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FOR THE
BASELINE 10 PROGRAM

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30 June 2016	1.0	Initial DRAFT version for SRR/SFR	All
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1 Scope

1.1 Identification

This System/Subsystem Design Description (SSDD) documents the design architecture for the Aegis Baseline (BL) 10, targeted for forward fit Flight III destroyers. ACB20 will be officially renamed BL10 at the conclusion of the ACB20 System Requirements Review (SRR) in August 2016.

1.2 System Overview

The Aegis Combat System (ACS) is an evolutionary development tailored for employment on Aegis Cruiser and Destroyer Class ship. It consists of a complex of personnel, equipment, and computer programs that provide Aegis platforms with the capability to effectively carry out their missions. The combat system provides the capability to strike land targets; to seek out and destroy surface and subsurface targets; and to destroy or neutralize space, air, surface, and subsurface threats to ownship and units in company. The combat system provides the capability to implement command doctrine to detect, localize, and track targets; evaluate targets and the threat environment; and disseminate tactical information. The combat system also provides for the allocation, assignment, and control of ownship resources and assigned units, and can utilize information provided by Tactical Digital Link (TDL) Interface Units (IU) and Cooperative Engagement Capability (CEC) Cooperating Units (CU). These resources are used to engage, destroy, or neutralize space, air, surface, subsurface, and land targets. The combat system provides the tactical situation displays and decision aids employed by Command (e.g., CO, TAO, etc.) to conduct independent and task group combat operations and non-combat operations as required.

The combat system includes communications, sensor, system control, weapon, and system support elements. The sensor elements gather tactical information from the surrounding environment. System control elements assist in tactical planning, in the interpretation of the environment, and in engagement direction. The weapon or engagement elements provide the capability of either neutralizing or destroying the targets. System support elements provide various system-level functions required by the combat system, including communications, data transmission, training, readiness assessment, and electrical power control. The combat system design includes the features necessary to meet safety, human factors, electromagnetic compatibility, reliability, maintainability, and security requirements.

The control structure of the combat system is distributed, with specific levels of control residing at appropriate levels of the battle organization. System control originates with Command, which exercises control over the use of sensors, weapons, and communications. Command establishes tactical plans and doctrine, monitors the tactical situation, coordinates warfare area actions, resolves system conflicts, order weapons release, and retains override control over lower level decisions. Aegis Warfare Area Coordinators control and direct engagements within their respective warfare areas. The sensor, control, and exterior communications elements provide required data processing support for these functions. Sensor operation control resides principally with each sensor; however, orders are received from an appropriate supervisor and, during engagements, from Warfare Area Coordinators. Weapons operation control resides with the respective Weapon System. The combat system elements are summarized in Figure 1.2-1.

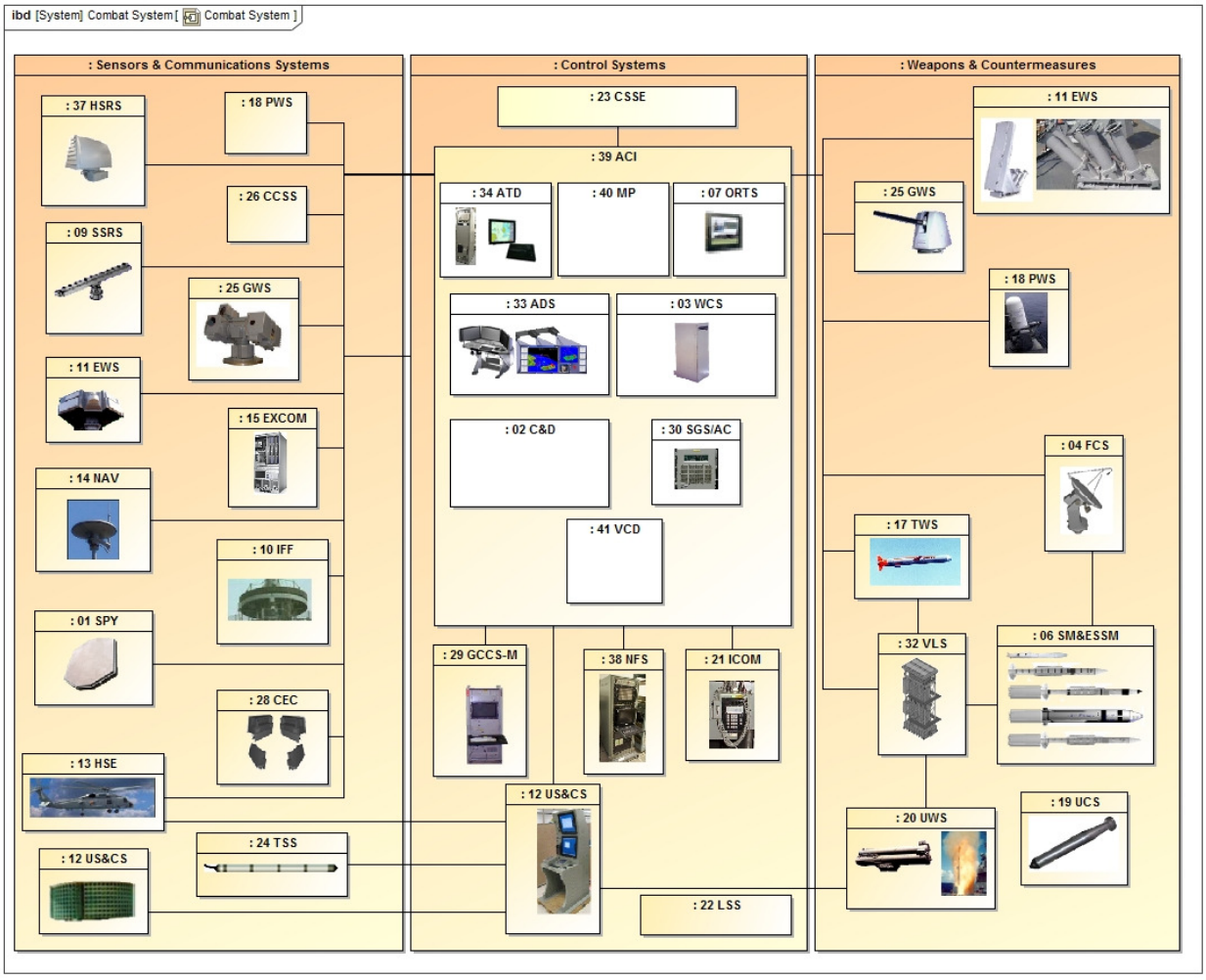

Figure 1.2-1 Aegis Combat System Elements

1.2.1 Aegis BL10 Definition

Aegis BL10 is the next generation of the Aegis Combat System for DDG Flight III.

OPNAV N96 has identified the need for an incremental enhancement to Aegis surface combatant capability that will be delivered on the Flight III ships of the DDG 51 class. Incorporation of additional capabilities on the Flight III DDGs or backfit of Baseline 10 onto earlier Flight DDGs will be addressed through other means.

