the two masts is the length of the OE-207/BR for integration into the TRIDENT sail. TRIDENT submarines are scheduled to receive the AN/USC-38(V)1 EHF terminal with the Type 8 Mod 3 periscope EHF antenna. The SHF/EHF HDR multiband antenna, when developed, will be added as a new mast. This class of submarines also has the OE-315 HSBCA. The SSBN has two AN/BRR-6 towed communications buoys. Figure A-8 shows the layout of the current baseline SSBN 726 sail.

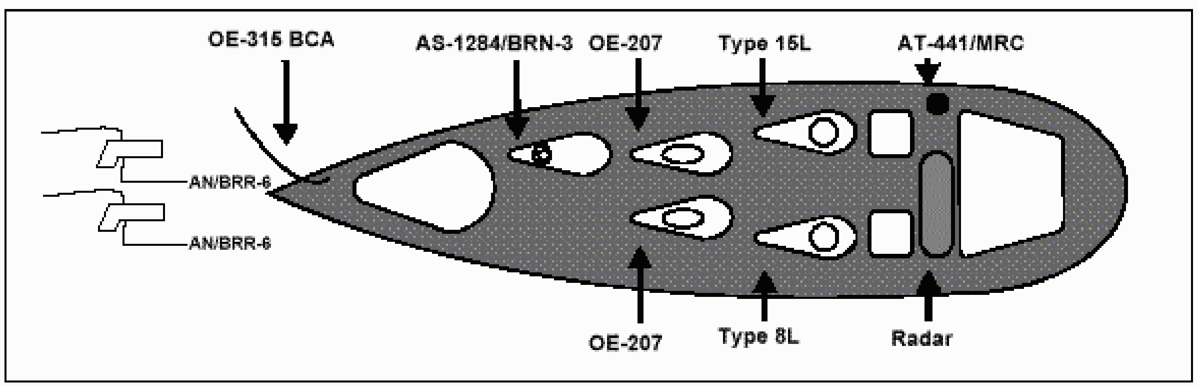


Figure A-8. TRIDENT Sail

A.3.1.4 NSSN Capabilities

Figure A-9 shows the current baseline sail configuration for the new SSN. The SHF/EHF HDR multiband antenna will be added and located in a modular antenna bay; the exact location has not been established.

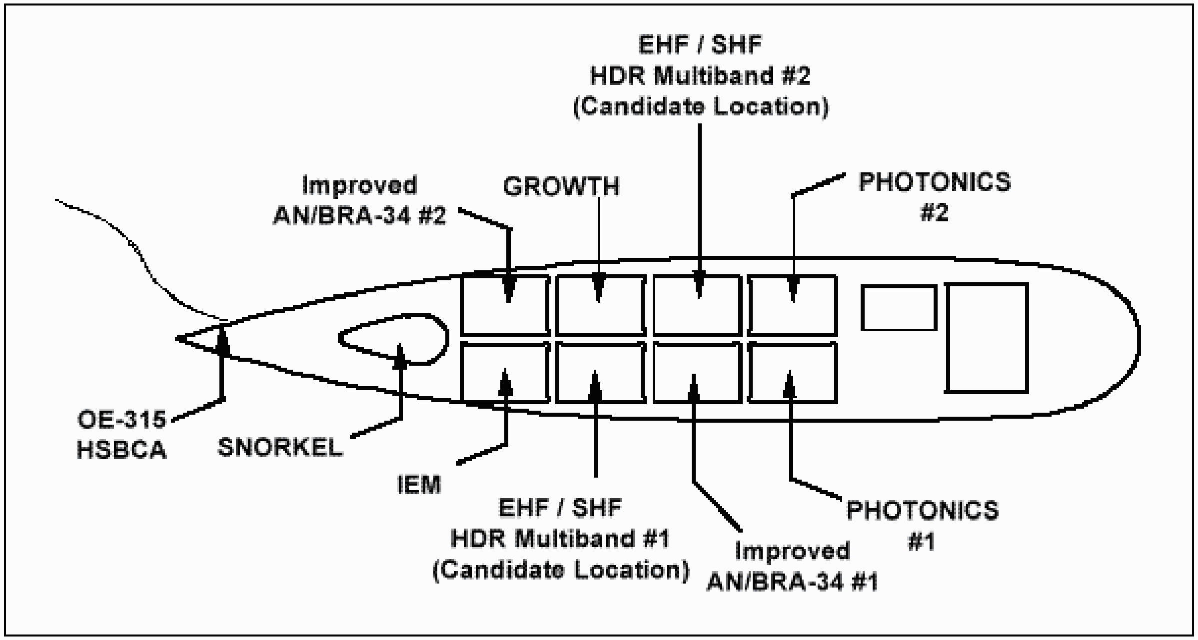


Figure A-9. New Attack Submarine Sail/Antenna Baseline Configuration

A.3.1.5 Antenna Inboard Switching And Distribution

Switching and antenna distribution is accomplished in the SSN 688 radio room by manual switches. The SSBN 726 IRR has a limited capability for remote switching and tuning. The SA-2112 Switching System has been developed and will be used in the SSN 21 radio room. This unit has limited remote switching capability, limited flexibility, and is not compatible with future open architecture design concepts. The ADS program, described in Section 4, will provide automated switching and antenna tuning for all submarine platforms as an element of the SCSS ECS.

A.4 Advanced Antenna Development

A.4.1 Submarine Super High Frequency Phased Array Antenna Advanced Technology Demonstration

A.4.1.1 Overall Advanced Technology Demonstration Objectives

The objective of this ATD is to design, build, and demonstrate a submarine phased array antenna. This antenna would allow two-way communications at SHF via satellite at higher data rates than currently available to the submarine. In addition, Low Temperature Co-fired Ceramics (LTCC) will be demonstrated as a low cost, thin, lightweight solution to submarine phased array antenna design. A.4.1.2 Advanced Technology Demonstration Technical Objectives Submarine satellite communication data rates are limited by the lack of a large aperture antenna. Current satellite resources, whether military or commercial, are limited in the amount of effective isotropic radiated power (EIRP) provided in the space-to-earth segment. Large antenna gains are therefore required at the submarine, which in turn requires large aperture antennas. To be interoperable, submarines require antennas with performance comparable to the least-capable TOMAHAWK-equipped surface ship. As a reference point, the least capable

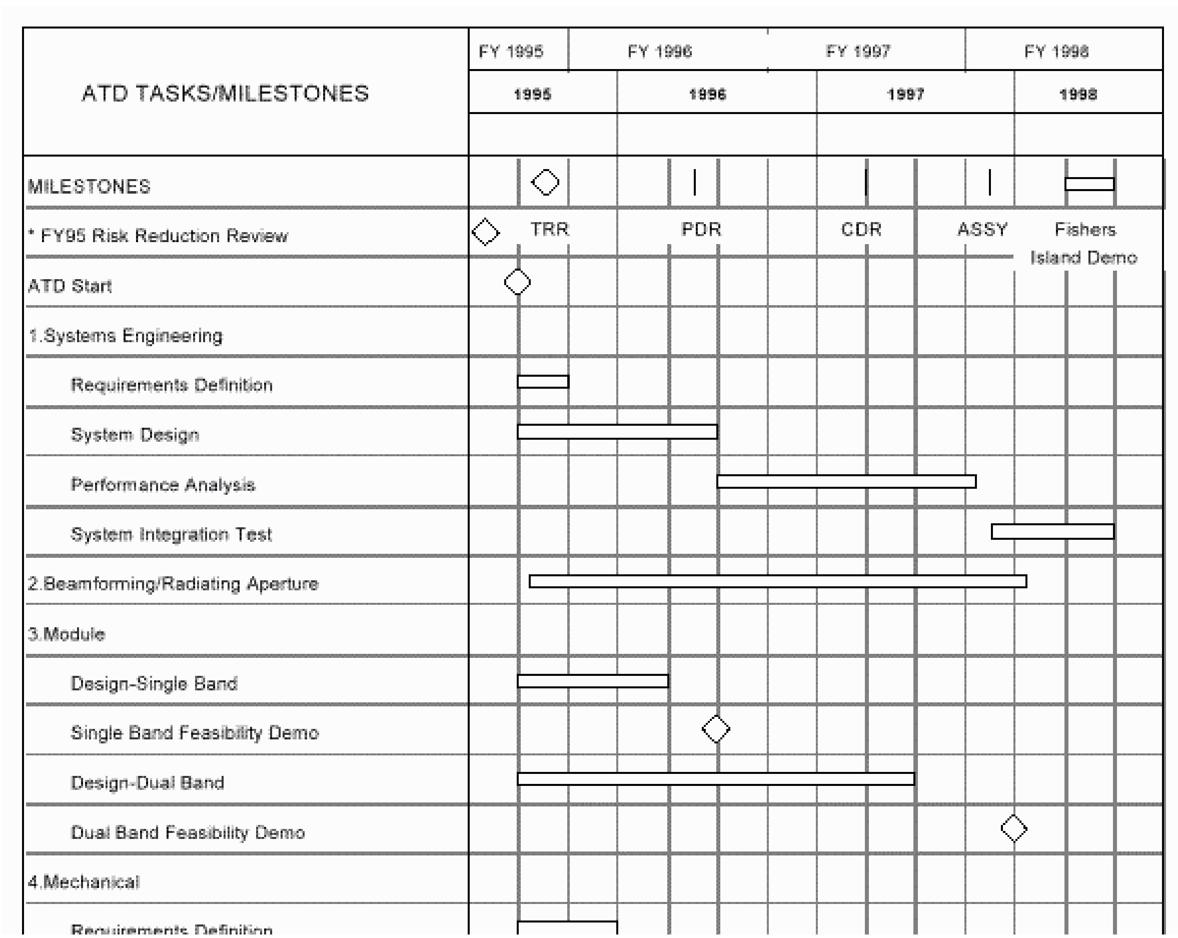
TOMAHAWK-equipped surface ship uses a four-foot reflector antenna for operation over the DSCS.

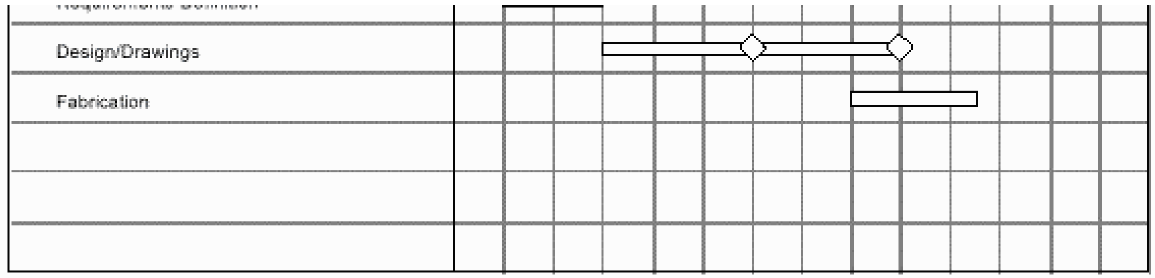
The two primary antenna designs which provide high gain and directivity are phased arrays and reflectors. Reflector antennas are commonly used on surface ship platforms, but they are typically bulky, difficult to store in a small volume, and require mechanical steering. Phased arrays are versatile, allowing electronic beam scanning, conformal design flexibility, and modular construction to improve stowability. Although phased arrays have been expensive in the past, recent technological breakthroughs have the potential to significantly reduce the design and manufacturing costs of phased arrays and their components.

This ATD is also pursuing the development of a dual band phased array module which would operate over DSCS and Commercial Ku bands. The ATD will develop a LTCC multilayer circuit substrate that will support multiple antenna elements and two or more communications bands. The LTCC circuit is very compact and will be packaged for the submarine environment. This technology would enable communications over two separate satellite systems simultaneously.

A.4.1.3 Schedule/Demonstrations

A high level schedule and milestone chart is shown in Figure A-10. Preliminary reviews will be held prior to the start of the ATD to address requirements definition and high-risk areas. Major reviews will be held during the ATD at the end of FY96 (Preliminary Design Review (PDR) and at the end of 3rd Qtr FY97 (Critical Design Review (CDR). These reviews will cover the entire scope of the ATD and will serve as the decision points for the final requirements definition and risk mitigation.





* The FY95 effort explored options [under the Office of Naval Research (ONR) exploratory development (6.2) program] to further enhance the payoff of the ATD effort, such as providing additional operating frequencies.

Figure A-10. Submarine Phased Array Antenna Plan of Action & Milestones

A.5 PMW 173 RADIO ROOM EQUIPMENT PROGRAMS

A.5.1 Submarine LF/VLF VMEbus Receiver

The SLVR is intended to provide the next generation VLF/LF receiver that will be used in 688 and SEAWOLF class SSNs and TRIDENT SSBNs. The SLVR will meet environmental, noise, EMI/EMC, TEMPEST and other requirements of targeted platforms. BIT, BITE, Mean Corrective Maintenance Time for Operational Mission Failures (MCMTOMF), MTBOMF, operational availability, and other system requirements will also be addressed during SLVR development. The SLVR will be capable of receiving and processing all Navy, special, and NATO modes presently required, and will be easily adaptable and expandable to future requirements through the use of COTS hardware and GOTS software. SLVR is based on two commercial, open systems architectures: VMEbus and VXI. VXI is used for the RF portion of the receiver, with VMEbus used for the message processing, cryptographic and user interfaces. The all-COTS demodulator and processor hardware can be programmed, at a later date, for use in a multi-band receiving system. Anticipated SLVR P 3 Is are the inclusion of a COTS VXI-based MF/HF receiver and addition of an ELF capability to allow removal of the OR-279. Developmental Testing (DT) of SLVR is scheduled for early FY97 and a production version of the DT model receiver will form the basis for an VLF/LF IOC in FY99.

A.5.1.1 ELF Receiver (OR-279/BRR)

The ELF receiver group is currently installed on all TRIDENT SSBNs and is being installed, under SHIPALT A3125, on all 688-class SSNs. The OR-279/BRR is used with either the OE-315 floating wire antenna or the HSBCA. The ELF SHIPALT will be complete by FY95. The ELF band provides a one-way, low speed communications capability to submarines at speed and depth.

A.5.1.2 Minimum Essential Emergency Communications Network

This program identifies and develops improvements to Minimum Essential Emergency Communications Network (MEECN) for transmission of EAMs via tri-service VLF/LF transmission systems. The purpose of these improvements is to increase EAM delivery reliability and reduce delivery time while retaining interoperability between the various equipment of the services. Program efforts include developing new MEECN communications modes and improved signal processing techniques in response to evolving threats and technical advancements. The HIDAR will be operationally fielded in FY96.

A.5.1.3 VERDIN/Enhanced VERDIN System Receiver

VLF Digital Information Network (VERDIN) is a VLF/LF communications system that provides secure command and control communications to the strategic and tactical submarine forces and the airborne VLF relay aircraft (TACAMO). VERDIN is being upgraded in accordance with STANAG 5030 to provide U.S./NATO interoperability for SSNs. The Enhanced VERDIN System (EVS) is a VERDIN product improvement developed to provide increased performance, reliability, and maintainability; a capability to process JCS directed 1600 baud mode MEECN interoperability; automatic mode recognition; message compression; automatic recovery/restart capabilities, giant step, high speed run up; and improved operator features for performance monitoring and fault location. The program replaced existing VERDIN processors, and modified the VERDIN equipment with a field change to permit 1600 baud MEECN interoperability on strategic submarines and TACAMO aircraft. The VERDIN/EVS receiver (R-1738) noise reduction circuit (NRC) field change has been incorporated into the EVS. This mod improves receiver performance in atmospheric noise. The non-linear adaptive processor (NONAP) has been provided to increase operational flexibility for submarines by pre-detecting differences between the desired VLF signal and noise interference; thereby enabling reception of messages during severe interference.

A.5.1.4 Submarine Message Buffer

The SMB will provide a means of non-volatile message storage and message generation and processing in LOS ANGELES and SEAWOLF class submarine radio rooms. The SMB will replace obsolete and unsupported paper tape data storage, the AN/UGC-136CX SKP and generally improve radio room operability. The SMB utilizes COTS and GOTS hardware and software products providing an easy migration path to current state-of-the-art systems. The system will be capable of performing all message handling functions which include: (1) receive and transmit on four asynchronous channels simultaneously; (2) file manipulation capabilities via a COTS relational database which will provide powerful relational query capabilities, multiple levels of ordering of query results, and fast data retrieval in response to complex queries; (3) word processing functions such as composing, editing and validating preformatted messages via commercial and military editors; (4) mass storage; and (5) secure message distribution via a shipboard LAN which will be DMS compliant using X.400/X.500 protocol.

Additionally, SMB will provide a JMCIS compliant graphical user interface (GUI), an interface to the BBS INM, ZBO management, guard list management, message file splitting, message redundancy analysis, database purge, and RAM purge for security. SMB will also provide a subscriber to the Navy EHF Communications Controller (NECC) to access EHF and UHF packet switched information as part of the overall integration effort with the SCSS. SHIPALT 3748 is installing the SMB and is expected to be completed by FY97.

Future improvements to the SMB include: (1) porting of the SMB to a VME environment, (2) improved security features via compartmented mode workstations and a distributed MLS database, and (3) evolution to a mission critical system.

A.5.1.5 Time and Frequency Distribution System

The Time and Frequency Distribution System (TFDS) will provide precision time and frequency input required by equipment in communications, electronic warfare, periscope, navigation, combat, and ship control systems aboard attack and TRIDENT class submarines. The TFDS hardware will be an NDI. The TFDS will be capable of automatic or manual selection of inputs from cesium beam standards (O-1824/U or O-1695/U) or GPS. Using inputs from the selected external standard, TFDS will be capable of distributing up to 20 5-MHz square wave (SW), 5 1- MHz SW, 5 100-kHz SW, 5 1-ppm, 10 1-pps, 16 Binary-Coded Decimal (BCD) time code (TC), and 5 TF signals. The TFDS will be a modular system with no single point failure, and which can be expanded by adding additional modules.

A.5.1.6 SA 2626/BR Red/Black Isolation Switch

The SA-2626, being installed under SHIPALT SSN 3837, provides the capability to manually switch red and black baseband data to the Submarine Keyboard Printer (SKP), while ensuring the printer memory is cleared before shifting between red (un-encrypted) and black (encrypted) modes. The SA-2626 SHIPALT is applicable to all 688-class SSNs and required prior to several other SHIPALTs (SMB, SSN Air Force SATCOM System [SAFS], KY-766). It is scheduled to complete by FY97.

A.5.1.7 Baseband System

The BBS program will procure three sub-systems: (1) Packet switches; (2) Circuit switches; and (3) an INM providing automated technical control of both switch types and selected legacy equipment. There will be a NDI and COTS-based procurement which will automate submarine radio room assets, provide remote control switching operation, allow preset configurations for quick reaction times, and reduce needed rack space. The program will replace 11 different switches presently installed in the SSN 688 radio room with one black switching matrix and one red switching matrix. The present switching systems have insufficient throughput, capacity, flexibility, and operability to handle future radio room switching requirements.

During FY94 and FY95, PMW 173 investigated possible BBS architectures and technologies prior to a MS-III decision and contract award in FY96. The BBS program will investigate OSA, NDI switching systems and will evaluate potential switching technologies through a prototype on-board a SSN 688I class submarine. This prototype will evaluate: (1) the NECC, a Transmission Control/Internet Protocol (TCP/IP) packet switch; (2) a prototype circuit switch, based on a hybrid of a VMEbus circuit switch and a COTS matrix switch; and (3) a COTS-based, JMCIS compliant INM, executing technical control of the radio room via SNMP over an Ethernet (IEEE 802.3) LAN. Additional equipment being fielded includes the GFCP, R-2368 MF/HF receiver, and the SMB. This BBS prototype is being used to refine submarine BBS requirements, prior to the BBS Request for Proposal (RFP) and contract award, anticipated in FY96. The BBS prototype will also be used by Commander, Operational Test and Evaluation Force (COMOPTEVFOR) to conduct an Operational Assessment of the BBS system. The prototype systems and lessons learned will be made available as GFI during the BBS procurement.