Baseline 10 is an incremental enhancement of the ACS Library [Common Source Library (CSL)] beyond BL9.C2.1. Baseline 10 ships are focused on Integrated Air and Missile Defense (IAMD). The approved R3B capability improvements identified for Aegis Baseline 10 are:

- SPY-6 Radar
- BMD 6.0
- SEWIP Block 3
- ESSM Block 2
- Mk 160 GCS upgrade
- CIWS sensor integration
- Link-16 J3.4 Message upgrade

All seven capabilities will be integrated over two phases: Phase 0 for the first three ships of DDG FLT III, and Phase 1 for the fourth ship and follow-on. Phase 0 of ACB20 will include all capabilities with the exception of BMD 6.0 Phase 1 and SEWIP Block 3. BMD 6.0 Phase 1 and SEWIP Block 3 will be added for the Phase 1 ships of ACB 20.

1.3 Stakeholders

1.3.1 Aegis Stakeholders

The Aegis combat system stakeholders include:

- Fleet warfighters and trainers, the ultimate user of PEO IWS systems, who provide inputs on needs, feedback on proposed designs, and acceptance of delivered systems.
- OPNAV, the sponsor, who provides operational requirements and funding and who collaborates in the acquisition approach.
- ASN(RDA), who provides acquisition management and oversight of PEO IWS programs.
- PEO SHIPS to whom PEO IWS provides integrated combat systems.
- PEO IWS Major Program Managers (MPM), who develop components or sets of components or who integrate sets of components into an Advanced Capability Build (ACB) for a given ship class.
- Aegis Ballistic Missile Defense (BMD), who is responsible for development of the naval component of the Missile Defense Agency's (MDA) Ballistic Missile Defense System.
- Other Service and Joint PEOs who develop systems to be integrated into the combat system or to which the combat system needs to interface.
- SYSCOMs and Technical Warrant Holders provide engineering expertise and technical authority oversight for the development of PEO IWS systems and certification of the resulting products, including safety and information assurance certification.
- ASN(RDA) CHSENG, who is focused on Naval System of Systems (SoS) engineering processes and integrated mission architectures.
- Human Systems Integration community, including organizations that define training requirements, assess designs from a human factors perspective, or determine ship manning requirements.
- Developers, including component and capability developers and integrators, developers of new technologies that will transition to combat system products (e.g., Office of Naval Research), and combat system Combat Systems Engineering Agents (CSEA) who bring the components and capabilities together to provide an end-to-end combat system.
- Testers, including combat system certifiers and COMOPTEVFOR.

1.3.2 Combat System Crew

Descriptions of the crew members supported by ACS are provided below. A notional CIC role hierarchy chart is shown in Figure 1.3-1. Detailed descriptions of each position can be found in OPNAVINST 3120.32 and WS-21200/20. The Embarked Commander description was derived from NWP 3-56 and the Antiterrorism Tactical Watch Officer description was derived from CNSF 3300.1.

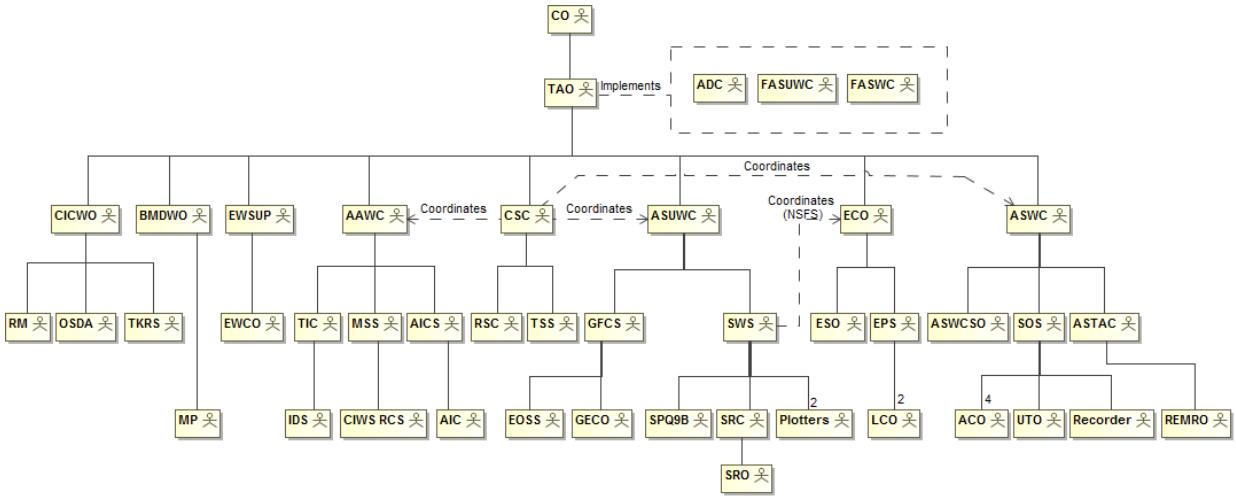

Figure 1.3-1 CIC Role Hierarchy Chart

- The Anti-Air Warfare Coordinator (AAWC) reports directly to the Tactical Action Officer (TAO). AAWC responsibilities include evaluating and countering Air and Ballistic threats to ownship, defended units and assets. The AAWC monitors ownship AW and Ballistic Missile Defense (BMD) posture and doctrine, conducts SM/ESSM, GWS/CIWS and softkill engagements, and kill evaluations when directed by the Commanding Officer (CO) or TAO. Mission areas are AW and BMD. The Air Intercept Control Supervisor (AICS), Air Intercept Controller (AIC) and Missile System Supervisor (MSS) support the AAWC with various activities to meet mission requirements. The CSC supports AAW self-defense and softkill engagements when delegated by AAWC. The primary communications are command nets (15) and external communications circuits as required.

- An Acoustic Console Operator (ACO) reports directly to the Sonar Supervisor (SOS). ACO responsibilities include operating one of the acoustic consoles in one of several modes depending on the sensors deployed. Passive returns from the Underwater Surveillance and Communications System (US&CS), Towed Sonar System (TSS), if installed, and sonobuoys can all be processed simultaneously as can active returns from the US&CS and sonobuoys. The primary communication is the internal sonar net.

- The Air Intercept Controller (AIC) reports to the AICS, AAWC, and Surface/Subsurface Warfare Coordinator (SSWC) depending on the mission requirements. AIC responsibilities include air intercept control, air identification, coordination of in-flight refueling and assessing the ability of aircraft, communications systems, sensors and control systems to perform missions. Mission areas are AW (DCA) and SUW (SUCAP and Strike). The primary communications are command nets (15) and external communications circuits as required.

- The Air Intercept Control Supervisor (AICS) reports to the AAWC or ASUWC depending on aircraft mission requirements. The ACS responsibilities include aircraft safety of flight, determining threat priorities for aircraft under control, supervising Air Intercept Controllers (AIC), managing incoming aircraft handovers, air identification, coordination of in-flight refueling and assessing the ability of aircraft, communications systems, sensors and control systems to perform assigned missions. Mission areas are Air Warfare (AW) as Combat Air Patrol (DCA), Surface Warfare Combat Air Patrol (SUCAP) and Strike. The AIC supports the AICS by controlling aircraft and making reports to meet mission requirements. The primary communications are command nets (15) and external communications circuits as required.