A.5.1.8 Submarine LF/VLF Signal Recorder

An LF/VLF Wideband Signal Recorder is used by the Fleet Ballistic Missile (FBM) Communications Continuing Evaluation Program (FBM COMM CEP) to conduct special tests and to assist in failure analysis. The Test Director for this program is COMSUBLANT (N9) and Johns Hopkins University Applied Physics Laboratory (JHU/APL) is the evaluating agent. The FBM COMM CEP is used as an integral part of Navy's strategic communications monitoring, assessment, and reliability performance evaluation for the TRIDENT IRR. Therefore, the replacement TRIDENT IRR SCSS must contain an LF/VLF Wideband signal recorder.

An improved Submarine LF/VLF Signal Recorder is under consideration for both SSBNs and SSNs which will provide recorder and analyzer functionality. This improved Submarine LF/VLF Signal Recorder design will be based on a VMEbus hardware design and will be compatible with the SCSS radio room architecture design. An initial implementation alternative for this signal recorder will make it part of the SLVR program as a P 3 I initiative.

Capabilities this improved system could provide submarine operators include: recovery of EAMs lost through operator errors or temporary equipment outages; display of signals of interest and sources of interference, including EMI, for radio room operators with cues to permit optimization of receiving equipment; providing a mechanism for special test data collection; crew training using realistic recorded scenarios; and the ability to generate test signals for troubleshooting and maintenance of radio room RF equipment. This advanced recorder/analyzer system is undergoing prototype development testing at JHU/APL and is not yet funded or approved for fleet introduction.

A.5.1.9 TRIDENT Integrated Radio Room

The TRIDENT IRR, frozen in FY94 (with the exception of EHF LDR installations (TRIDENT IOC FY98 and multiple HIDAR receivers (IOC FY99)) at revision 5.3.1, will begin installation of a TRIDENT-variant of the SCSS ECS (TRIDENT ECS) in FY01, based on a TRIDENT ECS prototype fielded in FY99. During the BBS Phase, program and maintenance support for Revision 5.3.1 will be continued. To address the JCS DAMA mandate, PMW 173 will investigate options to provide DAMA capabilities to the TRIDENT IRR prior to the SARR Phase and the planned TRIDENT ECS installations. One potential option is installation of the TD-1271 multiplexer.

The TRIDENT IRR, Rev 5.3.1, configuration includes a total of 23 racks of equipment necessary for the configuration of radio circuits to satisfy strategic communications requirements. Operational functions, including system control, monitor, test and message processing, are computer-aided and are performed at two centrally-located display consoles of the IRR Control, Monitor and Test (CMT) Subsystem.

A.5.1.10 Circuit Mayflower

The Circuit Mayflower (Shipboard) System is installed on a variety of U.S. Navy ships to provide a one-way-ship-to-shore HF radio link. It consists of an AN/BRT-2 system which has a KY-766A Keyer, TS-3858 silent tuner, modified AN/URT-23, and AN/USM-488 oscilloscope. The modification of the existing KY-766/BRT-2 Keyer to the KY-766A/BRT-2 configuration, which began in September 1991, will be completed in FY96. This change modified the existing punched tape reader and associated electronics of the KY-766/BRT-2 and replaced it with a direct electrical interface from the AN/UGC-136CX teleprinter via the SA-2626/BR and black switch board.

A.6 OTHER SUBMARINE SHIPBOARD RADIO ROOM EQUIPMENT

A.6.1 Submarine High Date Rate Satellite Communications System

To satisfy the HDR requirements (see Appendix E), SPAWAR is developing an acquisition program to provide submarines with an HDR SATCOM system. The submarine HDR SATCOM system will provide high capacity communications capability in both the SHF and EHF bands. Using selected equipment in the HDR equipment group and the appropriate antenna configuration, the submarine will be able to transmit and receive voice, data, video, and imagery in multiple frequency bands using one HDR antenna group. Figure A-11 shows the relationship of the submarine HDR system to other elements of the EHF and SHF communications environment. Under the Submarine HDR SATCOM Program, a Joint Submarine Communications Program Office (PMW 173) and Satellite Communications Program Office (PMW 176) Integrated Products Team (IPT) will develop an SHF/EHF multiband antenna with sufficient gain to provide a minimum SHF data rate of 128 kbps and a minimum EHF MDR data rate of 64 kbps. The SHF/EHF multiband antenna design will permit future upgrades to attain the data rates that have been identified by the Fleet to meet future requirements (256 to 1544 kbps). A dual band (SHF/EHF) transceiver will also be developed. This antenna will be installed in all attack submarines (including potential SSGNs) and is under consideration for SSBNs.

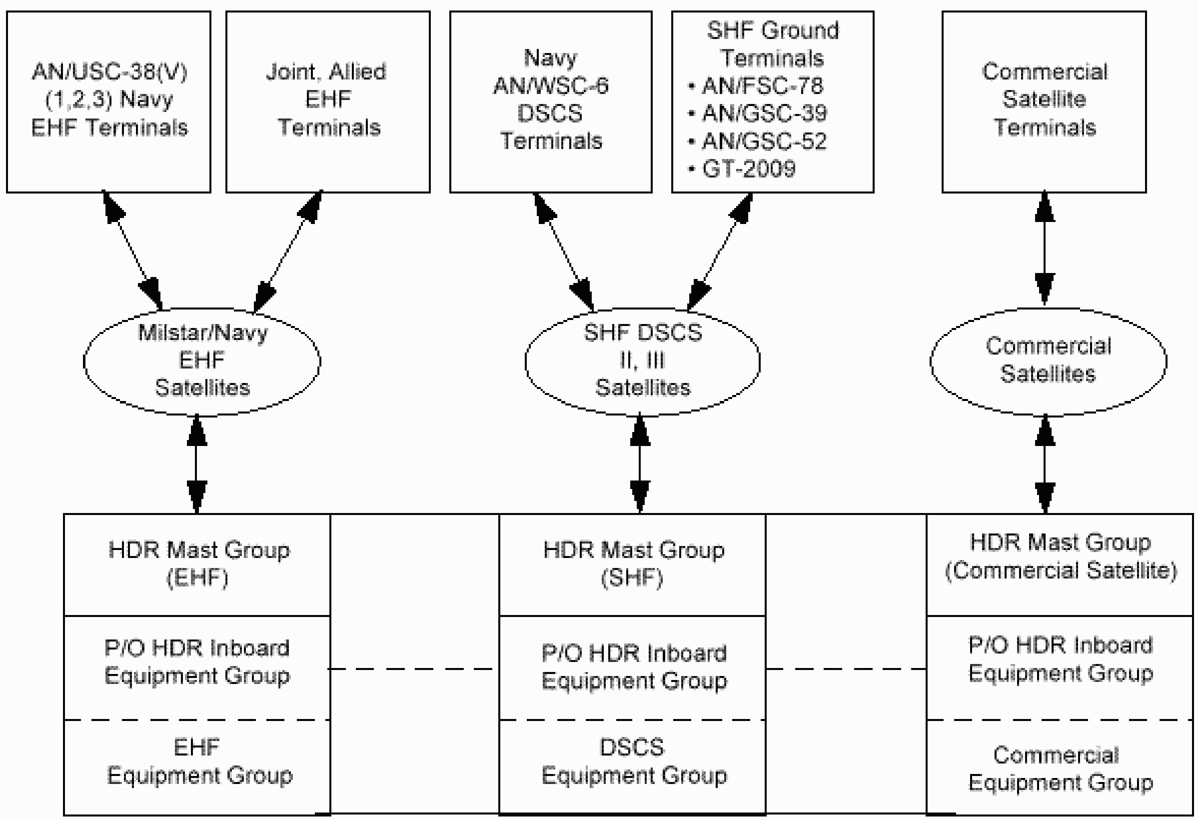


Figure A-11. Submarine High Data Rate Satellite Communications System Functional Relationships

A.6.2 Ultra High Frequency Satellite Communications

The primary submarine UHF SATCOM upgrades are: (1) Mini-DAMA; and (2) TRE/ Commander's Tactical Terminal (CTT). The DAMA time division multiple access (TDMA) protocol provides improved interoperability and much more efficient use of the UHF satellite RF spectrum. To achieve DAMA capability on SSNs as soon as possible, surface ship TD-1271 DAMA multiplexers have been and will continue to be installed (via TEMPALT) on deploying SSNs. The second upgrade to SSN UHF capability is the installation of the TADIXS B TRE/CTT, with IOC scheduled for FY96. Two TRE EDMs were installed during FY95 and are under evaluation.

UHF SATCOM shore site modifications are also being pursued which will allow the submarine force to continue to utilize the AN/BRT-6 Buoy once UHF Satellite has been fully upgraded to support DAMA. A non-DAMA satellite channel will be required to allow the AN/BRT-6 to remain functional into the next century.

In addition to Fleet Satellite (FLTSAT) UHF SATCOM, SSNs deployed to the polar region are outfitted with the SAFS as a TEMPALT. The satellites which support SAFS are expected to remain operational until approximately FY00. Beyond this timeframe, various SATCOM alternatives are being explored that will provide connectivity to submarines. Interim possibilities include an UHF Follow-On (UFO)/EHF (UFO/E) option.

A.6.3 Miniaturized Demand Assigned Multiple Access (AN/USC-42(V)1)

The Program Manager for Satellite Communications (PMW 176) is procuring the Mini-DAMA (AN/USC-42(V)1) communications set (MDCS), which will replace the TD-1271 multiplexers and AN/WSC-3 transceivers on submarines. In early FY95, PMW 176 re-directed the Mini-DAMA program to an OSA, based on the VMEbus standard (IEEE 1014). Beginning in FY96, two Mini-DAMA (AN/USC-42) EDMs will be evaluated on USS ALEXANDRIA (SSN 757).

Installation of production, OSA-based Mini-DAMA units will begin in FY96 and are scheduled to be complete during the SARR Phase. Starting with IOC in FY96, a two channel OSA-based Mini-DAMA capability will be installed on each SSN. Mini-DAMA will embed the protocol and interface functions for OTCIXS II (DAMA OTCIXS), UHF SATCOM Advanced Narrowband Digital Voice Terminal (ANDVT), and VINSON. It will also support three embedded communications security (COMSEC) functions: (1) an IXS COMSEC, implementing an embedded KG-84A for Mini-DAMA OTCIXS II data; (2) a Voice COMSEC, implementing KYV-5 and KY-58 COMSEC for the embedded VOCODER; and (3) a Data COMSEC, implementing KG-84A, KYV-5, and KY-58 data COMSEC functions. The Voice COMSEC can also be configured by the operator as a second KG-84A. Both the Voice and Data COMSEC functions are accessible via external RED I/O ports. The Mini-DAMA Voice and Data COMSEC functions enhance submarine throughput by supplying additional, general-purpose cryptographic devices (KG-84A).

An additional PMW 176 program, the GFCP II, will embed the functions of the ON-143(V)6, including TADIXS A, non-DAMA Officer-in-Tactical Command Information Exchange System (OTCIXS), and SSIXS. These embedded functions will replace existing legacy equipment. On an SSN, the combined embedded functions of Mini-DAMA and one GFCP-II are equivalent to: two KY-58s, two AN/WSC-3s, four TD-1271s and two ON-143(V)6s. The installation of this modern, OSA-based equipment is an important milestone in the transition of the hybrid SCSS. Installation of two channel Mini-DAMA (or equivalent) capability on TRIDENT is currently planned to be deferred until installation of the TRIDENT SCSS ECS, scheduled for IOC in FY01 (FOC in FY06). To address the JCS DAMA mandate, PMW 173 will investigate options to provide DAMA capabilities to the TRIDENT IRR prior to the SARR Phase (FY99).

A.6.4 Tactical Receive Equipment/Commander's Tactical Terminal (CTT) The TRE receives, decrypts, filters, formats, and transfers incoming Tactical Related Applications (TRAP) Data Dissemination System (TDDS) and TADIXS B data to various local baseband tactical data processors (TDPs) and printers for final processing. In addition to TDDS and TADIXS B, the CTT Hybrid Receiver (CTT H/R) also receives and processes the Tactical Information Broadcast Service (TIBS); a follow-on to the CTT (CTT H/3) provides a TIBS transmit capability. TDDS, TADIXS B, and TIBS are UHF SATCOM broadcasts designed to meet the requirements for delivering time-critical national and theater-derived sensor information to operational users deployed worldwide (e.g., Over-the-Horizon Targeting (OTH-T)/ TOMAHAWK weapon target changes). TRE EDMs, fabricated and tested by NRaD San Diego, are currently fielded, and are cross-decked to support operational requirements. Production TRE terminals are currently in First Article Testing, with planned deliveries starting in FY96. To comply with Congressional and DOD Inspector General (IG) direction, the Navy is procuring some CTTs, as a follow-on to the Production TRE, while the services migrate to a Joint tactical intelligence receiver, the Joint Tactical Terminal (JTT), planned for FY98 and beyond.

A.6.5 Generic Front-End Control Processor

PMW 176 is procuring the GFCP, which replaced the SIU on 688 class SSNs and provides the interface between SCSS, the CCS, and the JMCIS TAC-3/4. The GFCP, based on the OSA VMEbus standard (IEEE 1014), supports flexible I/O control and protocol conversion between Interface Design Specifications (IDS) 8648 and IDS 8649. GFCP IOC occurred in FY94 and GFCP is an element of the CY95 SCSS Prototype. As a funded P 3 I, GFCP II (ON-143(V)14) will host several functions of the ON-143 (V)6, including TADIXS A and OTCIXS. The inclusion of SSIXS capability is a PMW 176 goal and would allow removal of the legacy, closed system ON-143(V)6 units. GFCP II IOC is anticipated in FY96. GFCP capabilities are not currently required nor planned for TRIDENT ECS.

A.6.6 Navy EHF SATCOM Program AN/USC-38(V)

The NESP will provide the following communication capabilities : joint interoperability, robust anti-jam communication, low probability detection/interception, near global coverage, and enhanced data rates when compared to existing UHF satellite communication systems. The Navy EHF satellite system is comprised of two Fleet Satellites (FLTSAT 7 & 8) and will be augmented by the Navy UFO satellites which will have EHF packages. Navy UFO satellites began launching in December 1994 and will consist of a six satellite constellation when completed. Additionally, the joint service Milstar satellite communication program will be EHF capable when fielded and will be the primary EHF connectivity link for all the services. The Submarine force is an integral part of the overall Navy EHF SATCOM Program with 45 NESP shipboard terminals, AN/USC-38(V), already procured for SSN/SSBN use by N6/PMW 176. Until the submarine High Data Rate antennas are delivered, Type 8 Mod 3 periscopes are being modified with antennas to receive the EHF radio signal. Present EHF shipboard terminals are LDR capable, upgradable to MDR. Submarine EHF system testing to date has successfully demonstrated secure voice and secure data transfers. When fully fielded, the EHF satellite program will provide a robust, covert, high throughput tactical and strategic communication capability.

A.6.7 High Frequency Receiver/Transmitter Upgrades

Current R-1051 (SSN) and R-2108 (TRIDENT) HF Shipboard receivers are scheduled to be replaced by R-2368A MF/HF shipboard receivers. The R-2368A also replaces the WRR-3 MF receiver. No near-term replacement for the aging, legacy URT-23D HF transmitter has been identified for submarines. The Navy HFRG and HF modernization program will be tracked to ensure submarine requirements are supported. The IOC for HF modernization on destroyer-sized combatants and smaller, and submarines, is planned for FY99. As a follow-on to HFRG for modernization of HF radio suites on ships not scheduled to receive broadband HF Radio Groups, the Navy is evaluating NDI, OSA based HF radio architectures for ships of all sizes.

This will include capabilities of high data rate HF (4800 bps and higher), Automatic Link Establishment (ALE), HF e-mail and IP routing (i.e., the HF Channel Access Protocol [CAP] for CSS), and rapid circuit set up and quick tuning. All ship classes traveling in a Battle Group will be considered in the requirements. NDI, OSA-based HF transceivers and transmitters will be investigated as part of the SCSS Prototyping efforts. As new HF equipment is fielded, the function of legacy interface equipment, such as the URA-17, will be embedded and the legacy equipment removed.

A.6.8 Maritime Cellular Information Exchange System

MCIXS, also described as Battle Group Cellular, uses COTS cellular telephony components to support non-mission critical line-of-sight communications. MCIXS will be based on cellular base stations, installed on the flagships of Battle Group Commanders, Amphibious Ready Groups, and Fleet Commanders, and interfaced to a ship’s or submarine’s ECS, via a small remote unit. This remote unit allows any desktop phone, fax, or modem to use the cellular channels. COTS cellular telephones may also be used with the MCIXS. The MCIXS ORD is being staffed for approval and includes MCIXS requirements for SSNs. PMW 173 will coordinate with the MCIXS program to ensure that the SCSS ECS and SSN antennas can support full cellular interoperability.

A.6.9 Improved Link-11

The Link-11 Improvement Program (LEIP) is designed to improve existing Link-11 high speed computer-to-computer digital radio communications in the HF and UHF bands among NTDS equipped ships, submarines, aircraft, and shore sites.

The LEIP is made up of three efforts: near term improvements to existing Link-11; U.S. participation in the NATO Improved Link-11 (NILE) R & D program; and a U. S. companion production program to the NILE research and development program, identified as Enhanced Link-16 (EL-16). The near term program consists of: training initiatives; the development of a low cost; light-weight, stand-alone Link-11 Display System (LEDS) for non-TDS units; software upgrades to existing Link-11 Data Terminal Sets (DTS); the development of a Mobile Universal Link-11 Translator System (MULTS); the acquisition of an NDI Link-11 DTS to replace old units that are failing at an increasing rate; and the development of an Inter-American Naval Conference (IANC) data link for operations with South American Navies. The NILE program will produce a production specification and a reference system (testbed) against which each nation’s privately developed Improved Link-11 system can be tested and certified. The companion U.S. program is designed to take the NILE specifications into a competitive procurement. Of these efforts, only the NILE development and the U. S. companion effort continue in R&D beyond FY93.

A.6.10 VHF Special Operation Forces Communications

The purpose of VHF communications is to increase interoperability with SOF. Although HF and UHF communications are used in the different aspects of SOF missions, two way VHF communications is the method of choice for the insertion and recovery of SOF forces via the submarine. The VHF frequency range is attractive because significant transmission distances can be attained with minimal output power. In many insertion and recovery scenarios, the SOF forces are located in hostile areas where active transmissions of significant power could allow the enemy to determine the location of the SOF and lead to its capture. To complement the inherent benefits of VHF communications (significant transmission distances for minimal output power), some existing hand held VHF transceivers used by the SOF forces implement frequency hopping algorithms to further prevent Directional Finding (DF).

In current SOF operations involving communications with submarines, carry-on VHF transceivers, compatible with the hand held SOF radios, are brought onto the submarine and temporarily installed in either the control room or the radio room by the SOF forces since submarine radio rooms do not have VHF transceivers. The radio antenna used for SOF VHF communications aboard submarines is the Type 18 Periscope Sleeve Antenna. There is currently no plan to procure or install VHF transceiver radio equipment on submarines as a permanent part of the SCSS. The program plan is to design and install a standard set of radio room interfaces on all SSN submarines which will allow interoperability with the carry-on SOF radio equipment. Additionally, NUWC New London is exploring better VHF antenna assets for the submarine in order to allow better performance than the Type 18 Periscope Sleeve antenna in the VHF frequency range.

A.6.11 CONTROLLERS, PERIPHERALS, AND INTERFACES

A summary of planned developments for peripherals and other equipment is shown in Figure A-12.

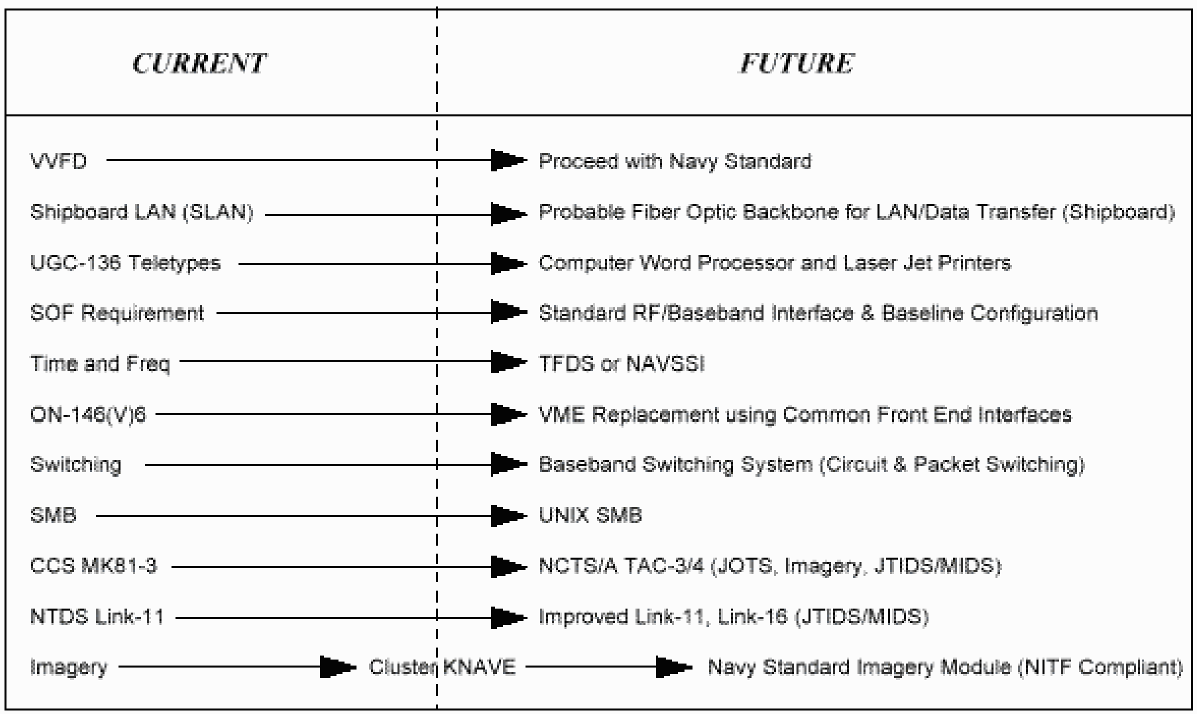


Figure A-12. Peripheral and Other Equipment

A.6.11.1 Submarine Keyboard Printer (SKP - AN/UGC-136CX)

The AN/UGC-136CX upgrades the existing SKP (AN/UGC-AX) and provides a single line LED display, larger buffer memory size, improved editing software, and automatic alphabet conversion (for NATO VLF broadcast reception). The UGC-136CX also provides an additional I/O interface port, which is used to connect the SMB to radio room traffic. The UGC-136CX field change is underway for all 688 and TRIDENT class submarines and will be completed in FY95. New construction submarines (688, SSN 21, and TRIDENT) will receive UGC-136CX during construction.

A.6.11.2 Navy Standard Teleprinter

The Navy Standard Teleprinter (NST) program started in October 1989 to replace outdated and insupportable Model 28 teletypes throughout the Fleet. The NST greatly enhances past generation teleprinter capability with higher speed, greater storage, better reliability, and easier maintenance. The procurement of NST teletypes has been completed and OPNAV (N61) is addressing requirements for the follow-on generation of NSTs. Navy-wide feedback to date for future teleprinter requirements are that computer word-processors and commercial printers will satisfy all future needed capabilities. The program plan for submarine teleprinters is to transition to these future capabilities from present UGC-136 series teleprinters.

A.6.11.3 Navy Tactical Command System - Afloat

Although not a radio room system, NTCS-A will be a primary user of the radio room information streams and is an important system with which the SCSS must interface. Procured by PD 70, the purpose of the NTCS-A is to provide a single, integrated Joint Command, Control, and Intelligence system for all Navy platforms. NTCS-A supports all levels of command, from each ship’s Commanding Officer/Tactical Action Officer to the Joint Component Naval Commander to the Joint Task Force Commander. NTCS-A is transitioning to become a subset of the JMCIS Common Operating Environment.

The NTCS-A program makes use of NDI hardware, i.e., the TAC-X workstation, as the standard computer engine and COTS/GOTS software whenever feasible as the software engine. Program plans for NTCS-A call for a Unified Build software release with modules capable of providing: intelligence processing, imagery processing and display, an Afloat Correlation System (ACS), access to the Naval Warfare Tactical Data Base, Automatic Electronic Intelligence, access and display of Tailored Environmental Support System (TESS) data, automatic access and display of Naval Tactical Display System (NTDS) information and various Warfare area specific tactical decisions aids.

Fleet installations of fully capable submarine NTCS-A systems begin in FY94 on CCS Mk1 platforms. The submarine NTCS-A program will provide operators with contact track database management functions on a TAC-3 computer workstation and will run with the Submarine Force Mission Program Library (SFMPL). Both of these programs will be integrated for use with the submarine Fire Control System (FCS). Interfaces for the radio communication circuits needed to provide information for the submarine NTCS-A program will be provided through a GFCP designed and tested by NUWC. Submarine NTCS-A planned upgrades will provide 2-way Link-11, a SSIXS interface, and other capabilities on CCS Mk2 platforms. Future submarine NTCS-A capabilities such as imagery processing on the TAC-3 are in the evaluation and planning stages. Applicable, tailored portions of the Fleet NTCS-A program will be continually assessed for use by the submarine NTCS-A program based on fleet requirements.

A.6.11.4 Joint Tactical Information Distribution System

JTIDS is an advanced information distribution system that provides secure, integrated communications, navigation, and identification (ICNI) capabilities for application to military tactical users of all the services. JTIDS can be employed in most types of aircraft and surface ships using either Class 1 terminals for large-scale airborne and surface command platforms or Class 2 terminals for small, mobile, platforms.

JTIDS operates in the radio Air Navigation "L" frequency band and employs a TDMA technique with a spread spectrum-frequency hopping waveform. JTIDS distributes encrypted information at high rates with sufficient jam resistance to yield high reliability communications in a hostile electromagnetic environment. The system has two navigation features: the TACAN function and an integral position-location capability within a common reference grid. JTIDS has the capability, through the secure dissemination of position information, to provide velocity and identity data on both friendly and hostile force elements.

Historically, the terms JTIDS and Link-16 have often been used interchangeably, since the JTIDS terminal is the principle component of Link-16. The Navy will initially be the principal user of Link-16, using it to replace less capable Link-11 (TADIL-A) and Link-4A (TADIL-C) data link systems.

A.6.11.5 Navy EHF Satellite Communications Controller

The NECC is one of the implementing programs of the CSS Architecture. The goal of the NECC program is to provide communication services for the TDP users over the new EHF SATCOM radios being implemented by the NESP. The NECC consists of a set of hardware and software elements that will be implemented in two “Builds”. Build 1 is the development phase and Build 2 is full scale production. Build 1 will provide the basic communication services to support the IOC for the NESP terminals. The NECC will perform its mission by supplying communications services to the users via a set of communications resources.

A.6.12 Cryptographic Devices and COMSEC Management System

A summary of planned cryptographic equipment improvements is shown in Figure A-13.

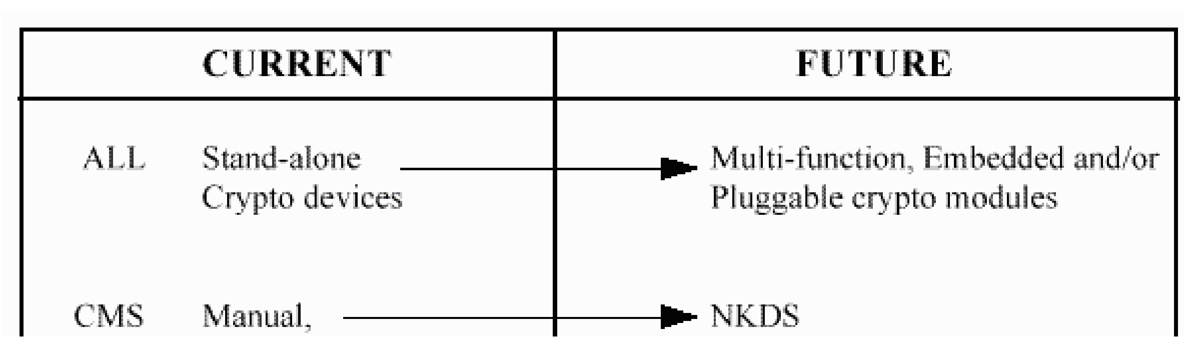
A.6.12.1 Navy Key Distribution System

The purpose of the Navy Key Distribution System (NKDS) is to: reduce the quantity of paper used in the Navy COMSEC Material System (CMS); reduce the administrative workload performed by Fleet CMS Custodians and Users; and reduce the security vulnerabilities of the present CMS system. The NKDS fielding plan will be implemented during two phases and will include: STU-III telephone, Local Management Device (LMD), Key Processor (KP), Data Transport Device (DTD), Printer, Bar Code Device, KG-84C, and ANDVT.

Phase I will be implemented during FY94 and will provide administrative reporting capability to the Director COMSEC Material System (DCMS) for destruction, accounting, and DCMS bulletin board access. During this phase, only a STU-III telephone and an LMD (PC variant) will be required.

Phase II will commence in FY97 and will allow the transfer of large quantities key material via the STU-III telephone and LMD into the on-board Key Processor. On a case by case basis, the system will allow Over-the-Air-Rekeying (OTAR) for an individual system key using the KG-84C or ANDVT equipment. Figure A-14 is a block diagram of the NKDS Phase II implementation.

The Submarine Force is participating fully in the NKDS program for both SSBNs and SSNs. NSA and the Navy staff are examining backup alternatives that can be used by Navy platforms to carry crypto key variables.



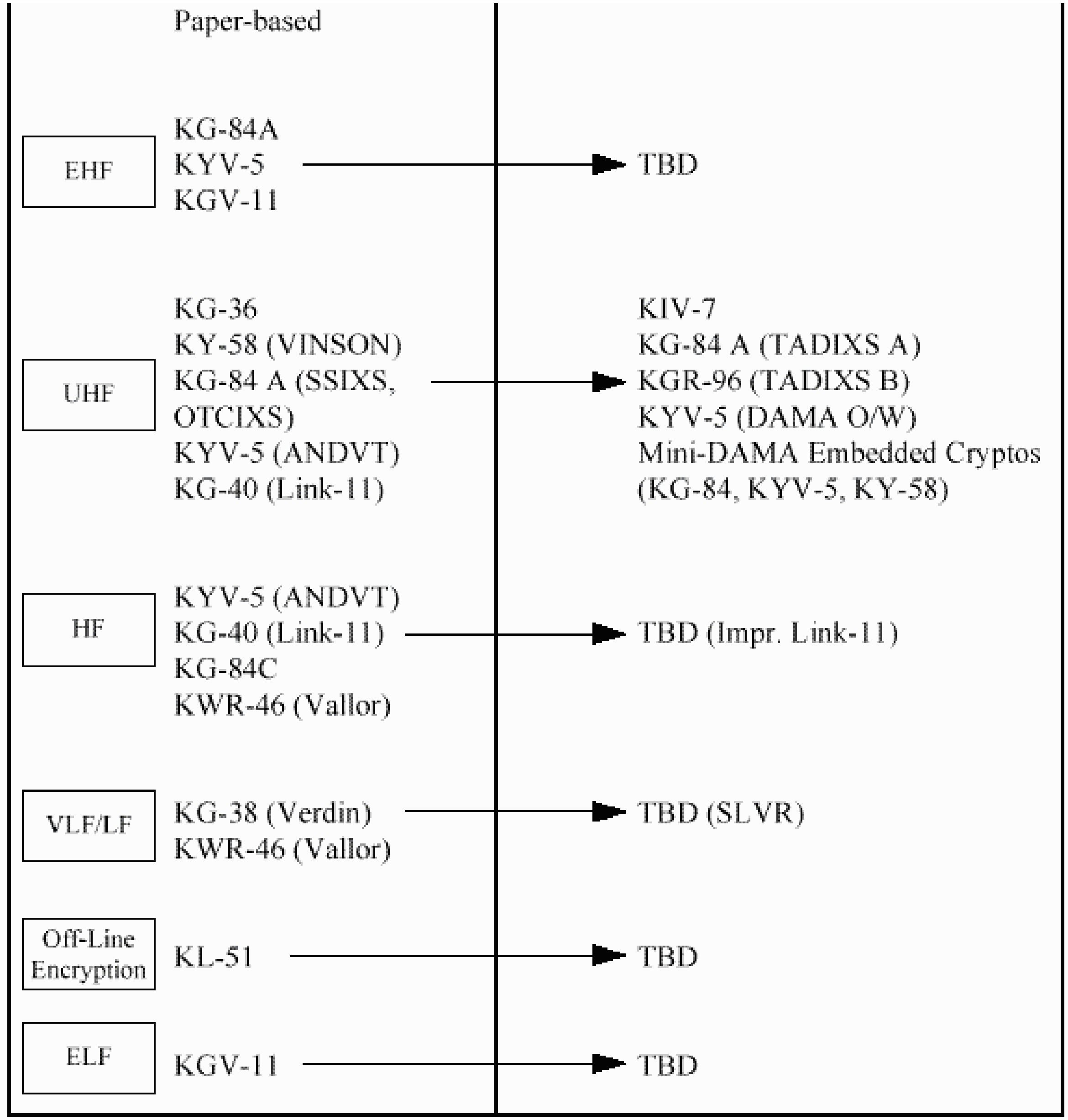


Figure A-13. Cryptographic Equipment

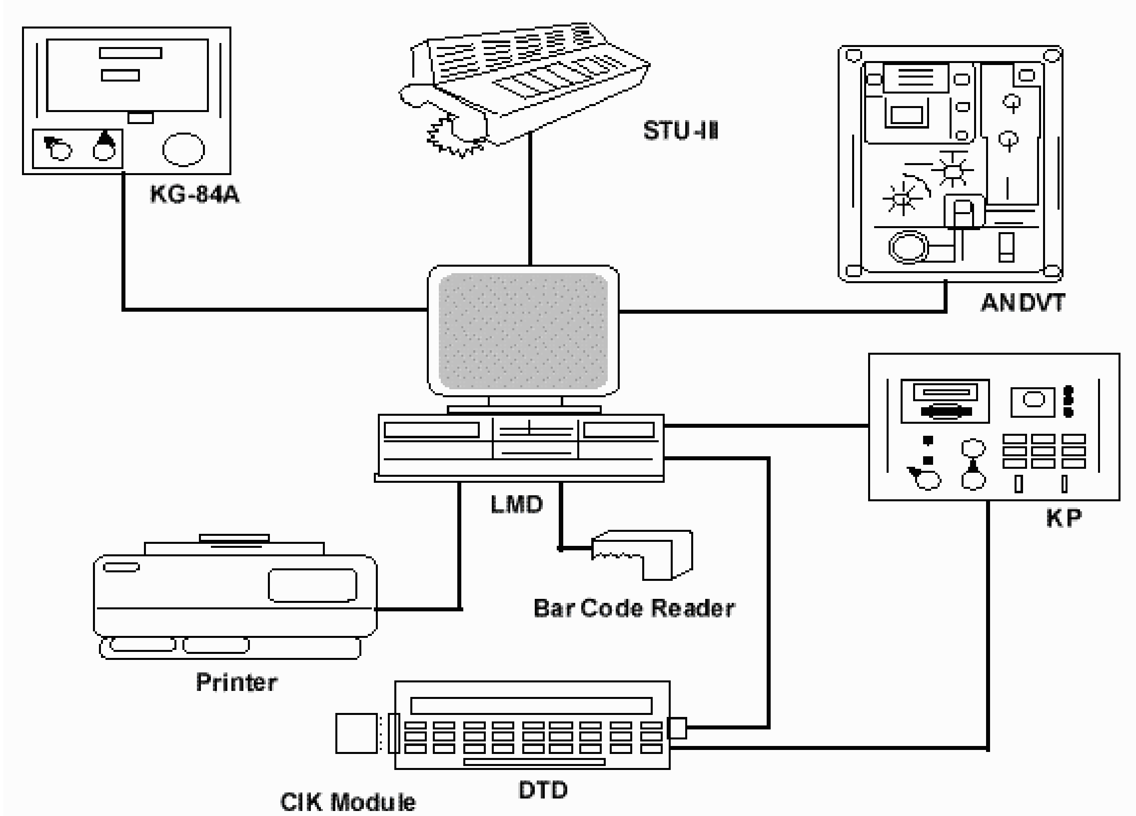


Figure A-14. NKDS Phase II Implementation Configuration

A.6.13 Submarine Imagery

The only operational submarine-based imagery system in use by the fleet today is the Cluster Knave imagery system developed by the Office of Naval Intelligence. It is used by submarines during tactical deployments and development of special tactical applications. Cluster Knave is a Macintosh-based image capture and processing system which uses the ANDVT for data transmission via low gain, limited RF bandwidth, noisy communication channels while minimizing transmission times. As part of the program plan, NUWC New London is working to port existing Cluster Knave system capabilities into the TAC-3 computer workstation. Future plans are to produce a unit that can communicate directly with Unified Build imagery module or the Joint Deployable Intelligence Support System (JDISS).

A.6.14 Submarine Local Area Network

A Submarine LAN will be an additional system with which the SCSS must interface. NAVSEA intends to implement shipboard LANs under the Integrated Interior Communications and Control ((IC)2) and SNAP programs. The SCSS must be able to interface with this ship-wide LAN. In a NAVSEA letter (Ser PMS335/7899 dated 14 July 1993), Standard NTCSS-C4I Local Area Network Backbone Architecture, PMS 335 and PMW 164 defined an implementation plan for shipboard command and control systems. Although this architecture does not include combat and weapons system requirements, it will be used for command and control systems to which the SCSS must interface. The joint NAVSEA/SPAWAR implementation plan calls for installation of a multi-mode fiber based LAN, using the Ethernet (IEEE 802.3) data link layer protocols and redundant, commercial-grade fiber cabling. Separate classified and unclassified LANs will be installed; Top Secret and SCI data will not be supported. This architecture provides an immediate capability (10 Mbps) with a defined growth path to Fiber-Optic Distributed Data Interface (FDDI) and ATM as requirements for these higher data rate services emerge. The SCSS will support, as a minimum requirement, the ability to interface to this C2 LAN, and use of this LAN for intra-SCSS data flows will be evaluated. During the SCSS Prototype, a shipboard LAN and possible security products will be evaluated.

A.7 SUBMARINE COMMUNICATIONS EXPLORATORY DEVELOPMENT PROGRAM

The following exploratory development submarine C 4 I research efforts are either in progress or planned.

A.7.1 Advanced Research Projects Agency Funded Research

A.7.1.1 Advanced Technologies for Submarines Operating in the Littoral

The Naval Undersea Warfare Center Division Newport (NUWC DIV NPT) and the JHU/APL are working with the Advanced Research Projects Agency (ARPA) on Advanced Technologies for Submarines Operations in the Littoral (ATSOL). This program was established to identify technologies that would support submarine littoral operations. The time frame for these technologies investigations is circa 2015. A major part of the ATSOL program focuses on identifying and developing advanced technology communication systems for submarine surface operations in the littoral. To address the ATSOL program, the communications team is performing the following:

- Considering antenna technologies determined to be high risk (including the evaluation of currently targeted technologies for higher performance);
- Performing a broad sweep of industry to solicit innovative ideas (given the more ambitious goals);
- Researching commercial communications trends;
- Exploring multifunctionality (e.g., shared apertures for communications, electronic support measures (ESM), radar, and imaging);
- Providing a high priority to signature control;
- Investigating integration of the antennas into the ATSOL sail; and
- Unmanned Aerial Vehicle (UAV) connectivity to submarines.