- The ASW/SUW Tactical Air Controller (ASTAC) provides basic air control, mission planning, emergency procedures, and pre-launch/launch procedures for Anti-Submarine Warfare/Surface Warfare Air Controller roles. The ASTAC is responsible for tactical control and flight safety of assigned USW aircraft (e.g. Maritime Patrol Aircraft). This includes tactical coordination, flight advisory control, and airspace flight safety of the MH-60R Multi-Mission Helicopter during specific mission phases. The ASTAC supports USW mission evolutions by planning and coordinating with the employment of the MH-60R Air and Ship Weapon Systems. The ASTAC provides positive control to the assigned MH-60R helicopter for detection, localization, and / or attack on surface/subsurface threats during SUW/USW missions. As the mission controller, the ASTAC is responsible for coordinating the acoustic segment activities of the ASO and electronic surveillance segment of the EWCO to accomplish SUW/USW missions. The ASTAC is responsible for monitoring the status and reporting of both the shipboard and airborne MH-60R systems, and reporting critical events to command.

- The Anti-Surface Warfare Coordinator (ASUWC) reports to the TAO and supports the Battle Group Commander and Composite Warfare Commander as required. The ASUWC is responsible for evaluating and countering the surface and subsurface threats to ownship and to defended units. He establishes and monitors ownship SUW posture and doctrine in accordance with rules of engagement, standing orders, and other applicable directives. He directs the actions of the Gunfire Control Supervisor (GFCS) and other ASUW operators and coordinates with the other Warfare Area Coordinators and resolves surface track identification conflicts.

- The Anti-Submarine Warfare Coordinator (ASWC) reports to the TAO and supports the Battle Group Commander and Composite Warfare Commander as required. ASWC responsibilities include controlling and directing USW engagements, performance of the total USW organization including ownship controlled USW aircraft, implementation of battle planning and mission control direction from the CO and TAO and, based upon this command direction. The ASWC is responsible for the subsurface long-range and short-range tactical plots, evaluates subsurface threats, and directs ownship USW sensors and weapons. The ASWC also coordinates subsurface / surface information with other warfare areas, directs the employment of ownship-controlled aircraft in ASW searches, tactics, and attacks, coordinates ownship USW reports to the force, and evaluates external source USW-related information, including data received from ownship and supporting ASW units. In performing mission control function, the ASWC coordinates the activity of escort submarines in direct support operations. ASWC is also responsible for resolving sub-surface identification conflicts.

- The ASWCS Operator (ASWCSO), aka Undersea Warfare (USW) Console Operator (USWCO) Acoustic Track Supervisor (ATS) / Fire Control Operator (FCO) or ATS / FCO reports to the ASWC and assists in USW battle planning and execution of USW mission tasks. The ASWCSO generates subsurface and surface tracks by receiving and correlating ownship contact and track data, conducting passive localization TMA, and performing intersonar triangulation and multi-unit cross fixing and coordination. The ASWCSO maintains the subsurface tactical data base and monitors sensor employment, performance, reconfiguration, and readiness. The ASWCSO is responsible for USW threat evaluation, recommending targets for engagement and for full control of ownship weapons from the designation for engagement to completion of attack and re-attack. The ASWCSO is also responsible for USW weapons status and inventory.

- The BMD Watch Officer (BMDWO) reports to the TAO and is responsible for the BMD mission area command and control (i.e., sending voice/other reports). BMDWO does not have the ability to engage tracks or modify doctrine. Those roles are executed by TAO, CSC, AAWC, RSC, and MSS.

- The Combat Information Center Watch Officer (CICWO)/ CIC Supervisor (CICSUP) reports to the TAO. The CICWO/CICSUP responsibilities include supervising the manning, communication capability, and readiness of CIC. CICWO/CICSUP mission areas include BMD, AW, Strike Warfare (STW), USW, SUW, and Amphibious Warfare (AMW). The ship's watch team supports

the CICWO/CICSUP with various activities to meet mission requirements. The primary communications are command nets (15) and external communications as required.

- The Close-In Weapon System (CIWS) Remote Control System (RCS) Operator reports to the MSS and is responsible for remote camera identification and self-defense engagements of air, missile and surface threats.

- As set forth in U.S. Navy Regulations, the Commanding Officer (CO) is charged with the absolute responsibility for the safety, well-being, and efficiency of his or her command, except when and to the extent that he or she may be relieved therefrom by competent authority.

- The Combat System Coordinator (CSC) reports to the TAO and is responsible for assisting the TAO in managing the Combat System and ensuring that the Combat System is operating at the highest degree of availability possible. The CSC has responsibility for application of doctrine controls and of ownship planning and assessment tools in support of the CO and TAO. The CSC is one of the on-watch Mission Planner operators, using the Mission Planner to develop, implement, and modify single-ship BMD missions when directed by the CO. The CSC also supports the AAWC during self-defense engagements and directing softkill employment as required. The ship's watch team and CSOOW support the CSC with various activities to meet mission objectives. Primary communications are command nets (15) and external communications as required.

- The Force ADC/ASUWC/ASWC operator performs warfare commander duties to ensure the force situation is current, warfare intentions are broadcast, asset planning and placement is executed, and communication between force units is established. The TAO will implement one or more of these Command responsibilities when directed by the Composite Warfare Commander (CWC).

- The Engagement Control Officer (ECO) reports to the TAO and is responsible for executing NSFS, Tomahawk engagement missions, when directed by CO or TAO to meet mission objectives.

- The Electronic Optical Site System (EOSS) operator reports to the GFCS and is responsible for operation of one or both optical cameras associated with the Gunfire Control System (GCS) to search, track, and engage surface and air targets as directed by GFCS.

- The Engagement Planning Supervisor (EPS) is responsible for developing firing, flight, and search plans for TLAM. The EPS is also responsible for conducting NSFS mission planning and coordination as well as recommending execution of fire missions via NFS / NFCS and GWS.

- The Global Command and Control System – Maritime (GCCS-M) Operator is responsible for maintaining the Common Tactical Picture (CTP) for non-real-time surface and subsurface data base tracks OTH via the GCCS-M system.

- The Electronic Warfare Console Operator (EWCO) is responsible for controlling the EWS and MH-60R ES and EA via the EWS Display and SLQ-32(V)6 Console. EWCO duties also include emitter detection and evaluation, emitter to emitter triangulation, including both local and remote, MH-60R ESM, and the data links. EWCO also responsible for the setup of the EW library, radio frequency bands and true bearing sector search. The EWCO is also responsible for softkill engagements using decoys including NULKA and, on AECM equipped ships, AECM in accordance with set modes of operation.

- The Electronic Warfare Supervisor (EWSUP) reports to the TAO and is responsible for the coordination of the EW systems information and accuracy of source data to the Combat System. EWSUP also is responsible for reporting force EMCON violations. The EWSUP is the primary

operator supporting softkill engagements and responsible for authorizing decoy launch, but can delegate responsibility to AAWC/CSC.

- The Gun Engagement Console Operator (GECO) controls one or both guns acting on gun assignments made by the GFCS. The GECO may also control one or both EOSS, if in external control, and released to GWS control by C&D.

- The Gun Fire Control Supervisor (GFCS) is responsible for the effective and safe employment of the Gun Weapon System (GWS). The GFCS takes direction from the ECO for NSFS using NFS / NFCS. The GFCS can also control the EOSS and SPQ-9B radar set controls during SUW surveillance and engagement missions.

- The SPA-25 Operator reports to the ASUWC and is responsible for manual detection, tracking, and DRT plot updates of surface contacts during Mode 3 casualty operations.

- The Identification Supervisor (IDS) reports to the TIC and is responsible for monitoring, identifying, and resolving identification of all air and space tracks within ownship's surveillance area. IDS is also responsible for the UPX IFF interrogator operation and readiness during surveillance missions.

- The Launch Control Operator (LCO) is responsible for TLAM missile preparation and executing the EPS firing, flight and search plans.

- The MP is an off-watch Mission Planner operator, using the Mission Planner submode to develop, implement, and modify single-ship BMD missions when directed by the CO/TAO.

- The Missile System Supervisor (MSS) reports to the AAWC and is responsible for Standard Missile (SM), Evolved Sea Sparrow Missile (ESSM), or Phalanx Weapon System (PWS), as installed, firing actions when required. MSS is also responsible for monitoring SM-2, SM-3, SM-6, ESSM, or PWS, as installed, system operation and tactical readiness and may act to enable or disable use of Fire Control System (FCS) (illuminators) and Vertical Launching System (VLS) equipment.

- The Ownship Display Assistant (OSDA), aka Ownship Display Controller (OSDC) supports command as required and operates the Digital Video Distribution System (DiVDS) Multi-Mission Display (MMD) including automated status boards, TACSITs, and video images as directed by the CICSUP and TAO. The OSDA also monitors assigned external communications circuits.

- The Dead Reckoning Tracer (DRT) Operator position has normally a north plotter (N-Plot) and a south plotter (S-Plot) stationed to support Dead Reckoning Tracer (DRT) plotting requirements. They function as DRT plotters for Naval Surface Fire Support (NSFS), surface tracking, man overboard or ASW operations. These plotters, when not supporting DRT plotting requirements, provide the long-range (beyond 30 nmi) surveillance and subsurface plotting in support of the SSWC and SWS.

- The Log Keeper/Recorder operator monitors the acoustic recorder, annotating the signal when ordered by the Sonar Supervisor.

- The Remote Radar Operator (REMRO) supports the ASTAC operator with remote sensor controls of Multi-Mission Radar (MMR), Identification Friend or Foe (IFF), Inverse Synthetic Aparture Radar (ISAR), and Forward Looking Infrared (FLIR) segments and includes track control management during MH-60R helicopter operations.

- The Radio Monitor (RM) reports to the CICSUP and monitor communication on exterior voice circuits as required. The RM personnel associated with GWS are responsible for communicating

with forward observers, and monitoring digital and voice Call for Fire (CFF) information during NSFS / NGFS operations.

- The Radar System Controller (RSC) is responsible for the operation, monitoring, evaluation, and performance of the SPY Radar System in multi-mission environments. The RSC is also an on-watch Mission Planner operator, using the Mission Planner to develop, implement, and modify single-ship BMD missions when directed by the CO/TAO.

- The Sonar Supervisor (SOS) performs acoustic sensor management functions. The SOS reports to the ASUWC or ASWC when manned for coordination of ship USW acoustic sensors, supervises Acoustic Sensor and Console Operators (ASO/ACO), and Underwater Telephone Operator (UTO) activities, correlates and integrates acoustic sensor data, and assists in USW battle planning and execution of mission tasks. The SOS assists the ASWC in evaluating and classifying acoustic contacts by assuring orderly reports of accurate contact, localization, and classification information to the ASWCS operator. The SOS coordinates, schedules, and employs acoustic countermeasures. The SOS supervises the execution of environmental sensing and acoustic performance prediction tasks. The SOS monitors and reports the status of USW acoustic sensor readiness.

- SPQ-9B Operator reports to the SWS on the status, settings, and modes of operation established for the SPQ-9B radar during AAW/SUW missions. The SPQ-9B operator monitors the performance and sectors enabled during ASMD operations.

- The Surface Radar Controller (SRC) aka Surface Radar Operator (SRO) reports to the SWS on the operation of the SPQ-9B radar when assigned. The SRC is responsible for detection, monitoring, and identification of SPQ-9B tracks and radar set control.

- The Bright Bridge Display (BBD) Operator is responsible for coordination and support of surface surveillance between CIC and the Pilot House during Condition I operations. The BBD Operator utilizes the Pilot House thin client for coordination of lookout visual identification and CIC recommendations to the OOD.

- The Surface Warfare Supervisor (SWS), reports to the ASUWC and is responsible for detecting, monitoring, identifying, and evaluating surface contacts within the surveillance area. The SWS will also assess, coordinate, and evaluate anti surface warfare operations. The SWS coordinates with IDS to enter, update, and correct identification of all surface tracks within ownship's surveillance area.

- The Tactical Action Officer (TAO) reports to the CO and is delegated with weapon release authority for the safe and effective operation of the combat systems (including aircraft under tactical control) and for any other duties prescribed by the CO. The TAO supports the Battle Group Commander and Composite Warfare Commander as required. The TAO is responsible for the smooth and efficient operation of the Combat Information Center (CIC) including collection, display, and dissemination of tactical and other operationally significant data. Circumstances permitting, the TAO carries out orders and reports any deviations to the Commanding Officer. The TAO keeps the CO fully informed of the current tactical picture and informs the CO on any and all matters which pose a potential combat threat to ownship. The TAO, when authorized by the CO will direct the employment of weapons and direct the Officer of the Deck to maneuver as required to fight or defend the ship. Primary communications are command nets (15) and external communication circuits as required.

- The Tactical Information Coordinator (TIC) reports to the TAO and is responsible for data link management including all tracking, identification, and reporting that is transmitted from ownship. The TIC coordinates directly with the AAWC to monitor, assess, and update track identification.

TIC also manages CEC DDS control and composite ID doctrine criteria during Battle Group operations.

- The Phone Talkers (TKRS) monitor and communicate on the Captain's Battle and Lookout nets.

- Tactical Signals Supervisor (TSS) or OPINTEL analyst reports to the TAO and performs functions associated with the cryptological combat support system to provide threat indications and warnings along with intelligence information.

- Tomahawk Weapons Control (TWC) Operator reports to the EPS and responsibilities include control and monitoring the targeting, pre-setting, and launching of Tomahawk missiles. TWC operators also conduct periodic OTH targeting database updates. Primary communications are command nets as required.

- The Underwater Telephone Operator (UTO) is an "as assigned" position not currently included in any ACS related SMD or NTSP. When assigned the UTO transmits and receives communications sent via the underwater telephone.

1.3.3 Other Ship Stakeholders

The following interfacing crew members from other shipboard departments have been included to provide context for combat system operations.

- The Antiterrorism Tactical Watch Officer (ATTWO) is the single action officer with weapons release authority while in port, and is responsible for execution of tactical command and control of security forces afloat when the ship is in port. The ATTWO is the single point of tactical leadership for all personnel manning security posts in support of the Antiterrorism (AT) plan. He reports directly to the CO, and is responsible for assessing the tactical environment, evaluating threat situations, exercising command and control over assigned forces, ensuring safe fields of fire, maintaining communication with organic and non-organic security forces, and maintaining awareness of any restricted zones around the ship and Naval Vessel Protection Zone. The roles of the Antiterrorism Tactical Watch Officer were derived from CNSF 3300.1.

- The Aviation Officer (AO) is the head of the Aviation Department, and in charge of the helicopter detachment on the ship. He/she is responsible, under the Commanding Officer, for the specific missions of the embarked aircraft, including safety of the aircraft and flight deck, maintenance of helicopters and assigned equipment, supervision of helicopter operations, training helicopter operations and support personnel, and advising the Commanding Officer on flight operations, including flight scheduling and improvements in air operations.