A.7.1.2 Unmanned Aerial Vehicle

During FY96 a demonstration will be conducted to show interoperability and connectivity between a UAV (Predator) and a SSN 688 class submarine. For this demonstration, a C-band data link will be used between the UAV and the SSN 688 submarine using an antenna (Flat Top Array and Horn Array) placed on top of the AN/BRD-7 mast. The ability to establish a video link and control the flight pattern of all UAV by the submarine will be shown. Potential follow-on UAV to submarine connectivity demonstrations being planned include evaluations using UHF and Ku-band links of the radio frequency spectrum.

A.7.2 Exploratory Development (6.2)

The Submarine Communications Exploratory Development Program is managed by the Submarine Electromagnetic Systems Department (Code 34) of the NUWC under sponsorship of the Office of Naval Research, Science and Technology Directorate (ONR-ST Code 313). The Submarine Communications Program is organized into two thrusts to support the requirements in the Post-Soviet era: 1) provide robust, high data rate interoperable submarine communications in all operational areas (Joint Interoperable High Data Rate Communications); and 2) improve downlink communications at speed and depth (Communications at Speed and Depth).

The first thrust, Joint Interoperable High Data Rate Communications, includes the research in submarine communications architectures to permit the submarine to participate in Navy and Joint forces networks. It also provides a focus for the development and improvement of submarine antennas which are needed to support this participation for the transfer of data at rates that exceed the capabilities of existing submarine communications systems. This is an area of increased emphasis.

The second thrust, Communications at Speed and Depth, includes the research needed to improve antennas and systems that permit the transfer of information to submarines operating in their speed/depth envelope below periscope depths. As a minimum, a one-way call-up system is needed. Research is also supported to increase the data rate capability of low profile antennas used to reach the surface from depth such as buoyant cable antennas. Emphasis on Arctic Communications has been curtailed by terminating research in this area at the end of FY93.

For FY96 there are four projects within the Submarine Communications Exploratory Development Program. These are:

- Low-Profile Submarine Communications Antenna,
- Open Architecture for Submarine Communications Networks,
- Submarine SHF Communications, and
- Submarine ELF Communications.

A.7.2.1 Low-Profile Submarine Communications Antenna

The Low Profile Submarine Communications Antenna Project addresses two of the four general requirements for future submarine communications that were identified jointly by SUBLANT and SUBPAC. These two requirements are: a) communications interoperability with the Joint Task Force, and b) covert receipt of continuous record traffic. These requirements stem from current restrictions in timeliness and data throughput of current communications available at speed and depth. Certain modes of operation are currently not available, such as extended transmission capability to a Task Force from a submarine at depth.

The objective of this project is to develop sustained 2-way UHF SATCOM capability for a submarine at depth and to explore HF transmit capability while at depth. This project will develop the appropriate antenna for UHF operation and will explore higher efficiency HF antennas. As the feasibility of a capable HF-UHF antenna module for a buoyant cable antenna (BCA) system becomes established, the implementation of accessory antenna functions, to support early warning, GPS and cellular telephony, will be investigated. This project will also develop the transmission line techniques to support the additional antennas, since the current BCA leader cannot support UHF, and is very inefficient at HF. Planned future work will include evaluation of techniques for higher frequency SATCOM operation and alternative antenna configurations.

A.7.2.2 Open Architecture for SUBCOMMS Networks

The Open Architecture for SUBCOMMS Project addresses the open systems radio room and communications network interoperability requirements for submarines. The objective of this project is to use an open systems architecture radio room that incorporates COTS/GOTS and other NDI products to the maximum extent possible and to develop techniques that will maximize the submarine's interoperability with communication networks. Investigations of this project include the study of frame relay techniques (i.e., ATM, SONET) and network performance assessments.

A.7.2.3 Submarine SHF Communications

The primary objective of this project is to identify and establish the feasibility of the technologies that will allow implementation of HDR SATCOM with the submarine at periscope depth.

A secondary objective of this project is to identify and implement an open systems approach to submarine phased array communications antenna systems that allows the collocation of additional electromagnetic capabilities such as ESM, radar, electronic countermeasures (ECM), and millimeter wave imaging within the same aperture. A companion objective is to investigate the feasibility of an integrated, communications-based "front end" electronics suite that can support the additional, electromagnetic capabilities. This objective would accommodate considerations of common processing and integrated platform data distribution.

A.7.2.4 Submarine ELF Communications

The Communications at Speed and Depth Project addresses two of the four general requirements for future submarine communications that were identified jointly by

SUBLANT and SUBPAC. These two requirements are: a) communications interoperability with the Joint Task Force; and b) covert receipt of continuous record traffic.

A second objective of this project is to develop the technology needed to demonstrate the feasibility of a hull-mounted ELF antenna with steerable beam pattern, capable of surviving maximum submarine speeds and depths and capable of providing reception down at several hundred feet at operational speeds.

APPENDIX B
SUBMARINE COMMUNICATIONS SHORE INFRASTRUCTURE
B.1 SHORE COMMUNICATIONS INFRASTRUCTURE

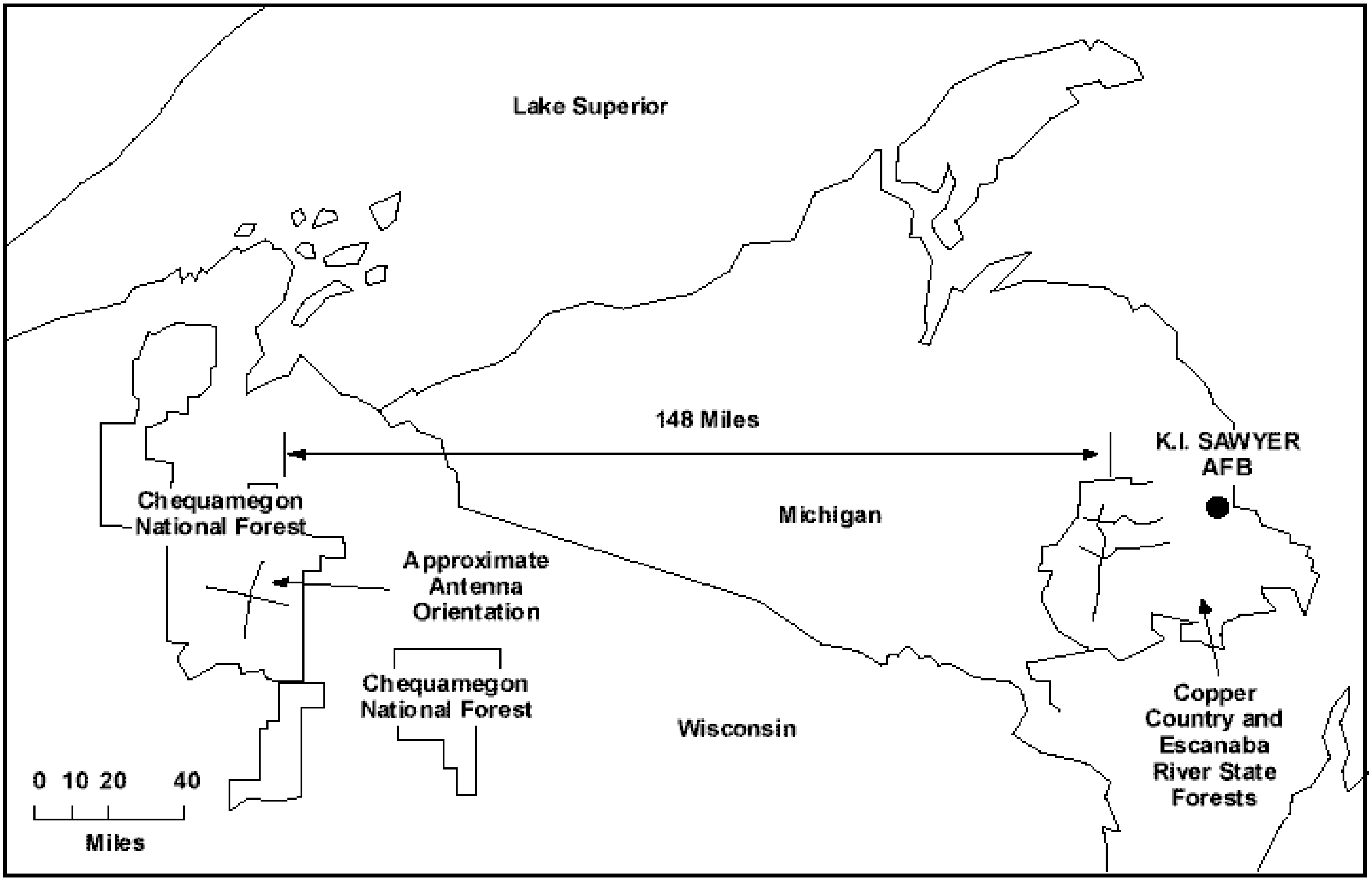
The following sections describe current and potential new programs to modernize and cost effectively operate submarine shore communication assets.

B.2 SUBMARINE SHORE COMMUNICATION INFRASTRUCTURE

The submarine communications system is an end-to-end system with connectivity established between the submarine shipboard SCSS node and the submarine shore site communication facilities node. The submarine shore communication facilities are located worldwide and consist of ELF, VLF, LF, HF, and SSIXS/ OTCIXS shore sites. In the future, submarine HDR Communications using EHF, SHF, and Commercial satellite RF resources will become an integral part of the submarine shore C 4 I infrastructure. Using all shore site assets, submarine command and control connectivity is assured. Submarine shore site facilities have the capability to be either transmitters, receivers, or both depending on their function and use within the radio frequency spectrum. The following procurement and operation/maintenance efforts support this infrastructure:

B.2.1 Extremely Low Frequency

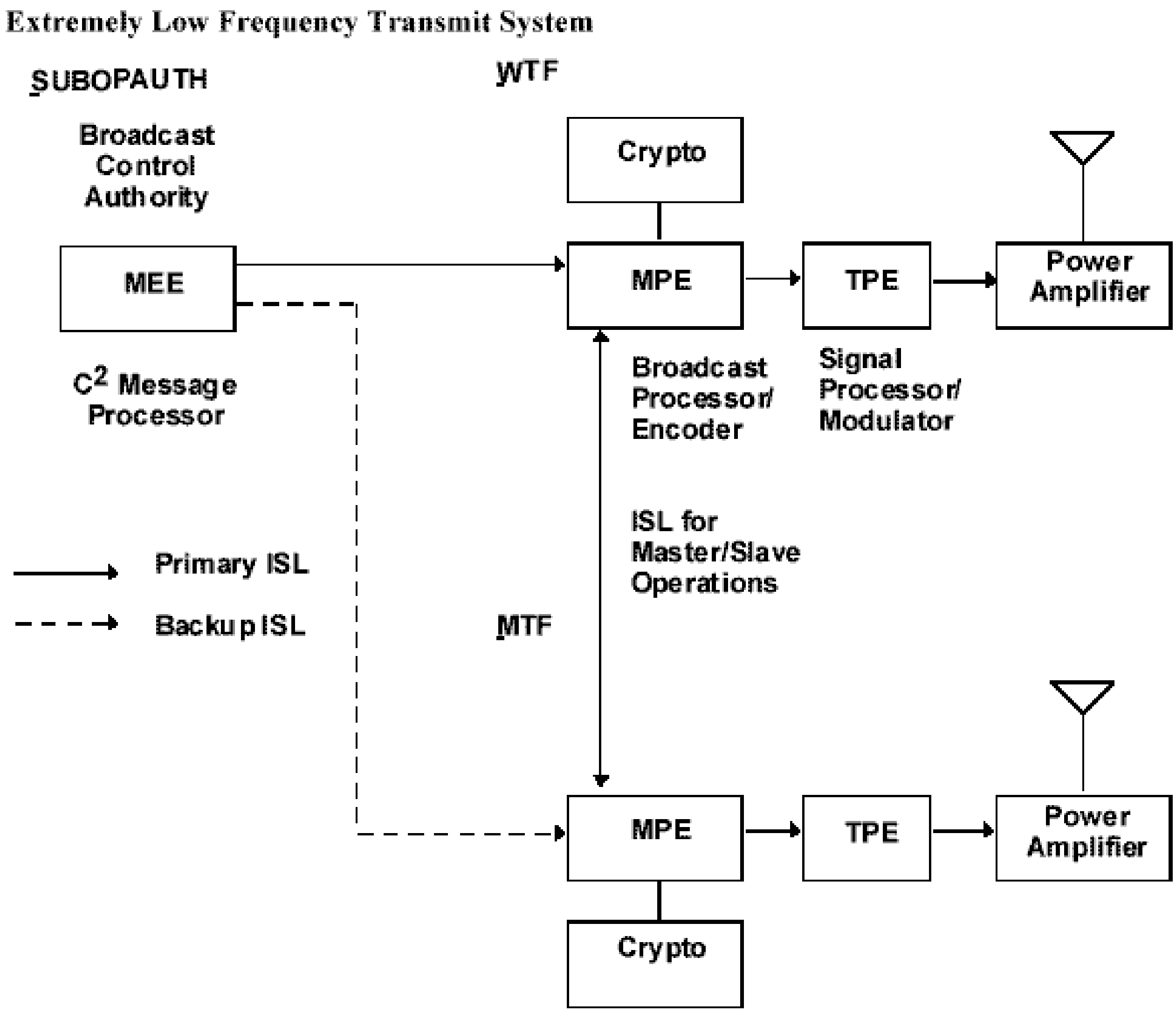
The ELF communications system consists of two high power shore transmitter stations controlled by a submarine BCA. The two ELF transmitter facilities are located at Clam Lake, Wisconsin and Republic, Michigan. The location of these transmitter facilities are illustrated in Figure B-1.



Extremely Low Frequency Transmitter Facilities

This unique communication system is designed to transmit short alerting messages to submarines operating far below the ocean surface. The ELF frequencies used, in the 40–80 Hz range, were selected for their long range signal propagation (i.e., global) and ability to penetrate seawater to depths several hundred feet below the surface. In addition to the inherent covertness this communication system provides, it also provides the submarine Commanding Officer with operational flexibility to remain at required mission depth and speed. The ELF communication system is used as a “bellringer” to notify the submarine crew to come shallow to copy a higher data rate broadcast (e.g., SSIXS). At present, POM funding is provided for two site ELF operation.

COMSUBLANT in Norfolk, Virginia and COMSUBPAC in Pearl Harbor, Hawaii alternate as the ELF BCA. The BCA injects messages generated by the Submarine Operating Authorities (SUBOPAUTHs) into the ELF system via the C 2 processor known as the Message Entry Operator Terminal (MEOT). These messages are relayed to the transmit sites by dedicated communication links, usually leased telephone lines, called intersite links (ISLs). At each transmitter site, the messages received over the ISLs are decrypted and input into the Message Processing Element (MPE). The MPE develops the ELF broadcast by encoding, queuing, and encrypting the messages to be transmitted. The Transmit Processor Element (TPE) produces the drive signals for the power amplifier and antenna. A simplified block diagram of the ELF transmit system is shown in Figure B-2.



B.2.2 Extremely Low Frequency Biological/Ecological Monitoring and Interference Mitigation

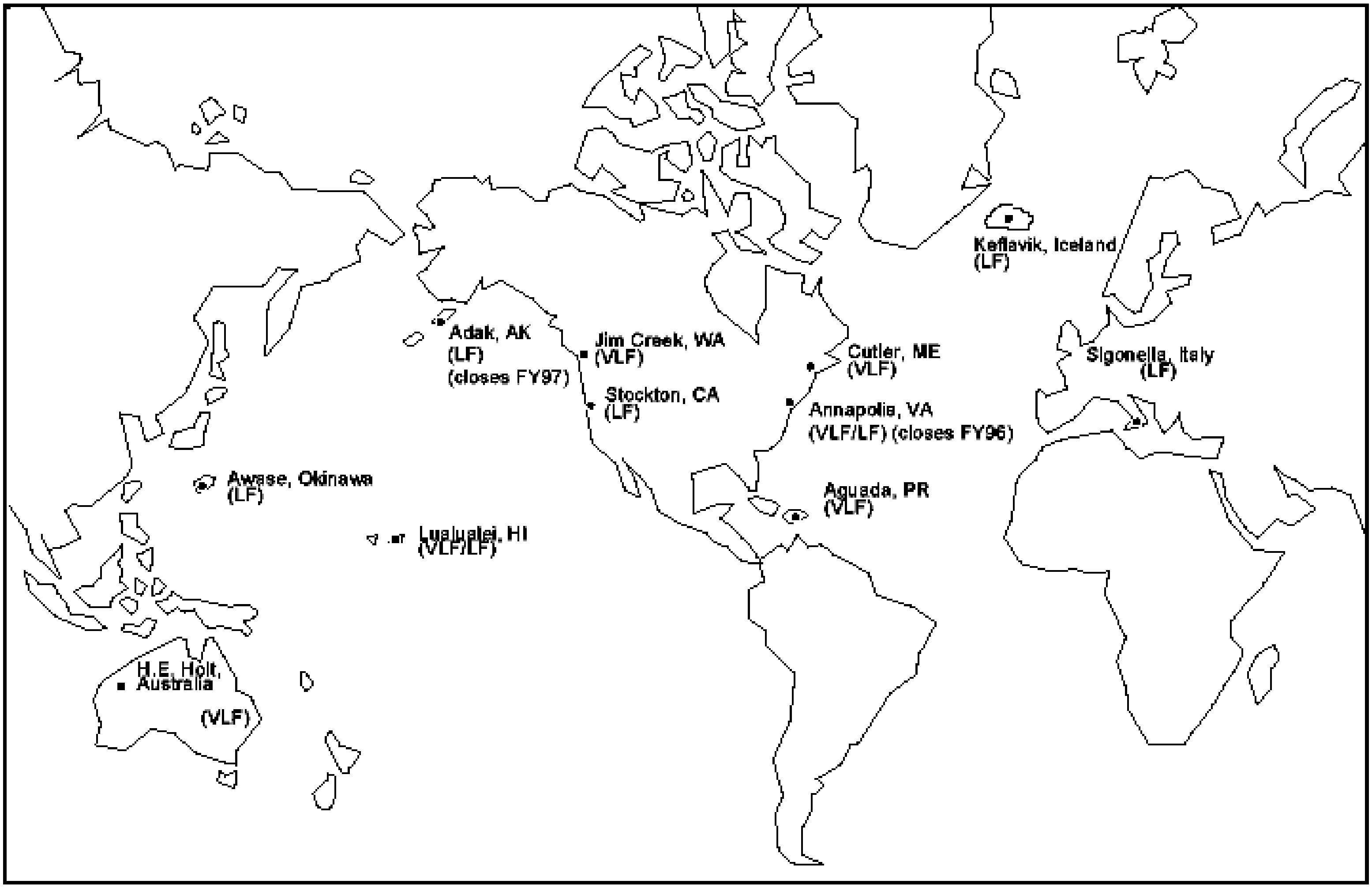
The ELF ecological monitoring program is an independent evaluation of the possible hazards ELF RF transmissions may have on the environment. Sampling and gathering of data was completed at the end of FY93 with review and comments on the resultant data by the National Academy of Sciences expected during FY96. The ELF interference mitigation efforts fund the procurement and maintenance of devices used to ground electrical voltages induced in long metal inductors (e.g., wire fences, cable lines) in areas adjacent to the Wisconsin and Michigan ELF radio transmitters.

B.2.3 Extremely Low Frequency Enhanced Data Rate

The ELF system provides the capability of sending short, highly formatted messages from the single continental U.S. (CONUS) transmitter facility (dual transmitter sites) to submarines at speed and depth operating essentially world wide. An Enhanced Data Rate (EDR) ELF system was successfully demonstrated on a deployed submarine during the first quarter of FY95. The EDR for ELF permits the use of longer messages (4 or 13 times the present message length) to slightly shorter ranges in the same time as presently required for the existing LDR system. The ELF EDR system has not been approved for fleet installation and is pending acceptance/funding.

B.2.4 Very Low Frequency/Low Frequency

The Navy shore VLF/LF transmitter facilities transmit a 50 baud submarine command and control broadcast which is the backbone of the submarine broadcast system. The VLF/LF radio broadcast provides robustness (i.e., improved performance in atmospheric noise), availability, global coverage, and has seawater penetrating properties. The submarine VLF/LF broadcasts operates in a frequency range from 14 to 60 kHz and consists of six high powered, multi-channel MSK Fixed VLF (FVLF) sites and seven multi-channel LF sites located worldwide. Figure B-3 lists the VLF/LF site locations. As part of the FY94 Base Realignment and Closure (BRAC), Navy Radio Transmitter Facility (NRTF) Annapolis is planned for closure in FY96 and NRTF Adak is planned for closure in FY97.



Very Low Frequency/Low Frequency Site Locations

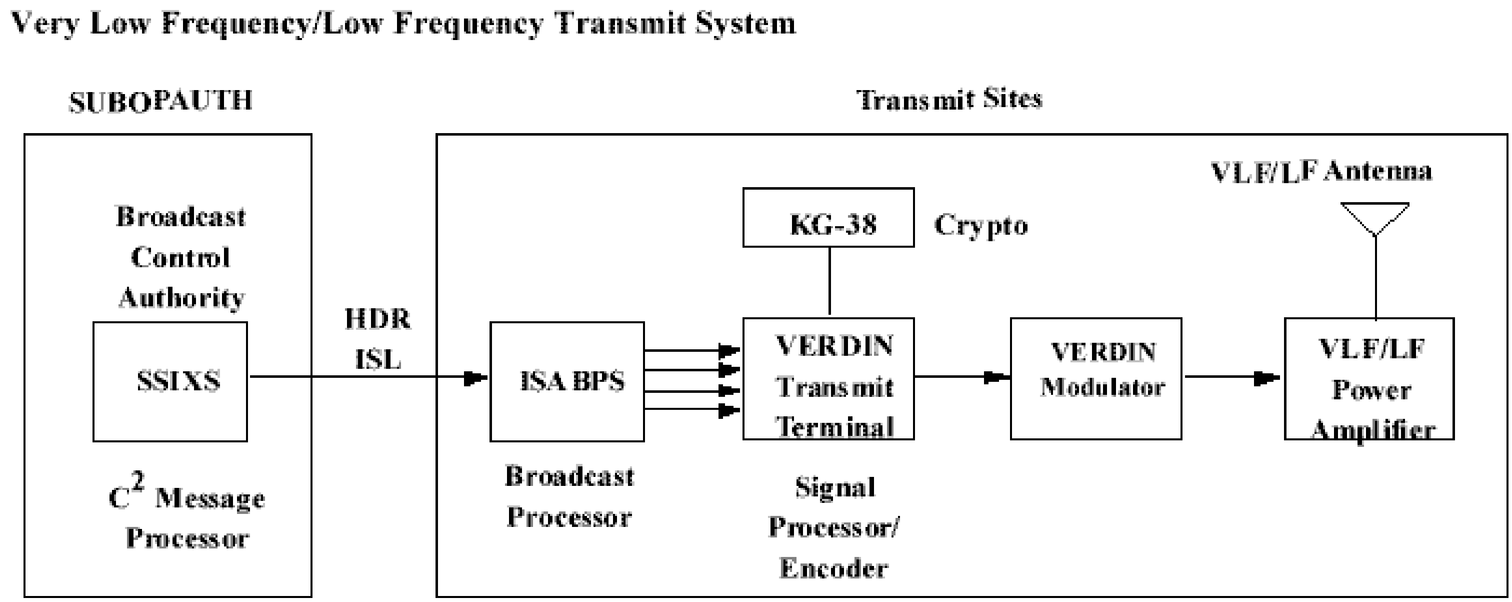


Figure B-4 shows a simplified block diagram of the VLF/LF transmit system. The submarine VLF/LF broadcasts are generated by the BCA or Alternate BCA from messages created locally by the C 2 processor, the SSIXS processor, or accepted for relay by the SUBOPAUTH. The BCAs and Alternate BCAs are connected to the transmitter sites by dedicated ISLs with the ability for JCS and USSTRATCOM to seize BCA, at any time, for EAM dissemination. At each of the transmitter sites, messages received over the ISLs are decrypted and input into the Integrated Submarine Automated Broadcast Processor System (ISABPS). Submarine VLF/LF broadcasts a continuous transmission sequence of prioritized messages which normally lasts two hours. It is generated by ISABPS and sent to the VERDIN transmit terminal. The VERDIN transmit terminal is used to multiplex, encrypt, encode, and modulate up to four 50 bps submarine broadcast channels into VLF/LF radio frequency signals which is amplified/radiated by the VLF/LF transmitter antenna.

B.2.5 Fixed Very Low Frequency Site Upgrades

This program maintains and upgrades antennas and transmitters at the FVLF sites. It consists of three individual programs: (1) The Solid State Power Amplifier-Receiver (SSPAR) program; (2) the Transmitter Keep-Alive Program (TKAP)/Service Life Extension Program (SLEP); and (3) Antenna Maintenance Program (AMP).

The SSPAR program could modernize the FVLF transmitter sites with solid state technology. This program could replace the current inefficient, unsupportable vacuum tube amplifiers and provide standardization for FVLF sites. The SSPAR program execution is being evaluated. SLEP is an interim program to extend the useful life of existing FVLF/LF equipment and systems until the delivery of SSPAR. The SLEP improvements includes switchgear, circuit breakers, solid state Intermediate Power Amplifiers (IPAs) and pre-IPAs, assorted electrical components, and updated technical manuals. SLEP has been completed at Jim Creek, Lualualei, Cutler FVLF, and Aguada, PR. H.E. Holt is scheduled to be accomplished in FY98. The AMP is administered by the Commander, Naval Computer and Telecommunications Command (NCTC) and provides for the ongoing maintenance and repair of FVLF/LF antennas and antenna components (e.g., insulators, top hats, guy wires, etc.).

As part of the overall DOD shore infrastructure reduction, NCTC and SPAWAR are examining modernization and cost savings alternatives within the submarine VLF/LF FSBS that could be accomplished which would maximize the return on initial investment. These study efforts, called the Smart Resource Management System (SRMS), are centered around consolidation of the shore VERDIN ISABPS equipment and more cost effective connectivity from the BCA/Alternate BCA to the BKSs and Broadcast Transmitting Stations (BTSs). Other initiatives being considered are Remote Transmitter Operation, Range Extension Mode, Power Management, Dynamic Channelization, and Split Array operation at the VLF sites.

B.2.6 Fixed Submarine Broadcast System Consolidation

CNO (N61) has tasked NCTC (N33) and SPAWAR PMW 173/PMW 172 to examine various cost savings alternatives for the submarine VLF/LF FSBS. An outgrowth of this initiative is the Consolidated Fixed Submarine Broadcast System (FSBS) which consists of two specific elements: connectivity cost savings and BKS consolidation. Implementation of the FSBS consolidation and cost savings is planned in three phases. During Phase I, WAN analysis and connectivity for the FSBS will be evaluated and demonstrated. This effort is scheduled to commence in FY96. Phase II is the design/validation phase of the Consolidated FSBS which will subsequently be followed by Phase III in which actual deployment and installations occur.

B.2.6.1 Connectivity Cost Savings

The purpose of this effort is to replace costly existing dedicated leased lines which provide connectivity between the BCA, BKS, and BTS. Use of existing DISN WANs, combined with short leased "tail circuits" between the nearest WAN node and BCA, BKS, or BTS locations, should significantly reduce these costs.

B.2.6.2 Broadcast Keying Station Consolidation

This effort consolidates the BKSs and the VERDIN ISABPS suites which key the transmitters, typically located at the transmitter site, to a smaller number of centralized locations. The current proposal being investigated would provide two consolidated keying stations on each coast. Each consolidated keying station would have the ability to drive any transmitter supporting that corresponding ocean area, providing some measure of reliability in the event one keying site were out of commission. Since, each BKS requires communication links to each transmitter site, connectivity costs using leased lines would make this consolidation impractical were it not for the reduced operating costs realized by using a WAN (such as the DISN-IP Network, formerly called the NAVNET Network). This proposal does incur initial costs to relocate the ISABPS suites, but saves money by reducing BKS operational personnel and training schools. These cost savings and payback period are being evaluated to determine the feasibility of this concept. ISABPS processor upgrades and the use of COTS routers to automatically relay broadcast traffic around network failures are also being considered.

B.2.6.3 Additional Fixed Submarine Broadcast System Cost Reduction Efforts

An additional concept which supports the cost reduction initiatives of the FSBS consolidation is remote transmitter operation. NCTC (N33) has funded a prototype Remote Control System (RCS) based on commercial radio broadcast controllers and is undergoing evaluation at the Lualualei FVLF transmitter. Technical issues, including remote control of the transmitter antenna parameters and off the air monitoring of the broadcast, remain to be resolved before a complete remotely-operated BTS is feasible. Program plans are to submit required funding for RCS as part of the Consolidated FSBS POM 98 submittal.

Power management of VLF/LF transmitters will make use of a computer hosted propagation and noise model to aid operators in assessing power required by a transmitter given the time of the year/day and geographic area needing VLF/LF broadcast coverage. A related benefit of this initiative is computer produced VLF/LF coverage prediction charts based on time of day and transmitter frequency that can be used by Fleet operators. Through this program, cost savings will be realized through the efficient use of transmitted power ensuring lower fuel and power bills and accurate VLF/LF coverage predictions.

VLF/LF Range Extension Mode would leverage RDT&E work that was performed at NRaD, San Diego, CA. The premise of Range Extension is that less transmitter power is required for the submarine shipboard VLF/LF receiver to receive the transmitted signal because it takes advantage of signal encoding and compression techniques. This capability would be implemented through VERDIN software changes at the shore transmitters and shipboard receivers.

Dynamic Channelization will provide submarine broadcast flexibility and potential cost savings by allowing a 4 channel VLF/LF broadcast to be reconfigured to either a 2 or 1 channel VLF/LF broadcast. Cost savings may be realized when operating either the 2 or 1 channel VLF/LF broadcast because less transmitter power is required as there is more energy per bit in the given data stream. Split Array VLF transmitter operation would allow for the transmission of two separate submarine broadcasts on different VLF frequencies. Besides broadcast flexibility, small saving may be accrued through lower transmitter power required at each transmitted frequency.

B.2.7 Take Charge and Move Out (TACAMO)

The Navy TACAMO program provides for survivable VLF/LF MEECN mode, HIDAR, and EHF transmissions during trans-attack and post-attack phases. The TACAMO program is managed by the Naval Air Systems Command and provides fleet support for two squadrons totaling 16 E-6A aircraft and a wing component located at Tinker Air Force Base, Oklahoma City.

The TACAMO program focuses on three primary areas: airframe procurement and maintenance, communications equipment integration (e.g., MILSTAR), and TACAMO-unique communications equipment (e.g., High Power Transmit System (HPTS), Long Dual Trailing Wire Antenna (LDTWA)).

As part of the DOD Airborne Command and Control consolidation, the Navy E-6A aircraft has been chosen as the common airframe to accommodate the USSTRATCOM battle staff and provide command and control communications to all three legs of the strategic triad. Funds required for modification of the E-6A communication and staff capabilities will be provided by retiring Air Force EC-135 aircraft. The TACAMO/Airborne Command Post (ABNCP) integrated aircraft nomenclature will be the E-6B.

B.2.8 Integrated Very Low Frequency Digital Interface Network Transmit Terminal

Integrated VERDIN Transmit Terminal (IVTT) replaces the aging VERDIN transmit/modulator terminals (AN/URT-30) at VLF/LF shore sites and provides equipment for emergent new shore site requirements. IVTT consists of: EVS control unit, modified electronic enclosure shelf, existing NDI processor (ISABPS PIP - AN/UYK-83), and Navy Research Laboratory (NRL) developed modulator.

B.2.9 AN/FRT-95(A) Low Frequency Transmitter

The AN/FRT-95(A) program will provide four 250 kW solid state LF transmitters. Sites planned to receive the new LF transmitters are: Aguada, PR; Keflavik, Iceland; Awase, Okinawa; and Sigonella, Italy. The LF solid state transmitter upgrades will improve area coverage in the Northern Atlantic and Northern Pacific regions. Testing of the first AN/FRT-95 (A) solid state LF transmitter has been successfully completed at the Aguada, PR transmitter site. The AN/FRT-95(A) transmitter installation and antenna upgrades at Iceland were completed in FY95 while those at Awase, Okinawa are planned to be completed in early FY98.

B.2.10 Submarine High Frequency

The Submarine shore HF infrastructure is operated and maintained by the Commander, NCTC and consists of eight HF receiver sites and eight HF transmitter sites. The HF receiver sites support the submarine Circuit Mayflower and Clarinet Merlin systems while the HF transmitter sites rekey the Strategic SSBN submarine broadcast. Functional control of the Clarinet Merlin and Circuit Mayflower programs are in process of being transferred to the Submarine TYCOMs. COMSUBLANT/COMSUBPAC will assume the lead responsibility for operation of the Circuit Mayflower and Clarinet Merlin Systems in their respective AORs. Naval Computer and Telecommunications Area Master Station, Atlantic (NCTAMS Lant) will maintain responsibility for maintenance of the Circuit Mayflower System worldwide. This transfer will start mid FY96 and be completed during FY97.

B.2.11 Submarine Satellite Information Exchange System

The SSIXS program provides UHF SATCOM capability at high data rates (currently 4800 baud) to deployed submarines. The SSIXS UHF SATCOM broadcasts are formed by the SSIXS computer operators at each of the four Submarine BCAs or their designated alternates. The SSIXS computer is also used to assemble the FVLF/LF broadcast, which is relayed to ISABPS for storage and transmission via the FVLF/LF transmitters. The SSIXS broadcast information is forwarded to the appropriate NCTAMS which transmits, receives, and relays satellite communication. The system uses the Navy’s FLTSAT satellites and will transition to UHF DAMA capability when the total Military SATCOM (MILSATCOM) architecture transitions.

An ongoing upgrade program, SSIXS II, has completed its initial hardware and software upgrades and is providing evolutionary enhancements via software revisions. Future capabilities will include screen-on-the-fly (multicast) for improved efficiency and reduced downlink time.

B.2.12 Officer in Tactical Command Information Exchange System

The submarine OTCIXS program provides tailored OTH-T information through a UHF SATCOM channel to submarines at high data rates (2400 baud). This broadcast is assembled at the submarine Shore Targeting Terminals (STTs) located at the submarine BCAs and then relayed to a supporting NCTAMS for transmission, as with SSIXS. The submarine OTCIXS net differs from the Surface OTCIXS in one way. The submarine OTCIXS broadcast is a “protected” broadcast, similar to the submarine SSIXS broadcast, while the Surface OTCIXS net is not. Both surface and submarine OTCIXS nets use KG-84s. In addition to OTH-T information, this link is also used to relay TOMAHAWK MDUs and TADIXS A information to submarines not currently equipped with TD-1271 DAMA modems (DAMA TEMPALT). As with SSIXS, submarine OTCIXS will transition to UHF DAMA.

B.2.13 Tactical Digital Information Exchange Subsystem A and B

TADIXS A provides the surface Navy, via a UHF DAMA circuit, a 2400 bps link used for MDUs and other file transfers. Following installation of Mini-DAMA and upgrades to the ON-143(V)6 firmware, SSNs will be able to receive TADIXS A, providing commonality with the surface navy. In the interim, SSNs equipped with the TD-1271 DAMA modem TEMPALT and KG-84A cryptographic devices can receive TADIXS A information. TADIXS B supports near real-time relay of intelligence data and requires installation of the TRE (AN/USQ-101), currently programmed for SSNs and discussed in section 4.2.1.3, Shipboard Transmitters and Receivers and Appendix A.

B.2.14 Strategic Communications Continuing Assessment Program/Fleet Ballistic Missile Continuing Evaluation Program

The Strategic Communications Continuing Assessment Program (SCAP) and FBM CEP are administered by JHU/APL as an independent agent for CNO and the Operational Commanders. The FBM CEP program evaluates communication links to SSBN submarines and reports: communications performance, identifying trends in material and operational performance, training deficiencies, material problems, and provides aid in developing operational doctrine. The SCAP performs qualitative and quantitative assessments of existing and planned strategic communications systems for the delivery of EAMs to SSBN submarines.

B.2.15 North Atlantic Treaty Organization/Allied Communications Interoperability

Alliance solidarity is a key to national defense strategy and, as would be expected, drives a key interest in bilateral and multilateral submarine operations and communications. As with the U.S., VLF/LF communications is the backbone of NATO submarine command and control. Within technology transfer and funding constraints, NATO has embarked upon a VLF/LF communications program modeled after the U.S. FSBS. To be interoperable with the NATO submarine broadcast, the U.S. has modified the submarine shipboard VERDIN receivers and one channel of the shore transmitter sites at Cutler, ME and Aguada, PR to be STANAG 5030 MSK waveform capable. The Vinson UHF secure voice system and its KY-58 crypto provide a NATO/Allied interoperable LOS voice circuit for submarines.

B.2.16 Submarine Broadcast Control Authority Modernization

To support the shift in submarine mission emphasis and to operate efficiently and cost effectively, the Submarine Operational Commander’s Command and Control facilities must be modernized and kept compatible with submarine shipboard and Joint Task Force C 2 systems. Submarine shore BCAs and their alternates require information transfer and processing systems that are highly automated and modern. These systems must leverage existing commercial technology so that BCA manning may be reduced and accompanying life cycle maintenance and logistic support costs are kept to a minimum. The BCA modernization efforts must address methods to effectivly consolidate BCA operator actions and fuctions. Seamless interoperability with the GCCS and DMS is essential.

As the single point of contact for all submarine C 4 I matters, SPAWAR PMW 173 has been directed to develop a plan to modernize and maintain the submarine BCAs based on TYCOM requirements submitted to CNO N87. CNO N87 is the sponsor for the submarine BCAs and will address funding for modernizing and maintaining the BCAs during POM 98.

B.2.17 Submarine Support Tender Communications Modernization

Submarine Tenders (ASs) support both tactical and strategic communications requirements and require continuing modernization efforts to ensure interoperability. As submarine force assets, Tenders are sponsored by CNO N87. CNO N87 and N6 will coordinate to address funding to ensure Tenders are included in the Fleet Modernization Program (FMP) and receive standard communications suite upgrades.