- The head of the Supply Department will be designated the Supply Officer (SO). In addition to those duties prescribed elsewhere by regulation for the head of a department, he/she will be responsible, under the Commanding Officer, for procuring, receiving, storing, issuing, shipping, transferring, selling, accounting for, and, while in his/her custody, maintaining all stores and equipment of the command, except as otherwise prescribed in OPNAVINST 3120.32C.

- The Officer of the Deck (OOD) underway is designated by the Commanding Officer to be in charge of the ship including its safe and proper operation. Among other duties described in OPNAVINST 3120.32C, the OOD is responsible for supervision of the personnel on watch on the bridge, being aware of tactical and geographic factors which may affect safe navigation, and issuing necessary orders to the helm and main engine control to avoid danger, to take or keep an assigned station, and to change course and speed following orders of proper authority. The OOD coordinates with the TAO to direct ship maneuvering for self-defense, helicopter recovery, or ship mission tasking.

- The Combat Systems Officer of the Watch (CSOOW) is the unifying watch station for coordinating all Combat System Operational Sequencing System (CSOSS)-based operations. Using CSOSS procedures, status boards, and other reference materials, the CSOOW communicates with CIC, Action Area Supervisors, Engineering, Damage Control, and Supply in order to coordinate system initialization, configuration changes, and casualty control/restoration. For non-combat and in-port periods, the CSOOW maintains positive control of the combat system during all evolutions. The CSOOW supports the CSC with various combat system maintenance activities to meet mission objectives, including directing network configuration. This centralized control enhances safety and security between times of heightened readiness.

1.4 Document Overview

This document is organized as follows:

1. Scope – identifies the architecture design description, its purpose, scope, and stakeholders.
2. Referenced Documents – provides a list of documents referenced within the main body of this document.
3. System-Wide Design Decisions – presents system wide-design decisions that are pertinent to system behavior and other decisions affecting the selection and design of elements.
4. System Architectural Design – contains the architecture design of the Combat System. This section is structured by domains and elements.
5. Requirements Traceability – provides a mapping from the Combat System functions and requirements to the elements.
6. Notes – Provides the acronyms used in this document
7. Appendix A – Aegis BL10 Combat System Use Case Report
8. Appendix B – Aegis BL10 Combat System Functional Architecture
9. Appendix C – Mapping of Aegis Functions to Combat System Elements
10. Appendix D – Capability Designs
11. Appendix E – AWS Component Level Capability Designs
    This appendix has been merged into Appendix D.
12. Appendix F – Element Behavior to Function Mapping and Description
    This appendix is no longer used.
13. Appendix G – SV-7 (MOPs, KPPs, TPMs)

2 Referenced Documents

The following references were used in development of this document. Additionally, the interface design specifications identified in Section 4.3 were also used as references.

ID	REFERENCE DOCUMENT
[ADD]	PEO IWS Surface Navy Combat Systems Product Line Software Architecture Description Document (ADD), Revision 1.0, 31 Jul 2009.
[IWS Ser IWS/129]	PEO IWS, Aegis Advanced Capability Build (ACB) 14 Execution Letter 3910, Ser IWS/129, 16 Apr 2010.
[OPNAV Ser N86/10U160299]	OPNAV N86, ACB-14 Implementation Letter 3910, Ser N86/10U160299, 4 Nov 2010.
[CSEL]	PEO IWS, DDG 112 Combat System Equipment List (CSEL).
[ACB 12 SAD]	ACD 9657/1, LM MS2, System Architecture Document (SAD) for the Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB 12), 2 Sep 2009.
[BL9A CG CDD]	ACD 9799/6B, LM MS2, Configuration Definition Document (CDD) for Baseline 9A (CG 59 – CG 62), 29 March 2012.
[BL9C DDG CDD]	ACD 9799/2C, LM MS2, Configuration Definition Document (CDD) for Baseline 9C (DDG 51 – DDG 78), 28 March 2012.
[DDG 113 CDD]	LM MS2, Configuration Definition Document for Aegis Guided Missile Destroyer Combat System (DDG 113 and Follow), Initial Issue, 16 December 2010
[F2D2]	RCA, DG-A028-04, DDG Combat System, Functional Flow Diagrams and Descriptions (F2D2) and Operational Sequence and Timing Diagrams (OSATDs), 1 May 1983.
[CG ROC/POE]	OPNAVINST 3501.160C, Required Operational Capabilities (ROC) and Projected Operational Environment (POE) for CG 47 (Ticonderoga) Class Guided Missile Cruisers, 19 September 2012.
[DDG ROC/POE]	OPNAVINST F3501.311B, Required Operational Capabilities (ROC) and Projected Operational Environment (POE) for DDG 51 (Arleigh Burke) Class Guided Missile Destroyers, 9 September 2012.
[ACB 12 C&D CPRS]	WS-21240/12, Computer Program Requirements Specification for Command and Decision System (C&D) Mark 3 Mod 5 and 6 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12), CDR Version, 2 Sep 2009.
[ACB 12 ADS CPRS]	WS-21366/8, Computer Program Requirements Specification for Aegis Display System (ADS) Mark 8 Mod 1 and 2 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12), CDR Version, 2 Sep 2009.
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3 System-Wide Design Decisions

This section presents system wide-design decisions that are pertinent to system behavior and other decisions affecting the selection and design of Combat System elements.

3.1 Product Line Software Architecture

The Program Executive Office, Integrated Warfare Systems (PEO IWS) is adopting a product line approach to combat system software acquisition. The Surface Navy Combat System Product Line Software Architecture is intended to guide the development and construction of new combat systems and new capabilities added to existing combat systems. The architecture defines a set of common core software components and services, as well as a common data model that PEO IWS intends to formally specify and use to manage component interfaces.

The following precepts were identified as the key precepts to govern the definition of the Surface Navy combat system product line software architecture and defined in the PEO IWS Surface Navy Combat Systems Product Line Software Architecture Description Document (ADD):

- Software Product Line Approach
- Component-Based Architecture
- Modular Open System Approach (MOSA)
- Common Data Model / Publish-Subscribe
- Layered and Multi-Tiered Design
- Net-Centric Data Strategy
- Service-Oriented Architecture (SOA)
- Location Transparency
- Component Distribution and Concurrency
- Fault Tolerance
- Managed Quality of Service (QoS)
- Support for Embedded Training
- Automated Software Testing

These precepts were followed as appropriate to the system wide design decisions required to implement BL10 capability upgrades within the context of the Baseline 9 legacy architecture.

3.2 Element Architecture Decisions

There are no new elements associated with BL10.

3.3 Capability Upgrade Decisions

BL10 capability behavior changes were categorized into the following areas:

- SPY-6 Integration
- BMD 6.0
- ESSM Block 2
- SEWIP Block 3 (Phase 1 Only)
- CIWS Sensor Integration
- Mk 160 Gun System Upgrades
- Link-16 J3.4
- Cybersecurity

The following paragraphs describe the overall architectural approach for each capability. Section 4.2, Concept of Execution, and Section 4.3, Interface Design, provide architectural details for each capability.

SPY-6 Integration

BL10 will implement the solid state, active face, phased array, Air and Missile Defense Radar (AMDR) (AN/SPY-6), the U.S. Navy's next-generation radar, for installation on future platforms to support joint battlespace threat awareness and defense, including BMD, area air defense, ship self-defense, and IAMD. SPY-6 will provide increased radar resource efficiency improving capabilities in the areas of sensor sensitivity, search frame time, raid handling, and performance in a natural complex environment. SPY-6 will integrate with BL10 by completing the same functional assignments previously held responsible by SPY-1 with the exception of the following: some missile communication functionality has been moved from SPY to WCS, and track reporting logic has been moved from SPY to C&D. SPY-6 still performs transmit/receive of uplinks/downlinks to the missile but uplink/downlink processing is performed by WCS. The Electronic Protection (EP) enabled by new digital architecture and software within SPY-6 provides a capability against complex noise and deceptive jamming. SPY-6 will also provide capabilities to support surface target tracking, splash detection, and projectile tracking; and Electronic Support (ES), Electronic Attack (EA), and Electronic Warfare (EW) operations.

BMD6.0

BL10 will integrate with the next increment of AEGIS BMD capability, the AEGIS BMD 6 baseline. Implementing BMD6.0 will leverage the radar benefits and improved capability delivered by AN/SPY-6 and the associated ACS modifications. BMD6.0 will retain all capabilities delivered in BMD5.1 as well as increased capability with organic engagements, raid density planning and execution, and surveillance and tracking. Increased capability refers to improvements in performance, threat space, engagement type, number of simultaneous engagements, and BMDS layered, defense-in-depth capabilities to actively defeat ballistic missiles.

ESSM Block 2

BL10 will utilize the newly developed RIM-162 Evolved Sea Sparrow Missile (ESSM) BLK 2, a short range missile intended to provide self-protection for surface ships through the ability to engage a variety of antiship cruise missiles and aircraft to support self-defense. The integration of the ESSM BLK 2 will be developed by Baseline 9.C2.

SEWIP Block 3 (Phase 1 Only)

BL10 will support the Surface Electronic Warfare Improvement Program (SEWIP) BLK 3 installations using the product line architecture. SEWIP BLK 3 provides a full suite of EW capabilities that can be managed and controlled manually, semi-atomatically, or automatically by the combat management system. The SEWIP BLK 3 sensor, SLQ-32A(V)7, is the next iteration of the SLQ-32 sensor, introducing new capabilities for organic EA and EA jamming techniques to defeat modern ASCMs. The integration of SEWIP BLK 3 with BL10 will require new processing of the ACS to manage hardkill and softkill coordination and prevent destructive interference.

CIWS Sensor Integration

BL10 is leveraging the sensor data from the search and track sensors from the Close-In Weapon System (CIWS). Integration of the search and track data increases frequency diversity by combining the CIWS, AN/SPY-6, and SPQ-9B radars. The additional sensor will also provide coverage in the AN/SPY-6 blockage zones and in high clutter or littoral environments.

Mk 160 Gun System Upgrades

BL10 will be implementing the next upgrade for the Mk 160 Gun Computer System (GCS). The upgrade will permit sending multiple target engagements from ACS to GCS, allowing GCS to maintain multiple targets in track. New processing will decrease the time required to shift between targets and enable a distributed firing doctrine.

Link-16 J3.4

BL10 is enhancing the Link-16 J3.4 message, which modifies the subsurface track message to a real-time message with a new track quality field. The new field will allow track number continuity between unique tracking platforms. The enhancement will increase the warfare commander's ability to prosecute subsurface tracks, improve situational awareness, and reduce delay in ASW detection to engagement sequence.

Cybersecurity

The cybersecurity architecture for ACB20 is built upon a layered application of security controls creating a Defense-in-Depth (DiD) strategy that begins at the skin of the ship and continues to build to the core of the computing infrastructure. This is illustrated in Figure 3.3-1.

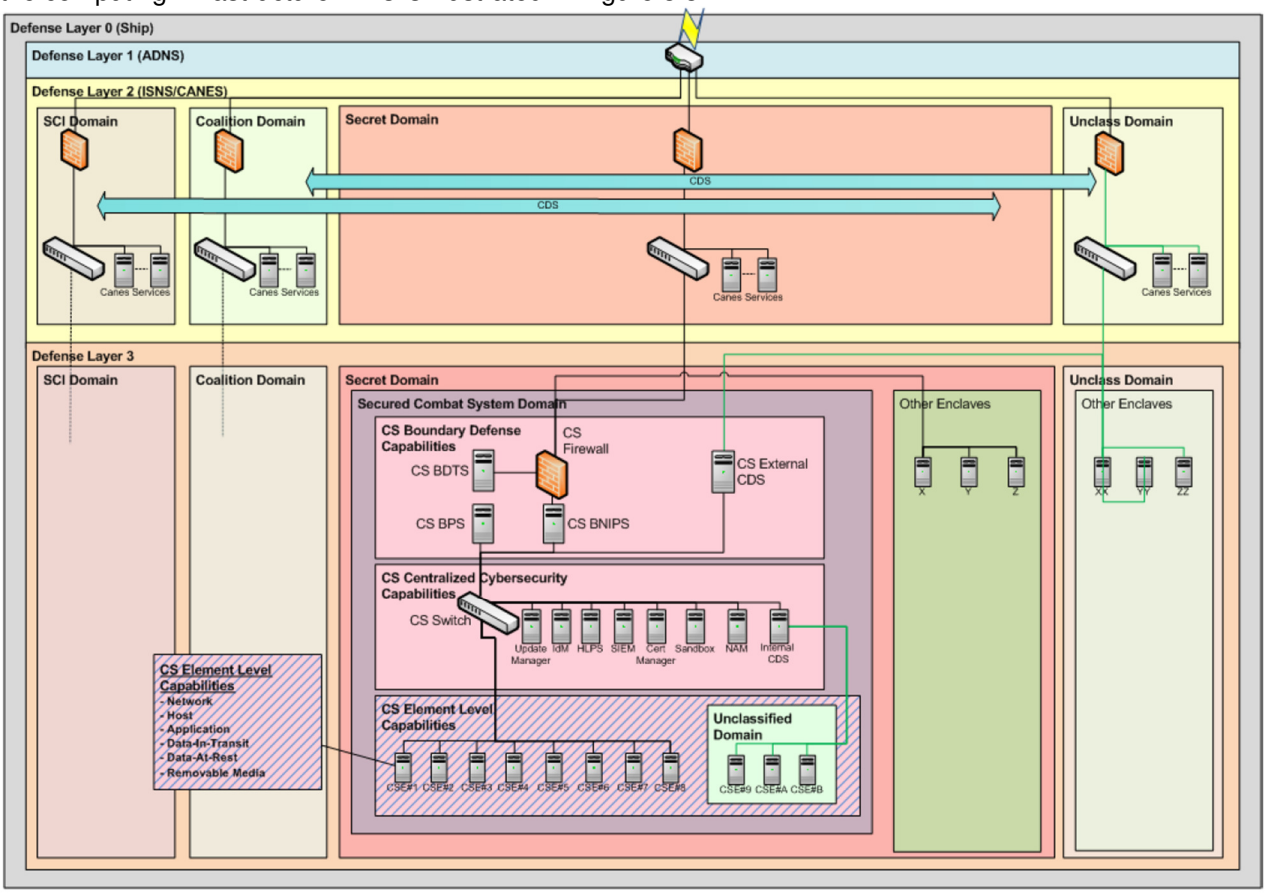

Figure 3.3-1 ACB20 Defense in Depth Architecture

The NAVSEA PEO-IWS 7.0 Information Assurance Manager (IAM) has defined an overall breakdown of the ship into following levels:

- **Defense Layer Zero** – Physical Ship Control: This level represents the ship and the physical controls provided.
- **Defense Layer One** – Ship Point of Entry (POE): This level's primary purpose deals with data entering and exiting the ship.
- **Defense Layer Two** – Ship Network Backbone: This level's primary purpose deals with moving data between various systems and domains within the Defense Layer Three.
- **Defense Layer Three** – Communities of Interest (COI) Domains: This level contains multiple domains which contain one or more systems. These domains have similar functional purposes. Examples of those maybe Combat Systems (CS) and Hull, Mechanical and Electrical (HM&E). This layer contains the Secured Combat System Domain which is the focal point of the cybersecurity requirements defined for the ACB20 baseline. Figure 3.3-2 Figure 3.3-2 Secured Combat System Domainidentifies the components that make up the controls for the domain.

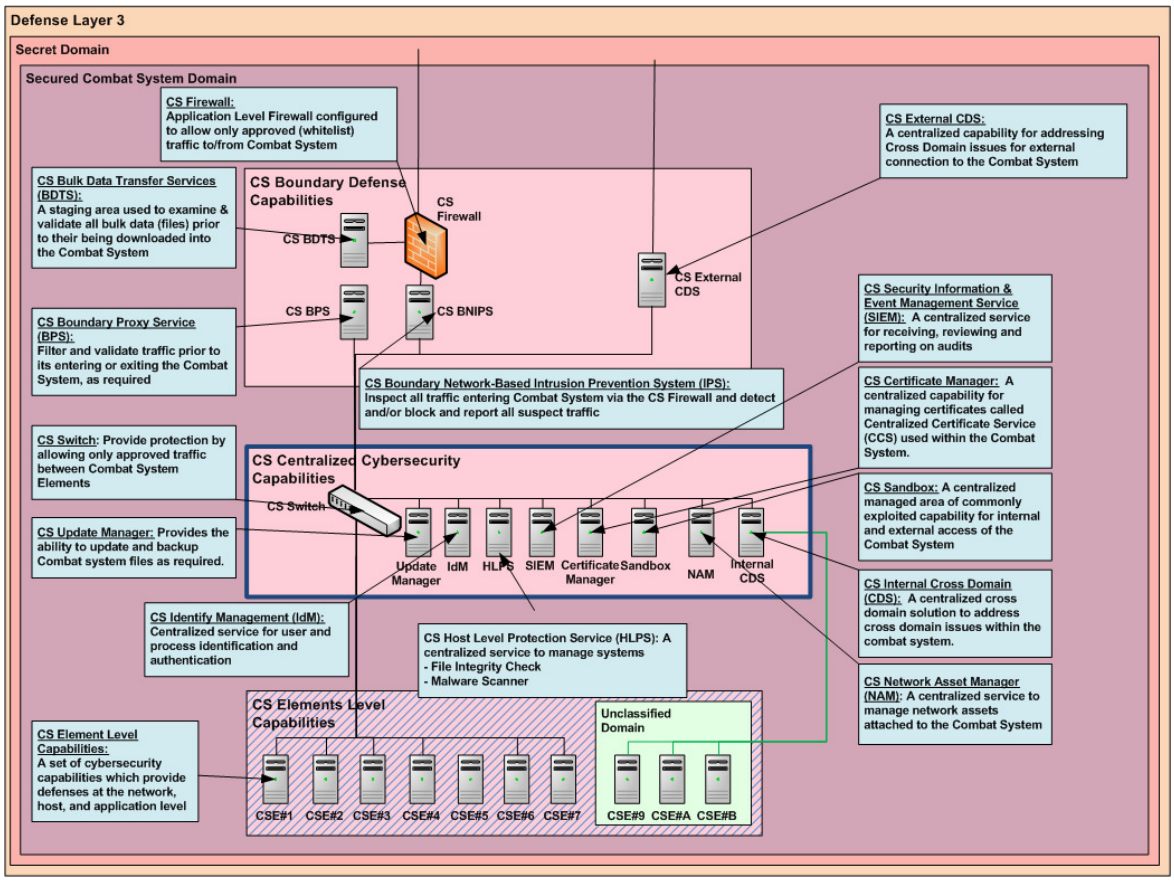

Figure 3.3-2 Secured Combat System Domain

Specification Updates

Table 3.3-1 shows the elements with A-Specification Volume II or Volume III updates and the capability area causing the impact. Using the element level allocation as a foundation, interface impacts were identified and A-Specification Volume II and Volume III System Changes (SC) were created. It does not include editorial changes.

Table 3.3-1 Impacted Elements (Volume II/III Requirements Change) per Capability Area Analyzed

	SPY	ADS	C&D	WCS	MP	VCD	EWS	HSE	US&CS	ATD	ACI	CSSE	ORTS	GCCS- M	IFF	NAV	EXCOM	GWS	CEC	HSRS	PWS	SGS/AC	NFS
SPY-6	X	X	X	X	X		X			X		X	X					X	X	X			
BMD6.0	X			X	X								X										
ESSM BLK 2			X	X	X								X										
SEWIP BLK 3					X								X										

CIWS Sensor Integration		X	X	X	X						X								X				
Mk 160 Upgrade	X	X	X			X				X			X					X					
Link-16 J3.4			X																				
Cybersecurity	X	X	X	X	X		X	X	X	X	X	X	X		X		X	X	X	X	X	X	X

4 System Architectural Design

The BL10 Aegis Combat System design is described from four perspectives. Section 4.1 provides the functional and structural perspectives on the system. Section 4.2 provides the dynamic view of the ACS by showing how the element level structural components interact to provide BL10 system capabilities. Section 4.3 provides the interface perspective and documents the system external interfaces and the internal element-to-element interfaces.

4.1 System Overview

This section provides the functional and structural perspectives of the ACS architectural design. Section 4.1.1 describes the top tier of a three tier functional decomposition of the combat system. Appendix A provides details of the functional decomposition. Section 4.1.3 provides the element level structure of the ACS. Section 4.1.2 references Appendix C which provides a mapping between the functional and structural perspectives.

4.1.1 Functional Architecture

This section provides a summary of the Aegis BL10 Functional Architecture including the top level (Tier 0) function definitions, and a simplified representation of the Tier 0 functional flow. The complete functional architecture including Tiers 0, 1, and 2 function names, definitions and activity diagrams are presented in Appendix A.

The Aegis Combat System functional architecture has been developed through careful review of existing Aegis combat system element requirements found in Section 3.7 of WS-21200/20, and is partitioned into several Tiers. Tier 0 has been reorganized from 14 to 8 functions to reflect operational “use cases” that are derived from Naval Tactical Activities (NTA) assigned to Aegis by Fleet Forces Command [DDG NMETL]. This was done to allow direct mapping to fleet training requirements that are categorized by NTAs. Tier 1 decomposed the 8 Tier 0 functions into manageable sub-functions. Each Tier 1 function is decomposed into system specific Tier 2 functions. The Tier 2 functions are from the Joint Common System Function List (JCSFL) (where applicable). Use of the JCSFL ensures that future DoDAF architecture products comply with DON CIO guidance that requires the use of the JCSFL for DoDAF SV-4 Systems Functional Descriptions [DON ADG].
Tier 3 functions have been defined to reflect specific functionality that is allocated to the combat system elements; i.e. the JCSFL derived Tier 2 functions within this document provide reference architecture functionality that is further decomposed to system specific Tier 3 functions that are allocated to elements and within the scope of the reference function.