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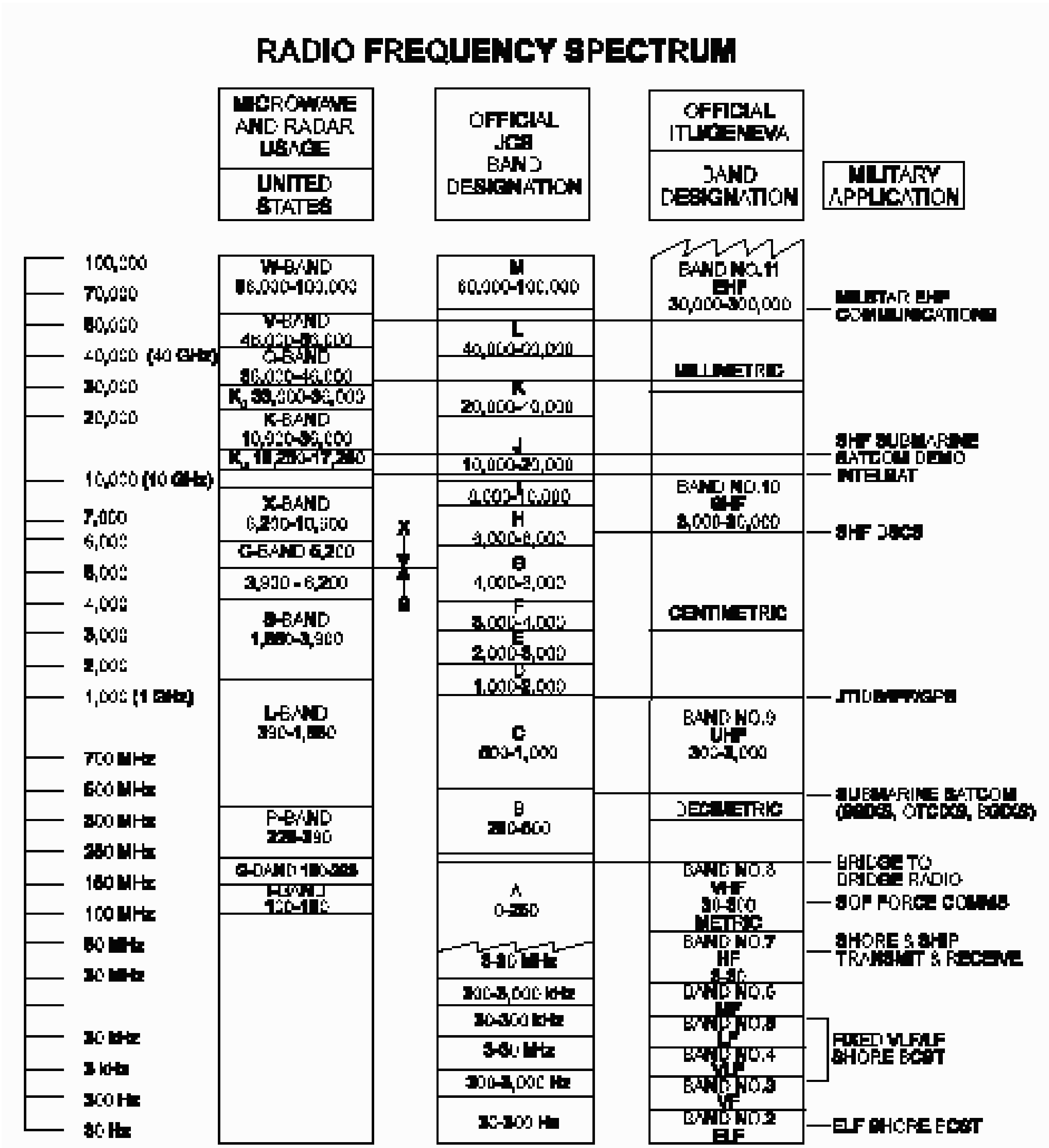
APPENDIX C SUMMARY OF RADIO FREQUENCY COMMUNICATIONS SPECTRUM



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APPENDIX D CURRENT SUBMARINE COMMUNICATIONS REQUIREMENT DOCUMENTS

Table D-1 lists the programmatic documentation, consisting of MNS, Operational Requirements (ORs), ORDs, Test and Evaluation Master Plans (TEMPs), or Non-Acquisition Program Description Documents (NAPDDs), which identify the operational requirements for submarine and Joint/Navy communications programs.

Table D-1. Summary of Requirements Documents

PROGRAM	REQUIREMENT DOCUMENT	DATE
AN/BRA-6B	SECNAV MEMO SPAWAR CONCEPT OF OPS	06 NOV 85
AN/BRA-34 IMPROVED	NDCP # X-0742.CC PCAD PEO 604502N/S0742	03 MAR 80 17 MAR 89
AN/BRR-6A/B	CNO LTR Ser 2287575707	29 OCT 88
AN/BRT-6	NDCP # X-0742-CC TEMP # 679 REV 2	03 MAR 80 18 AUG 88
AN/BST-1	CNO LTR Ser22/8U574751 CNO LTR Ser22/0U583657 TEMP# 679-2	11 JAN 88 05 NOV 91 05 SEP 90
ANTENNA DISTRIBUTION SYSTEM	COMSUBLANT/COMSUBPAC JOINT LTR 00/8616 DRAFT ORD	4 NOV 93 APR 95
BASEBAND SYSTEM	DRAFT ORD	APR 95
CIRCUIT MAYFLOWER	OR (UNNUMBERED DOCUMENT) TEMP x016 CNO LTR 8460 Ser 325C/5C388260(A)	30 APR 56
DEMAND ASSIGNED MULTIPLE ACCESS (DAMA)	Joint OR H-C123-75; "UHF DAMA Satellite Modem" DCP 99R5 MJCS 63-89	1975 SEP 76 17 APR 89

	MJCS 63-89	17 APR 89
DATA LINK CONTROL SYSTEM (DLCS)	CNO LTR 02/57385567	03 DEC 85
DEFENSE BROADCAST SYSTEM	MNS CNO ltr 2050 Ser N631/4U561983	26 MAY 94

Table D-1. Summary of Requirements Documents (continued)

PROGRAM	REQUIREMENT DOCUMENT	DATE
EHF	JOINT ORD # 005-79-I-II-IIIA DCP X0728 UPDATED ADM	 JUN 82 14 APR 89 02 JUN 89
ELF	TEMP # 197 OR 199 REV 3	07 NOV 91
ENHANCED VERDIN SYSTEM (EVS)	CNO LTR 2040 Ser 941D/8U536539 TEMP # 683-1	18 OCT 89 13 JAN 89
FBM COMM CEP	CNO LTR Ser 00344P094	16 APR 70
HIGH DATA RATE (HIDAR) VLF	LANT RS 1-88 JCS MCM 156-91	23 AUG 88 30 AUG 91
HIGH FREQUENCY RADIO GROUP (HFRG)	ORD # 322-06-92	DEC 92
HSBCA	OR # 236-02-90 PCAD CHG. 1 TEMP #1328	23 DEC 88 27 SEP 90 04 FEB 92
ISABPS PIP IVTT	CNO LTR Ser 941D/8U536513	06 SEP 88
Integrated Maritime Communications Systems (IMCS)	MNS Ser M063-06-95	16 FEB 95
JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM (JTIDS)	MROC # MJCS-194-89	08 AUG 89
LINK 11 IMPROVED	OR # X1327 MOU CNO LTR Ser 942/9U539150	12 FEB 82 11 NOV 87 17 JUL 89
LINK 16	MROC #MJCS 194-89	08 AUG 89
LOW FREQUENCY(LF) SOLID STATE SHORE TRANSMITTER UPDATED RQMTS	OP-941D ltr Ser 7U337589 OP-941H ltr Ser 1U555205	31 JUL 87 30 JUL 91
MARITIME CELLULAR	ORD in Staffing	9 JUN 95

MARITIME CELLULAR INFORMATION EXCHANGE SYSTEM (MCIXS)	ORD in Staffing CNO ltr Ser N61/5U0026	9 JUN 95
MEECN	NAPDD # 134-094 OR JCS MCM 156-91	10 OCT 91 8 JAN 86 30 AUG 91
MINI-DAMA AN/USC-42(V)1	OR # 174-094-87 MJCS 63-89	12 AUG 87 17 APR 89

Table D-1. Summary of Requirements Documents (continued)

PROGRAM	REQUIREMENT DOCUMENT	DATE
Naval Modular Automated Communications System (NAVMACS)	OR CC-72 Ser 987C/C69862	24 JUN 75
NON-PENETRATING EHF MAST (NPM)	OR # 270-02-89	11 OCT 91
NATO Interoperable Submarine Broadcast System (NISBS)	CNO ltr 2000/Ser 941D/7U337566	18 MAY 87
NEW ATTACK SUBMARINE (NSSN)	MNS ORD #342(1)-87-95 NSSN CHARACTERISTICS CNO ltr Ser 00/2U500037 (NSSN) C3I SYSTEM FUNCTIONAL REQUIREMENTS DOCUMENT NSSN TEMP No. 1425 REV A	10 OCT 91 29 JUN 95 19 FEB 92 01 AUG 95 28 JUN 95
NTCS-A	DRAFT ORD x0709	
OE-315(V)BRC	NDCP #X-0743-CC	03 MAR 80 06 AUG 91
RED/BLACK SWITCH SA-2626/BR	SECNAV MEMO SPAWAR CONCEPT OF OPS	06 NOV 85
SEAWOLF	SEAWOLF Submarine Top Level Requirements Document OPNAVINST C9210.332	AUG 91
Submarine Imagery System	MNS COMSUBLANT ltr 3120 N7/Ser 3605	22 JUL 94
SUBMARINE LF/VLF RECEIVER	DRAFT ORD CVLF OR # 103-94-84 CNO LTR 2U47 Ser 941H/1U55108 TEMP 838-3 REV 1	12 MAY 95 16 JUN 86 17 JUN 91 18 AUG 84
Submarine High Data Rate Communication Requirements	CNO ltr 3000/Ser N87/4U656589	24 OCT 94

Submarine High Data Rate Communication Requirements	CNO ltr 3000/Ser N87/4U656589 COMSUBLANT ltr 2300/Ser 00/5872	24 OCT 94 29 NOV 94
SUBMARINE KEYBOARD PRINTER (SKP)	OR # X-1511-CC	MAR 81
Submarine Special Forces Connectivity Requirements	COMNAVSPECWARCOM Ltr 3120/Ser N6/0640	8 MAY 95
SUBMARINE MESSAGE BUFFER (SMB)	NAPDD # 184-02 CNO LTR Ser 22/1U584275 TEMP # 1347 DRAFT ORD	13 JUL 88 05 NOV 91 31 DEC 91 31 MAR 93

Table D-1. Summary of Requirements Documents (continued)

PROGRAM	REQUIREMENT DOCUMENT	DATE
SSIXS II	OR # 031-02-85 MJCS 63-89	29 MAR 85 17 APR 89
TACTICAL DATA INFORMATION EXCHANGE TADIXS B	OR # 048-94-85	SEP 85
TIME & FREQUENCY DISTRIBUTION SYSTEM (TFDS)	NAPDD # 184-02 CNO LTR Ser 098R/8U550749	 13 JUL 88
TACTICAL RECEIVE EQUIPMENT (TRE) (AN/USQ-101(V))	OR # 048-94-85 ADM	02 OCT 85 14 MAY 90
TRIDENT IRR MAJOR REVISIONS	TEMP # 113 CNO LTR# 3960 Ser 22/9U575564	AUG 82 28 AUG 89
VERDIN (COMPLETE) EVS W/NONAP	CNO LTR# 2040 Ser 941D8U536539 TEMP # 683-1	18 OCT 93 13 JAN 91
VLF SOLID STATE SHORE TRANSMITTER	ORD # 293-094-92	OCT 92

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APPENDIX E SUBMARINE FORCE COMMUNICATIONS REQUIREMENTS

This appendix contains several recent statements of communications requirements from the Submarine Force TYCOMs and related commands, such as the Special Operations Forces (SOF). They are indexed as follows:

Requirements Document Page


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Enclosure (1) to
COMSUBLANT/COMSUBPAC Joint Letter 2000 Ser 00/08606 dtd 04
November 1993:

1. To aid in preparation for the Navy Program Review (PR) 1995-1999 and
Program Objectives Memorandum (POM) 1996-1999, COMSUBLANT/COMSUBPAC
request you propose a detailed plan of evolving submarine communications
programs to incorporate capabilities that support the shift in submarine
```

mission emphasis. This shift is from a global sea control mission to the support of regional conflict ashore as defined in “From The Sea” and represents support for the Submarine missions of: Joint Strike, Littoral, Surveillance, Space and Electronic Warfare (SEW)/Intelligence, Strategic Deterrence and Sealift/Protection. The following capabilities should be emphasized: Timeliness, rapid TLAM retargeting, reliable connectivity, robust throughput and a common tactical picture.

2. This request is based on results of the CNO (N8) POM wargames and Joint Military Assessment (JMA) process which highlight and need for a shift in emphasis in submarine communications capabilities and requirements. These wargames and JMA results agree with the recommendations of N87 sponsored studies and conferences to define post-cold war submarine communications needs. The thrust of the new emphasis in submarine communications is based on the following general requirements:

a. The need to be fully interoperable and have the ability to send/ receive mission related information to/from the JTF.

b. The desired submarine radio room should be a flexible open system designed to be in step with architectures such as Copernicus. Additionally, it should be automated, CSS capable with basedband switching.

c. The need for sufficient data throughput to allow timely transfer of strike and surveillance missions; this includes data throughput capability necessary to support imagery.

d. The need to maintain continuous shipboard record traffic without mast exposure for force management and direction. This system should support all submarine related missions. The “current” (with authorized improvements), VLF/LF Fixed Submarine Broadcast System (FSBS) meets this requirements.

3. The following specific requirements should be addressed in your plan:

a. New antenna design/configuration is a critical need.

(1) Submarine antennas must be designed for operations in all submarine communications bands with primary emphasis on the higher frequency and high throughput regimes of the future (e.g., SHF, EHF, MDR and UHF). The feasibility of using a stealth sail as an antenna should be evaluated.

(2) The submarine antenna suite should be designed to provide assured connectivity across the spectrum of conflict.

(3) Submarine antenna should allow interoperability with joint Task Force Commanders and Joint Operating Force communications systems and other joint architectures.

(4) Our SSBNs require antennas capable of LDR EHF for Ship to Shore report back in a Low Probability of Intercept/Low Probability of Detection (LPI/LPD) environment and a back-up Emergency Action Message (EAM) source.

(5) All submarines will need medium data rate EHF capable antennas with low data rate antennas in the interim. SHF is a requirement for operations with JTF. This will provide both increased data throughput and interoperability. A throughput to support retargeting is required.

b. Submarine inboard communications should allow interoperability with Joint Task Force Commanders and Joint Operating Force communications systems and other joint architectures. Specifically:

(1) A Link 16/JTIDS capability for submarines is required. The bandwidth and capacity inherent in Link 16 will provide future flexibility for submarine connectivity with the JTF. Similarly, improvements in Link 11 with expansion to Link 22 is required for submarines to be interoperable with Navy Battle Groups.

(2) Battle group and JTF interoperability and commonality are of paramount importance. Battle Group unique systems such as a BGIXS enable the submarine to maintain rapid access to the Battle Group Commander and must be supported until replacement by a fleet wide standard. The use of submarine unique systems and equipment should be chosen only when necessary to provide required capabilities.

(3) The accelerated procurement of DAMA capable systems should continue.

(4) Your program plan should reflect radio room support for NTCS/JMCIS installations on all submarines including appropriate interfaces with the submarine’s combat control system.

(5) Our fleet ballistic submarines continue to be the backbone of the national strategic forces. Upgrades should concentrate on interoperability, reliability, open architecture and obsolete equipment replacement.

(6) Standard Navy or joint equipment upgrades should be the primary means of replacing obsolete equipment.

(7) The submarine radio room should support new expansion concepts like a Local Area Network, and Voice, Video, Fax, and Data (VVFD), with interoperable Joint Imagery Format.

(8) Other received/transmitted signals such as IFF and GPS and their expected follow-on systems will remain an integral part of submarine communications capability and must be supported.

(9) Connectivity with SOF communications (e.g., SOCRATES) must be supported by providing onboard equipment and antenna connection points for carry on equipment packages.

(10) Global Maritime Distress and Safety System (GMDSS) reception is required on all submarines, including reception of open ocean SAFETYNET warnings transmitted on INMARSAT-C and coastal navigation warnings transmitted on NAVTEX.

4. The two-site ELF system must continue to the supported.

5. Operational Commander Command and Control Facilities must be kept compatible with submarine systems and JTF systems.

6. Budgetary projections demand that affordability be a key factor in this plan. Procurement strategy should emphasize COTS/GOTS, Life cycle costs and Fleet Training requirement costs. This is a joint CSL/CSP letter.

COMMUNICATIONS CONNECTIVITY REQUIREMENTS FOR SUBMARINES

2000
Ser 00/00686
3 Feb 94
From: Commander Submarine Force, U. S. Atlantic Fleet
To: Chief of Naval Operations (N87)
Subj: COMMUNICATIONS CONNECTIVITY REQUIREMENTS FOR SUBMARINES
Ref: (a) COMSUBLANT ltr Ser 2000 00/06606 of 4 Nov 1993

1. Reference (a) discussed requirements for the submarine force

communications architecture. Since that letter, certain issues have come to my attention, which require further discussion.

2. I now consider connectivity to the SHF link absolutely essential . Battle groups are passing mission essential data and critical information via SHF circuits which have no direct data path to the submarine communication suite. The commanding officer of the submarine must be able, for example, to pick up his STU-III and access the Joint Task Force Commander, as can the CO of a Spruance class destroyer. Additionally, the submarine must be capable of receiving the data transmitted via SHF links. The current plan to put SHF on all Tomahawk - capable CGs and DDGs is a clear invitation to leave the SSN out of the TLAM picture.

3. High data rates are required to enable the submarine to obtain mission essential data within a tactically reasonable period. The current stumbling block to this is the lack of a capability to communicate above the UHF range. Transfer of imagery data highlights this shortfall. Surface ships routinely obtain imagery data at 128 kbps while submarines are stuck at 2.4 kbps with the current ANDVT/CLUSTER NAVE path. For a submarine to obtain a black and white 64 grey shade image (at a relatively low 640 x 480 pixel resolution) at this low data rate requires the antenna to remain completely dry for nearly half an hour. This is not tactically reasonable . At a reasonable data rate of, say 64 kbps (the data rate advertised for MDR EHF), the time required could be reduced to about 45 seconds. This not only greatly enhances the probability the image will be successfully transferred, but frees the submarine to proceed onward with mission tasking.

4. I am concerned that the current plan of record (which I understand is to provide this connectivity to/from the submarine via a "seamless" EHF link) is in trouble. This program depends on several independent elements coming together. Even if all goes without a hitch, we will still be limited to relatively low data rates compared to other forces.

a. First, a constellation of EHF satellites must be placed in orbit (for which there does not seem to be a robust round of support). This minimal constellation is not to be complete until well into the next century. The EHF (MILSTAR) constellation has been reduced to only six satellites, with no polar adjunct capability. Thus, there will be no coverage beyond 65 degrees north (this includes UHF after AFSATCOM is discontinued in 1998). Additionally, the reduced constellation provides no backup in the event of catastrophic failure of any one satellite.

b. Second, the Non-Penetrating Mast (NPM) or some other advanced antenna must come to fruition in order to support Medium Data Rate (MDR). At least we may be able to exercise some control over the mast.

c. Third, the MDR (64 kbps) capability of the system is yet to be developed. The current EHF suites installed in both of our EHF equipped submarines are not MDR capable (installation of the MDR drawer is planned to coincide with launch of the MDR capable satellites). Neither are any current satellites EHF (MDR) capable. The first two MILSTAR satellites in the constellation of the six in stationary equatorial orbits will only be LDR capable, leaving a wide gap in MDR coverage . The plans for satellites to replace these two satellites at the end of their useful life (about 2001) have yet to be defined.

5. A possible alternative for the satellite path would be seamless "cross banding" between EHF and SHF bands for both uplinks and downlinks. This capability would provide a portion of the architecture for full use of the RF spectrum as described for the TADIXS Communications Support System (CSS). However, this would still not provide SHF connectivity with the battle group ships via a line of sight path such as envisioned for the Cooperative Engagement Capability (CEC) system.

6. The SHF demonstration from one of our submarines planned for mid-1994 will utilize a commercially developed antenna housed in the AN/BRD-7 radome, which may provide an SHF data capability of 64 kbps (downlink) and 32 kbps (uplink). We need to keep working on these advanced antenna development efforts and the utilization of commercial equipment.

7. I believe that unless a more forward thinking plan is put forth, the submarine force will become a "disadvantaged user" relegated to secondary missions. With the surface forces having current connectivity at 128 kbps and higher, 64 kbps is already obsolete, and will be more so five and ten years from now.

SUBMARINE HIGH DATA RATE COMMUNICATIONS REQUIREMENTS

3000
Ser N87/4U656589
24 Oct 94
From: Director, Submarine Warfare Division (N87)
To: Director of Space and Electronic Warfare (N6)

Subj: SUBMARINE HIGH DATA RATE COMMUNICATIONS REQUIREMENTS
Ref: (a) CNO ltr ORD 2050 Ser N81/4S6428 26 of 25 Feb 94 (Lightweight SHF Satellite Communications Terminals)
(b) N63 Commercial Satellite Communications ORD
(Draft) (c) USCINCSOC 1612222 Sep 94

1. This letter identifies the omission of attack submarines from the high data rate C4I architecture that supports the joint naval battle force. MILSATCOM connectivity that will provide attack submarines with the information transfer required for Task force operations, intelligence gathering, Tomahawk strikes, and SOF missions should be identified and included in the Navy's program of record.

2. High data rate requirements are specified for Tomahawk capable ships in reference (a), for CVBG support ships in reference (b) and SOF support submarines in reference (c). These operational requirements have been compared to the technical capabilities for SATCOM transmissions to submarine antennas. The results show that data rates of 128 kbps should be provided now, with 256 kbps by 1998, and 512 kbps by 2002. The C4I architecture should support achieving these data rates using mast mounted antennas that are no larger than 16 inches in diameter.

3. In order to ensure that the development of a submarine high data rate antenna is optimized for the Navy's MILSATCOM architecture, it is requested that the plan for submarine high data rate connectivity be formalized by 15 January 1995.

4. My points of contact are CDR E. R. Jablonski, N872E and LCDR N. P. Moe, N872E4, (703) 697-2008.

/S/
D. A. JONES
By direction

HIGH DATA RATE SATELLITE COMMUNICATIONS REQUIREMENTS FOR SUBMARINES

2300
Ser 00/5872
29 Nov 94
From: Commander, Submarine Force, U. S. Atlantic Fleet
To: Commander in Chief, U. S. Atlantic Fleet

Subj: HIGH DATA RATE SATELLITE COMMUNICATIONS REQUIREMENTS FOR SUBMARINES
Ref: (a) CNO ltr ORD 2050 Ser N81/4S642826 of 25 Feb 94
(b) N63 Commercial Satellite Communications ORD (Draft)
(c) USCINCSOC 1612222 Sep 94
(d) CNO message 191715Z Oct 94
Encl: (1) High Data Rate Requirements
(2) Consolidate Submarine H DR Communications Requirements
(3) High Data Rate Mission Drivers

1. Reference (a) specifies High Data Rate (HDR) communications requirements for Tomahawk capable ships. Reference (b) discusses emerging High Data Rate Satellite communications needs for CVBG support ships. Reference (c) specifies HDR communications requirements for SOF support submarines. Reference (d) requested Fleet input on HDR requirements fro submarines.

2. Enclosures (1) through (3) provide the HDR communications requirements to meet the current and anticipated submarine force needs from present to the year 2006. I consider HDR connectivity to be absolutely essential in order to properly carry out the submarine forces assigned missions. Battle groups are passing mission essential data and critical information via SHF circuits which have no direct data path to the submarine. The commanding officer of the submarine must be able, for example, to pick up his STU-III and access the Joint Task Force Commander. Additionally, the submarine must be capable of receiving data transmitted via HDR links. The current plan to put SHF on Tomahawk-capable platforms needs to include SSNs if the are to remain a viable strike warfare platform. Submarines are essential components of BG/TG commands and need to be able to communicate with the BG/TG commander on both tactical and non-tactical circuits including communications paths identified in reference (b).

3. The transfer of imagery data highlights the problem with current submarine communications systems. for a submarine to obtain a black and white 64 gray shade image (at a relatively low 640 x 480 pixel resolution) with its current data rate capability of 2.4 kbps requires the antenna to remain completely dry for nearly half an hour. This is not tactically reasonable . Higher data rates are needed to ensure images are successfully transferred and to free the submarine to proceed with mission tasking.

4. The HDR communications requirements identified in enclosures (1) through (3) represent the current and future needs of the submarine force. Enclosures (2) and (3) were a result of a joint effort by

COMSUBPAC and COMSUBLANT.

5. COMSUBLANT point of contact is CDR D. L. Olberding, (804) 445-6633, DSN 564-6633.

/S/
GEORGE W. EMERY
Copy to:
CNO (N87)
COMSPAWARSYSCOM (PMW 173)
COMSUBPAC

HIGH DATA RATE REQUIREMENTS

1. COMSPAWARSYSCOM (PMW-173) and COMSUBDEVRON Twelve hosted a submarine high data rate requirements working group in August 1994. Results of this working group are graphically displayed in enclosures (2) and (3). Additional information requested in reference (d) is enclosed below.

2. Deployers requiring simultaneous support . Baseline planning requires that a minimum of nine submarines deploy within COMSUBLANT area of responsibility simultaneously.

a. JTG/BG support - minimum of four submarines are deployed to support JTG/BG's (3 Med/1 Caribbean).

b. SPECWAR - a minimum of one submarine is deployed in support of SPECWAR (Med).

c. Surveillance - a minimum of four submarines are deployed in support of surveillance operations (various locations).

3. Potential operating areas . Mission requirements continually place submarines in all oceans of the world, thus dictating the necessity for full time on-demand worldwide coverage in all geographic AORs. Additionally, the submarine fleet has requirements for polar satellite coverage.

- The EHF (MILSTAR) constellation is not to be complete until well into the next century and will comprise only 6 satellites, with no polar adjunct capability. This will leave no EHF converge beyond 65 degrees North and no UHF coverage after AFSATCOM is discontinued in 1998. Additionally, the reduced constellation provides no backup in the event of catastrophic failure of any one satellite.

4. Connectivity . Interoperable connectivity is required among fleet units, Joint forces, Allied forces, Navy C4I Commands and theater shore communication activities.

5. Information requirements . Enclosures (2) and (3) graphically display minimum data rate requirements and mission areas.

6. System responsiveness . Minimum data rates established were based on the submarine maintaining its stealth posture by minimizing mast exposure while at periscope depth. The system must be structured that mast exposure is limited to between one and five minutes.

7. Protection . The high data rate system should have a low probability of intercept (LPI)/low probability of detection (LPD) and should be jam resistant. Spread spectrum waveforms may meet the requirement for LPI/ LPD. Jam resistant throughput should meet the minimum data rate requirements as described in enclosure (2).

Enclosure 2. Consolidated Submarine HDR Communications Requirements

	TIMEFRAME							
SYSTEM	1994		1998		2002		2006	
UHF DAMA	X	2.4	X	~19.2 NECC	X	~19.2 NECC	X	~19.2 NECC
JTIDS (SSN ONLY)	X	YES Stand Alone System	X	YES Integrated System	X	YES Integrated System	X	YES Integrated System
EHF LDR	X	YES 2.4	X	YES 9.6 NECC		YES SSBN		YES SSBN
EHF MDR					X	YES	X	YES
VIDEO	X	128	X	256	X	512	X	T1

Notes:
1. MDU: 2.7M MDU @ 0.99 PCMR WITHIN 5 MINUTES
2. 19.2 DAMA DATA RATE INDICATES AGGREGATE DATA RATE
3. SOF REQUIRES EHF CONNECTIVITY TO DSNET-3/DSNET-1
4. "X" INDICATES SIMULTANEOUS COMMUNICATIONS
5. JTIDS STAND ALONE SYSTEM ON ONE SSN/JTIDS CAPABLE BATTLE GROU
6. JTIDS INTEGRATED IN JMCIS SYSTEM REQUIRED ON ALL SSNS

Enclosure 3. HDR Mission Drivers

		SURVEILLANCE	STRIKE	SPEC WAR	BG OPERATIONS
VOICE	SECURE/NON-SECURE				
	TELEPHONE (COMMERCIAL)				BGC
	OTHER (VHF)			SINCGARS	
VIDEO	VIDEO TELECONFERENCING (VTC)				
	"MEDIA-LIKE" CHANNELS				QOL / CNN
	REAL-TIME VIDEO	PERIVIZ / PHOT.		PERIVIZ / PHOT. / UAV	PERIVIZ / PHOT.
IMAGE	FILE TRANSFER				
	JDISS				
	OTHER				
DATA [TACTICAL]	LINK 16				
	RAPID TARGETING PACKAGES				
	MDU				
	ATO				
	FILE TRANSFERS/UPDATES				
	TADILS/IXS				
	BROADCAST				
	NAVAL MESSAGES				
	OPNOTES				
	SIOP		NUC ONLY		
	TADIXS B				
SUPPORT	E-MAIL (BGIXS-2)				
	FAX				
	LOGISTICS/ADMIN				
	ON-BOARD TRAINING UPDATES				
	MEDICAL/FINANCIAL				
	PERSONNEL TELEPHONE SERVICE				QOL
	OTHER				

SPECIAL OPERATIONS FORCES (SOF) APPENDIX TO CHIEF OF NAVAL OPERATIONS (CNO) SUBMARINE COMMUNICATIONS PROGRAM SUMMARY

3120
Ser N6/0640
8 May 95
From: Commander, Naval Special Warfare Command
To: Commander in Chief, U.S. Special Operations Comm and (SOJ6-I)
Subj: SPECIAL OPERATIONS FORCES (SOF) APPENDIX TO
CHIEF OF NAVAL OPERATIONS (CNO) SUBMARINE
COMMUNICATIONS PROGRAM SUMMARY
Ref: (a) COMSPAWARSYSCOM C4I mtg. of 8 and 9 Mar 95
(b) CNO Submarine Communications Program Summary Document
Encl: (1) SOF communications Appendix to CNO Submarine Communications

Program Summary (Draft)

1. Reference (a) requested SOF communications requirements for inclusion into reference (b) by 25 May 1995. Enclosure (1) is a draft of SOF communications requirements.

2. Upon USCINCSOC approval of enclosure (1) COMNAVSPECWARCOM will forward requirements to COMSPAWARSYSCOM (PMW-173) for inclusion into reference (b).

3. COMNAVSPECWARCOM point of contact is LT. Long, DSN 577-2237 or commercial (619) 437-2237.

/S/
A. J. RONACHER
By direction
Copy to:
COMNAVSPECWARGRU ONE (N6)
COMNAVSPECWARGRU TWO (N6)

COMMUNICATIONS CONNECTIVITY REQUIREMENTS FOR SPECIAL OPERATIONS FORCES (SOF)

E1. INTRODUCTION

The current unstable world environment has created a greater need for highly trained, and superbly equipped Special Operations Forces (SOF). The multiple threat scenario now emerging poses an increasing requirement for timely, accurate information to support the varied, diverse roles and missions assigned to United States Special Operations Command (USSOCOM). Given the draw-down of forces and reduced Department of Defense (DOD) budget, SOF must rely on commercial development to maintain state-of-the-art command, control, communications computers, and intelligence (C4I) capabilities and to satisfy operational and intelligence information requirements.

SOF are surgically precise, penetration-and-strike forces capable of responding to limited, specialized contingencies across the full range of military operations with stealth, speed, and audacity. The traditional roles of SOF include performing as warrior-diplomats who influence, advise, and train foreign indigenous forces. Becoming more and more the force of choice SOF must be equipped and trained to perform a wide variety of diverse special operations missions.

To carry out these missions, SOF are drawn from the following USSOCOM components:

- U.S. Army Special Operations Command

- Naval Special Warfare Command

- U.S. Air Force Special Operations Command - Joint Special Operations Command

G2. PURPOSE

The primary purpose of the USSOCOM C4I strategy is to provide the finest support possible to the warfighter. To ensure the required C4I support is available, USSOCOM performed a detailed bottom-up review of requirements resulting in a comprehensive C4I strategy.

This strategy is designed to yield direct benefits by giving SOF state-of-the-are technology through improvements to existing inventory. New developments will be pursued only when necessary Direct operational support is the product of this strategy Access to the infosphere will be transparent to the user allowing operational elements to deploy anywhere in the world with command and control connectivity assured from garrison or deployed locations. The intent is to enable exploitation of the infosphere at the lowest possible tactical level. As stated in the C4I for the Warrior paradigm: “The infosphere contains the total combination of information sources, fusion centers, and distribution systems that represent the C4I resources a warfighter needs to pursue his operational objective. “The desktop or tactical computer, in the hands of the special operator, will become a gateway into the infosphere.

The USSOCOM C4I strategy is composed of C4I doctrinal principles, a new open and flexible C4I architecture, and a redesigned investment strategy.

G3. SOF C4I DOCTRINE

Special operations C4I fundamental principles are: Global, Secure, Mission Tailored, Value Added, and Joint. These five principles ensure successful C4I support to special operation. Global. C4I systems support special operators worldwide across the full range of military operations.

Secure. Humans are more important that hardware. C4I must never compromise a live team on the ground or contribute to mission failure.

Additionally, all submarine operations involving SOF must be conceptualized and executed in such a way that protects the most vulnerable component of the mission, namely the special operations forces. Hostile, or potentially hostile, systems which pose no threat to the submarine may pose a significant threat to special operations. Operational doctrine must ensure that new systems do not alert a potential enemy to impending actions by SOF.

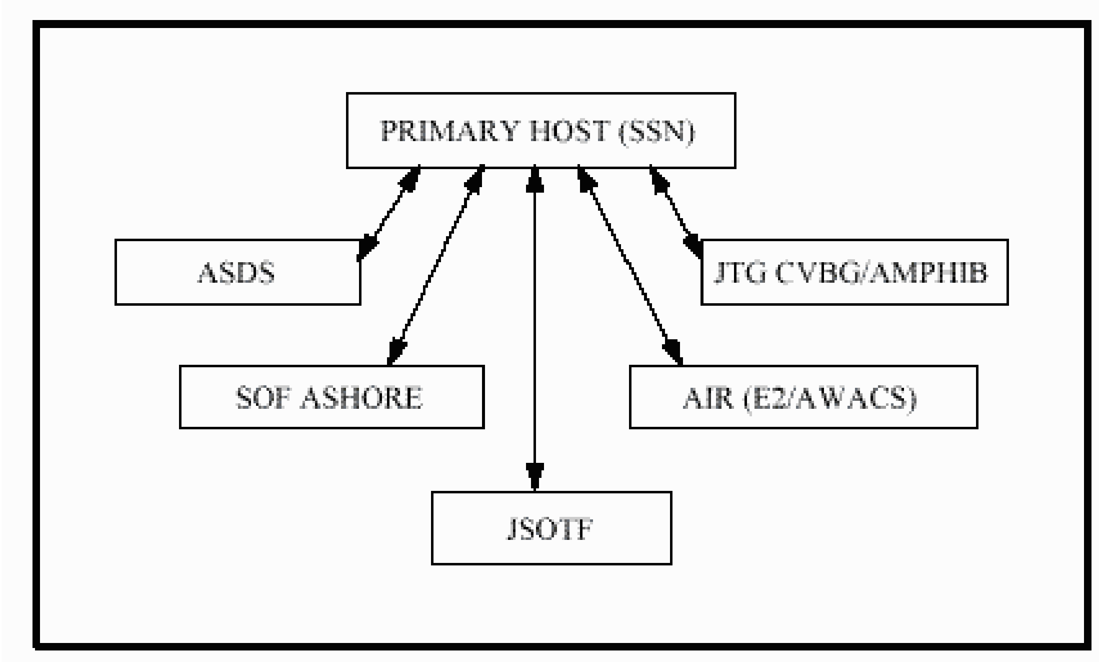
Mission Tailored. SOF cannot be mass produced. C4I systems must deploy in relation to the projected operational environment. Value Added. Quality is better that quantity. SOF must push new C4I technologies, equipment, and techniques to maintain the competitive edge.

Joint. Competent SOF cannot be created after emergencies. Special operation C4I is joint and supports joint, combined and coalition operations.

G4. SOF C4I ARCHITECTURE

The special operations C4I architecture is seamless, robust, automated, standards compliant, and utilizes the full spectrum. The architecture allows access to the infosphere to be pushed down to the lowest possible level. It also interlaces national and commercial C4I architectures with current special operation functional architectures. With proper security measures, use of commercial and host nation telecommunications structures are encouraged. The C4I structure uses National Security Agency (NSA) approved technology, procedures, and safeguards to ensure operational elements are not compromised or exploited by an enemy. To be effective, the special operations C4I architecture must be relevant to today’s conditions and adaptable to those anticipated into the 21st Century.

G5. SOF/SUBMARINE INTERFACE



G6. SOF/SUBMARINE COMMUNICATIONS REQUIREMENTS

1. HF Requirements (2-50 MHz)

a. Special Mission Radio (SMRS). The principle SMRS components are the AN/PRC-137 long-range manpack radio (MPR), its associated Digital Messages Entry Device (DMED), and the AN/TRQ-43 transportable base station (TBS). The SMRS components will be enhanced with new features and capabilities, including the implementation of the Interlocking Base Station (IBS) network. SMRS is optimized for the special reconnaissance mission but may be employed on any special operations missions requiring long-range, low-observable, or highly reliable data communication. The SMRS communications system will supplement and interoperate with other SOF C4I systems. For SOF/SUB application the MPR and DMED may be used.

b. All other HF radio applications will use Automatic Link Establishment (ALE) or straight HF, data, voice LPI/D.

2. VHF Requirement

a. Low Band (30-88 MHz). LOS communications used primarily with OF ashore and air assets. This requirement may be employed with or without SINCGARS, data, voice, LPI/D.

b. High Band (116-149 MHz). LOS communications used primarily with SOF ashore and air assets. This requirement may be employed with or without SINCGARS, data, voice, LPI/D.

c. Inter Team Radio (136-174 MHz). LOS communications to include LPI/D used between SOF Commander onboard and teams ashore. This concept employs a base station (FASCINATOR COMSEC equipment) onboard the submarine . 3. UHF Requirement

a. LOS. LOS communications used primarily with SOF ashore and air assets. This requirement may be employed with or without HAVEQUICK . b. Inter Team Radio (403-430 MHz). LOS communications to include LPI/D used between SOF commander onboard and teams ashore. This concept employs a base station (FASCINATOR COMSEC equipment) onboard the submarine.

c. SATCOM (225-499 MHz). Will be used in the 5 kHz (NB) and 25 kHz (WB) mode. DAMA and non-DAMA will be used.

Summary of SOF Threshold and Objective Capabilities

Frequency Band	Threshold Capability	Objective Capability (in addition to Threshold)
HF	Military ALE, Voice, Data	Non-military ALE, LPI/LPD
VHF Low and High Band Inter-Team Radio (ITR)	 SINCGARS, Voice, Data ITR (136-174 MHz)	 LPI/LPD ITR LPI/LPD
UHF LOS Inter-Team Radio (ITR) SATCOM	UHF LOS ITR (403-430 MHz) 5/25 kHz DAMA and Non-DAMA Voice and Data	HAVEQUICK ITR LPI/LPD

4. SHF Requirement

a. Interoperability with national/DOD databases and intelligence systems. The Joint Deployable Intelligence Support System (JDISS) access could be provided though a shared use of submarine assets or though an ADP terminal brought onboard by SOF operators.

b. Increased Data Rate to support imagery and video to and from SOF forces onboard.

c. TRI-Band. Interoperability between Ku, X, and C band required at the JSOTF and TG and TU level.

5. EHF REQUIREMENT. Interoperability with JSOTF afloat or shore.

6. IMAGERY and INFORMATION TRANSFER REQUIREMENT

a. Connectivity to an imagery and information exchange system is required. JDISS is the DOD Intelligence Information System (DODIIS) standard for accessing national and DOD intelligence databases. A laptop JDISS terminal could satisfy this requirement for the SOF operator. Additionally, connectivity to digital camera imagery transmissions is a requirement for the SOF operator to receive near real time operational updates.

b. Currently, the Naval Special Warfare Information Exchange System (NSWIXS) prototype provides the capability to transfer information to/ from SEAL operators. This data stream could be a candidate to satisfy imagery and information transfer requirements. Operating in a personal computer environment, the NSWIXS provides the SOF operator the ability to push and pull information as necessary. NSWIXS can operate over all frequency mediums. Radiant TIN compression utilized with NSWIXS makes it very effective for passing imagery. NSWIXS and Radiant TIN are currently in the prototype stage.

c. Provide a state of the art digital imaging system. The system must be capable of imagery collection and dissemination in a digital format which can be interfaces and integrated with other SOF system applications. Currently available is the Digital Video Imaging Terminal (DVITS) which has an RS232 port capable of transmitting or receiving up to 32kpbs.

7. HDR REQUIREMENTS.

These requirements include voice, VTC, PERVIZ, Photo nics, UAV, file transfer, JDISS, ATO, broadcast, IXS, naval message, OP notes. Video is the largest HDR driver with bandwidths of 128 kbps to T1 connectivity.
8. Remote SOF C2. This concept would allow simultaneous utilization of the submarine’s antenna assets by submarine and SOF operators.

G7. SOF/SUBMARINE CONFIGURATION

1. A two phased approac h needs to be considered. Short term and long term options are provided below. a. Short Term. Current DDS/SDV configured submarines that are not scheduled for SCSS upgrade require installation of SOF equipment. Current configuration consists of PRC-104 (HF Non-ALE), PSC-7 (UHF SATCOM Non-DAMA) KY-57, KY99, ADC (data packet switching device), stand alone PC, and AM-7175 (power supply). This set up is installed on the USS KAMEHAMEHA. It is desired to make this

permanent alteration for both east and west coast DDS/SDV submarines.

b. Long Term. For future requirements SCSS should include SOF communications capabilities. these capabilities include HF ALE, VHF SINCGARS, UHF HAVEQUICK , UHF SATCOM 5/25KHZ DAMA, and ADC. If these capabilities exist inherent to the SCSS then SOF would utilize submarine equipment on a not to interfere basis. However, if the SCSS cannot accommodate these capabilities then space, weight, and power would have to be available for a carry on SOF C4I capability.

MINIMUM ESSENTIAL EMERGENCY COMMUNICATIONS NETWORK MODES

Reply ZIP Code:
20318-0300 MCM-156-91
30 August 1991
MEMORANDUM FOR: Chief of Staff, US Army
Chief of Naval Operations
Chief of Staff, US Air Force
Commander in Chief, US Atlantic Command
Commander in Chief, US Pacific Command
Commander in Chief, Strategic Air Command
Subject: Minimum Essential Emergency Communications Network Modes

1. In order to provide a solid basis for operational and acquisition planning for the VLF/LF portion of the Minimum Essential Emergency Communications Network (MEECN), the following mode architecture is promulgated:

CJCS Modes 15, 9, and 9 MMPM (MEECN Message Processing Mode) are designated as the standard CJCS interoperable MEECN modes for Emergency Action Message (EAM) dissemination at VLF/LF. When the High Data Rate mode reaches Full Operational Capability, it will be included as an interoperable MEECN mode. CJCS Mode 8 (although still used by SAC for timing) and Mode 29 are deleted as interoperable MEECN modes. The above changes will be included in future updates of Emergency Action Procedures of the Chairman, Joint Chiefs of Staff, Volume VII.

2. The Joint Staff point of contact is Lieutenant Colonel Harvey Le Cato, USAF, DSN 224-5651.

For the Chairman, Joint Chiefs of Staff:
/S/

HENRY VICCELLIO, JR.
Lieutenant General, USAF
Director, Joint Staff

APPENDIX F GLOSSARY

ACRONYMS

A/D Analog-to-Digital
ABNCP Airborne Command Post
ACNO Assistant to the Chief of Naval Operations
ACS Afloat Correlation System
ACU Antenna Control Unit
ADS Antenna Distribution System
AFSATCOM Air Force Satellite Communications
AFTS Audio Frequency Tone Shift
AIS Automated Information System
AJ Anti-Jam
AM Amplitude Modulation
AMHS Automated Message Handling System
AMP Antenna Maintenance Program
ANDVT Advanced Narrowband Digital Voice Terminal
APL Applied Physics Laboratory
ARPA Advanced Research Projects Agency
AS Anti-Scintillation
AS Submarine Tender
ASDS Advanced Swimmer Delivery System
ASW Anti-Submarine Warfare
ATD Advanced Technology Demonstration
ATIS Automated Technical Information System
ATM Asynchronous Transfer Mode
ATSOL Advanced Technologies for Submarines Operating in the Littoral
AUTODIN Automatic Digital Network

BBS Baseband Switch
BCA Broadcast Control Authority
BCD Binary-coded Decimal
BCIXS Battle Cube Information Exchange System
BGC Battle Group Commander
BISDN Broadband Integrated Services Digital Network
BIT Built-In Test
BITE Built-In Test Equipment

BKS Broadcast Keying Station
BOA Basic Operating Agreement
bps Bits Per Second
BRAC Base Realignment and Closure
BTS Broadcast Transmitting Station

C 2 Command and Control
C 2 W Command and Control Warfare
C 4 I Command, Control, Communications, Computers and Intelligence
CBT Computer-Based Training
CCC CINC Command Complex
CCS Combat Control System
CCSM Combat Control System Module
CDR Critical Design Review
CDS Combat Direction System
CEG Communications Equipment Group
CEP Circular Error Probability
CEP Continuing Evaluation Program
CFE Contractor Furnished Equipment
CINC Commander-in-Chief
CINCLANTFLT Commander-in-Chief, Atlantic Fleet
CINCSOC Commander-in-Chief Satellite Operations Center
CJCS Chairman, Joint Chiefs of Staff
CMS Control and Management System
CMS COMSEC Material System
CMT Control, Monitor and Test
CNO Chief of Naval Operations
CNR Chief of Naval Research
CO Commanding Officer
COATS CCSM Off-Hull Assembly Test Site
COMOPTEVFOR Commander, Operational Test and Evaluation Force
COMSEC Communications Security
COMSUBLANT Commander, Submarine Forces, U.S. Atlantic Fleet
COMSUBPAC Commander, Submarine Forces, U.S. Pacific Fleet
CONUS Continental United States
COTS Commercial Off-The-Shelf
CSS Communications Support System
CTAPS Contingency Tactical Air Control System Automated Planning System
CTP Common Tactical Picture
CTT Commander's Tactical Terminal
CVBG Aircraft Carrier Battle Group
—MA Multiple Access
    CDMA — Code Division

DAMA — Demand Assigned
FDMA — Frequency Division
TDMA — Time Division
CW Continuous Wave

DAA Designated Approval Authority
DAMA Demand Assigned Multiple Access
DCMS Director, Communications Security Material System
DDS Dry Deck Shelter
DF Directional Finding
DII Defense Information Infrastructure
DISA Defense Information Systems Agency
DISN Defense Information Systems Network
DISN-NT Defense Information Systems Network-Near Term
DLCS Data Link Communications System
DMP Depot Maintenance Plan
DMP Depot Modernization Period
DMS Data Management System
DMS Defense Message System
DOD Department of Defense
DPSK Differential Phase Shift Keying
DSCS Defense Satellite Communications System
DSN Defense Switched Network
DSS Data Standards and Structures
DT Developmental Testing
DTD Data Transport Device
DTS Data Terminal Set

EAM Emergency Action Message
ECM Electronic Countermeasures
ECP Engineering Change Proposal
ECS Exterior Communications System
EDM Engineering Development Model
EDR Enhanced Data Rate
EHF Extremely-High Frequency
EIP Embedded INFOSEC Products
EIRP Effective Isotropic Radiated Power
EL-16 Enhanced Link-16
ELF Extremely Low Frequency
EMC Electromagnetic Compatibility
EMI Electromagnetic Interference
EOC Early Operational Capability
ESM Electronic Support Measure

ET Electronics Technician
EVS Enhanved VERDIN System

FAR Federal Acquisition Regulation
FBM Fleet Ballistic Missile
FCS Fire Control System
FD Full Duplex
FDDI Fiber-Optic Ditributed Data Interface
FEP FLTSATCOM EHF Package
FFP Firm Fixed Price
FIST Fleet Imagery Support Terminal
FLTSAT Fleet Satellite
FM Frequency Modulation
FMP Fleet Modernization Program
FOC Full Operational Capability
FSBS Fixed Submarine Broadcast System
FSK Frequency Shift Keying
FVLF Fixed Very Low Frequency
FY Fiscal Year
FYDP Future Years Defense Program

GBS Global Broadcast Service
GCCS Global Command and Control System
GENSER General Service
GFCP Generic Front-End Control Processor
GFE Government Furnished Equipment
GFI Government Furnished Information
GLOBIXS Global Information Exchange System
GMDSS Global Maritime Distress and Safety System
GOSIP Government OSI Profiles
GOTS Government Off-the-Shelf
GPS Global Positioning System
GUI Graphical User Interface
GWIS George Washington Information System

HD Half Duplex
HDR High Data Rate
HF High Frequency
HFDS High Frequency Data System
HFRG High Frequency Receiver Group
HIDAR High Data MEECN Mode
HMI Human Machine Interface
HPTS High Power Transmit System

HSBCA High Speed Buoyant Cable Antenna
HSFB High Speed Fleet Broadcast

I&A Identification and Authentication
IANC Inter-American Naval Conference
(IC)2 Integrated Interior Communications and Control
ICNI Integrated Communications, Navigation and Identification
ICS Integrated Communications System
IDS Integrated Design Specification
IEM Integrated ESM Mast
IETM Interactive Electronic Technical Manual
IF Intermediate Frequency
IFF Identification, Friend or Foe
ILS Integrated Logistic Support
INM Integrated Network Manager
INMARSAT-C International Maritime Satellite C
IOC Initial Operational Capability
I/O Input/Output
IP Internet Protocol
IPA Intermediate Power Amplifier
IPT Integrated Product Team
IRR Integrated Radio Room
ISABPS Integrated Submarine Automated Broadcast Processing System
ISB Independent Sideband
ISL Inter-Site Link
ITU International Telecommunications Union
IVTT Integrated VERDIN Transmit Terminal
IXS Information Exchange System

- BC — Battle Cube
- CUD — Common User Digital
- GLOB — Global
- MC — Mobile Cellular
- OTC — Officer in Tactical Command
- SHF — Super High Frequency
- SS — Submarine Satellite
- TAD — Tactical Data
- TADIXS A — Provides one way satellite delivery of digital data from various shore sites (SOCC/MPCC/ FOSIC/FOSIF) to Tomahawk missile equipped ships/ submarines and major afloat commanders.
- TADIXS B — Provides a UHF satellite broadcast of near-real-time contact reporting on ocean surveillance and land based emitter intercepts to tactical receive equipment (TRE) configured users, including flagships and TOMAHAWK missile equipped platforms. The standard configuration is a dual channel receive capability merged into a single processor.

JCS Joint Chiefs of Staff
JDISS Joint Deployable Intelligence Support System
JHU John-Hopkins University
JMA Joint Mission Area
JMCIS Joint Maritime Command Information System
JOTS Joint Operational Tactical System
JSIPS Joint Service Imagery Processing System
JTF Joint Tactical Force
JTIDS Joint Tactical Information Distribution System
JTS Joint Tactical Support
JTT Joint Tactical Terminal

kbps Kilobits Per Second
KP Key Processor

LAN Local Area Network
LCC Life Cycle Cost
LCS Launch Control System
LDR Low Data Rate
LDTWA Long Dual Trailing Wave Antenna
LEDS Link-11 Display System
LEIP Link-11 Improvement Program
LF Low Frequency
LFRU Lowest Field Replaceable Unit
LIC Low Intensity Conflict
LINK 16 JTIDS
LINK 22 NATO Improved Link-11
LMD Local Management Device
LOS Line-of-Sight
LPD Low Probability of Detection
LPE Low Probability of Exploitation
LPI Low Probability of Intercept
LRI Limited Range Intercept
LTCC Low Temperature Co-fired Ceramics

MAP Manufacturing Automation Profile
MATT Multi-Mission Advanced Tactical Terminal (TRE)
Mbps Megabits Per Second
MCIXS Maritime Cellular Information Exchange System
MCMTOMF Mean Corrective Maintenance Time for Operational Mission Failures
MDCS Mini-DAMA Communication Set
MDR Medium Data Rate
MDU Mission Data Update

MEECN Minimum Essential Emergency Communications Network
MEOT Message Entry Operator Terminal
MF Medium Frequency
MFI Multifunction Interpreter
MIDS Multi-functional Information Distribution System
MILSATCOM Military SATCOM
MIMIC Microwave Monolithic Integrated Circuit
Mini-DAMA Miniaturized Demand Assigned Multiple Access
MISSI MLS Information System Security Initiative
MLS Multi-Level Security
MMPM MEECN Message Processing Mode
MMS Multi-level Mail Server
MPE Message Processing Element
MPR Man-Pack Radio
MNS Mission Needs Statement
MSK Minimum Shift Keying
MTBOMF Mean Time Between Operational Mission Failures
MUST Multiple Use SATCOM Terminal
MULTS Mobile Universal Link-11 Translator System

N/A Not Applicable
NAPDD Non-Acquisition Program Description Document
NATO North Atlantic Treaty Organization
NAVCIP Naval Inventory Control Point
NAVCOMPARS Naval Communications Processing and Routing System
NAVMACS Naval Modular Automated Communications System
NAVSEA Naval Sea Systems Command
NCA National Command Authorities
NCCOSC Naval Command, Control and Ocean Surveillance Center
NCTAMS Naval Computer and Telecommunications Area Master Station
NCTC Naval Computer and Telecommunications Command
NDI Non-Developmental Item
NECC Navy EHF Communications Controller
NECC Navy EHF Communications Controller
NESP Navy Extremely High Frequency Satellite Communications Program
NILE NATO Improved Link Eleven (LINK 22)
NISE NCCOSC In-Service Engineering
NKDS Navy Key Distribution System
NMCC National Military Command Center
NONAP Non-Linear Adaptive Processor
NPM Non-Penetrating Mast
NRaD NCCOSC Research, Development, Test and Evaluation Division
NRC Nuclear Regulatory Commission

NRC Noise Reduction Circuit
NRE Non-Recurring Engineering
NRL Navy Research Laboratory
NRTF Navy Radio Transmitter Facility
NSA National Security Agency
NSSN New Attack Submarine
NST Network Signalling Terminal
NST Navy Standard Teleprinter
NTCS-A Navy Tactical Command System-Afloat
NTDS Naval Tactical Display System
NUWC Naval Undersea Warfare Center
NSWIXS Naval Special Warfare Information Exchange System

OBT On-Board Training
OEM Original Equipment Manufacturer
ONR-ST Office of Naval Research, Science and Technology Directorate
OPALT Operational Alterations
OPEVAL Operational Evaluation
OPNAV Office of the Chief of Naval Operations
OR Operational Requirements
ORD Operational Requirements Document
OSA Open Systems Architecture
OSD Office of the Secretary of Defense
OSI Open Systems Interconnection
OSS Operational Support System
OT Operational Testing
OTAR Over-the-Air-Rekeying
OTCIXS Officer in Tactical Command Information Exchange System
OTH-T Over-the-Horizon Targeting
OTS Off-The-Shelf

C — Commercial (no spec-procurable from any vendor)
G — Government (no/some spec-supply system stock)
R — Ruggedized (meets shock aspects of mil-spec)
M — Militarized (meets mil-spec)

P 3 I Pre-Planned Product Improvement
PARM Participating Manager
PC Personal Computer
PCMCIA Personal Computer Memory Card International Association
PDR Preliminary Design Review
PEIP Programmable INFOSEC Products
PLAD Plain Language Address Data
POM Program Objective Memorandum

POSIX Portable Operating System for Computing Environments
PPD Performance Planning Document
PPU Pre Production Unit
PSA Post-Shakedown Availability

RO Receive Only
RAM Random Access Memory
RCS Remote Control System
RF Radio Frequency
RFP Request for Proposal
RM Radioman

SACCS Submarine Automated Communications Control System
SARR Submarine Automated Radio Room
SATCOM Satellitte Communications
SAFS SSN Air Force SATCOM System
SC4IPS Submarine C4I Program Summary
SCAP Strategic Communications Continuing Assessment Program
SCE Standard Communications Environment
SCI Special Compartmental Information
SCI Sensitive Compartmented Information
SCMP Submarine Communications Master Plan
SCONOP Security Concept of Operations
SCPI Standard Commands for Programmable Instruments
SCPS Submarine Communications Program Summary
SCS Submarine Communications System
SCSS Submarine Communications Support System
SCUDR Submarine Communications Universe Description Report
SECT Submarine Emergency Communications Transmitter
SECNAV Secretary of the Navy
SFMPL Submarine Force Mission Program Library
SHF Super High Frequency
SHIPALT Ship Alteration
SIAS Submarine Integrated Antenna System
SIU Sensor Interface Unit
SISEM System In-Service Engineering Manager
SKP Submarine Keyboard Printer
SLBM Submarine-Launched Ballistic Missile
SLEP Service Life Extension Program
SLVR Submarine Low Frequency/Very Low Frequency VMEbus Receiver
SMB Submarine Message Buffer
SMRS Special Mission Radio System
SMTP Simple Mail Transfer Protocol

SNAP Standard Non-Tactical Automated Data Processing Program
SNMP Simple Network Management Protocol
SOF Special Operations Forces
SONET Synchronous Optical Network
SPAWAR Space and Naval Warfare Systems Command
SPECOM Special Communications
SRA Selected Restricted Availability
SRMS Smart Resource Management System
SS Support Subsystem
SSB Single Sideband
SSBN Ballistic Missile Submarine, Nuclear
SSGN
SSIXS Submarine Satellite Information Exchange System
SSLEM Supply Support Logistics Element Manager
SSN Attack Submarine, Nuclear
SSPAR Solid State Power Amplifer-Receiver
STT Shore Targeting Terminal
STU Secure Telephone Unit
SUBOPAUTH Submarine Operating Authority
SVC Switched Virtual Circuit
SW Square Wave

T Transmit Only
T/R Transmit/Receive
TAC Tactical Advanced Computer
TACAMO Take Charge and Move Out
TADIL Tactical Digital Information Link (message standard)
  TADIL-A — NATO Link 11
  TADIL-B — NATO Link 1
  TADIL-C — NATO Link 4
  TADIL-J — NATO Link 16
TADIXS Tactical Data Information Exchange Subsystem
T-AGOS Military Sealift Command Auxiliary General Ocean Surveillance
TBS Transportable Base Station
TC Time Code
TCC Tactical Command Center
TCP Transmission Control Protocol
TDA Technical Development Agent
TDMA Time Division Multiple Access
TDP Tactical Data Processing
TECHEVAL Technical Evaluation
TEMP Test and Evaluation Master Plan
TEMPALT Temporary Alteration

TESS Tailored Environmental Support System
TF Timing Fault
TFDS Time Frequency Distribution System
TFE Tailored Forward Element
TIBS Tactical Information Broadcast Service
TKAP Transmitter Keep-Alive Program
TOP Technical and Office Protocols
TPE Transmit Processor Element
TRAP TADIXS-B Broadcast
TRE Tactical Receive Equipment (TADIXS B)
TS Top Secret
TSMB Trusted Submarine Message Buffer
TTD True Time Delay
TYCOM Type Commander

UAV Unmanned Aerial Vehicle
UFO UHF Follow-on
UFO/E UFO/EHF
UHF Ultra High Frequency
USSTRATCOM United States Strategic Command
UUV Unmanned Underwater Vehicle

VERDIN VLF Digital Information Network
VHF Very High Frequency
VICS VME Integrated Communications System
VINSON VHF/UHF Wideband Tactical Secure Voice System Cryptographic Equipment
VLF Very Low Frequency
VLS Vertical Launch System
VMEbus Commercial Bus Standard (IEEE 1014-1987)
VTC Video Teleconferencing
VTS Video Teleconferencing System
VVFD Voice/Video/Facsimile/Data
VXI VMEbus Extension for Instrumentation

WAN Wide Area Network
WG Working Group

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