4.1.1.1 Tier 0 Functional Architecture Summary

The Aegis Combat System functional architecture and requirements are organized by 8 top-level functions that are depicted in Figure 4.1-1.

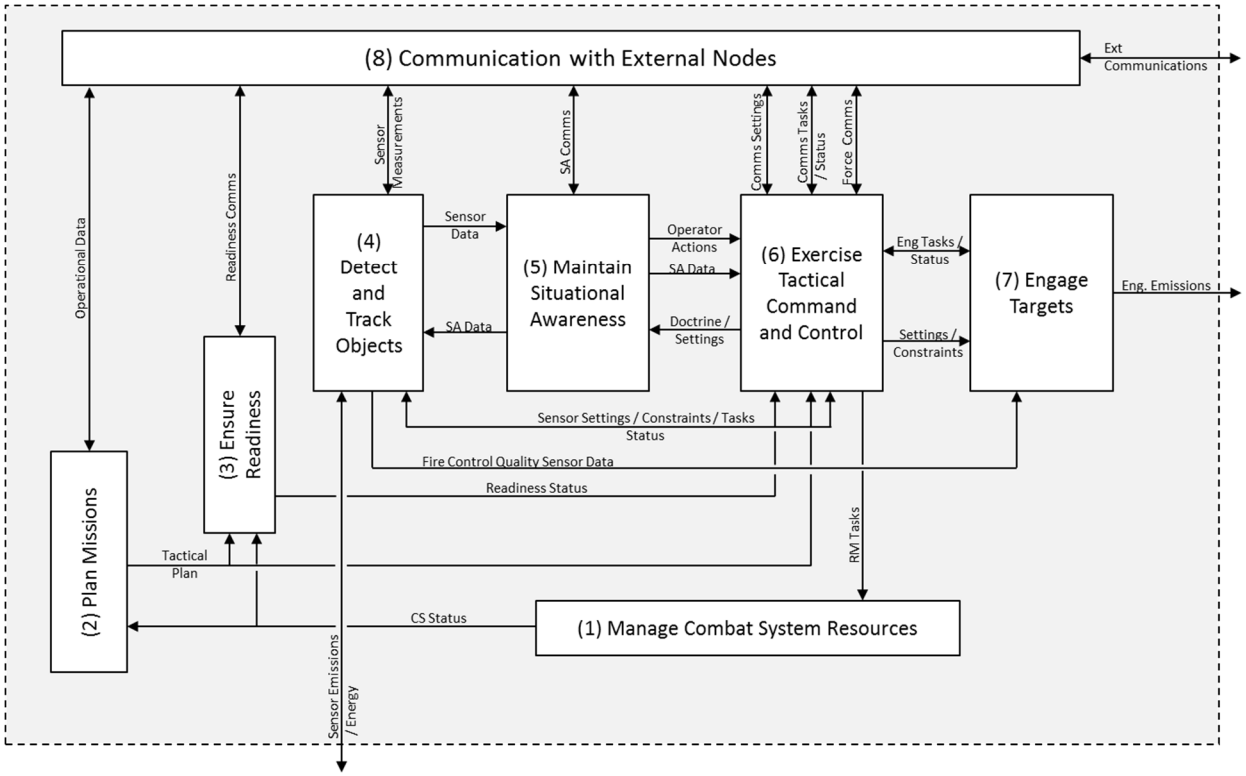

Figure 4.1-1 Aegis Combat System Tier 0 Functional Architecture

The combat system functional analysis process began with the development of 7 use cases that were derived from Naval Tactical Activities (NTA) assigned to Aegis by Commander, Fleet Forces Command (CFFC) (2010), defined in Appendix A. This approach was used to enable direct mapping of Aegis Combat System functions and requirements to fleet training requirements that are categorized by NTAs. NTAs are defined by Universal Naval Task List (UNTL) from OPNAVINST 3500.38B. The use cases were mapped into 8 functions that are further decomposed in the functional architecture in Appendix B.

Table 4.1-1 identifies the list of ACS Use Cases, the NTAs from which they were derived, and the derived Tier 0 functions. The definitions of the Tier 0 functions follow the table.

Table 4.1-1 Mapping of Use Cases to Naval Tactical Activities (NTAs) and Tier 0 Functions

Use Case	NTAs	Functions
Assess Mission Readiness	• NTA 4.3.2.1 Perform Preventive Maintenance • NTA 4.3.2.2 Diagnose and Repair • NTA 4.9.1 Conduct Mission Area Training • NTA 4.9.2 Assess Training • NTA 5.4.5 Report and Analyze Mission Readiness • NTA 5.5.5 Perform Information Assurance	Manage Combat System Resources (1) Ensure Readiness (3)
Plan Missions	• NTA 5.2.1.2 Review and Evaluate Mission Guidance • NTA 5.3 Determine and Plan Actions and Operations	Plan Mission (2)
Detect and Track Objects	• NTA 2.2.1 Collect Target Information • NTA 2.2.3.1 Search Assigned Areas • NTA 2.2.4 Assess Tactical Environment • NTA 5.5.4 Conduct Electronic Warfare Support (ES) • NTA 5.6 Conduct Acoustic Warfare	Detect and Track Objects (4)
Maintain Situational Awareness	• NTA 5.1.3.1 Maintain and Display Tactical Picture • NTA 6.1.1.3 Positively Identify Friendly Forces	Maintain Situational Awareness (5)
Exercise Tactical Command and Control	• NTA 5.2.1.1 Review and Evaluate Situation • NTA 5.2.1.3 Review Rules of Engagement (ROE) • NTA 5.2.2 Decide on Need for Action or Change • NTA 5.4.1.1 Issue Orders	Exercise Tactical Command and Control (6)
Engage Targets	• NTA 3.1.5 Conduct Tactical Combat Assessment • NTA 3.2.1.1 Attack Surface Targets • NTA 3.2.1.2 Attack Submerged Targets • NTA 3.2.2 Attack Enemy Land Targets • NTA 3.2.5 Conduct Electronic Attack • NTA 3.2.7 Intercept, Engage, and Neutralize Enemy Aircraft and Missile Targets (Defensive Counter Air) • NTA 3.2.8 Conduct Fire Support • NTA 3.2.10 Integrate Tactical Fires • NTA 6.1.1.1 Protect Individuals and Systems	Engage Targets (7)
Communicate with External Nodes	• NTA 5.1.1.1.1 Provide Internal Communications • NTA 5.1.1.1.2 Provide External Communications • NTA 5.4.1.2 Exercise Tactical Command and Control • NTA 6.1.2.1.3 Employ Communications Security	Communicate with External Nodes (8)

Summary definitions of the 8 Tier 0 functions are provided below.

1. Manage Combat System Resources

The Manage Combat System Resources function manages the computing resources within the combat system including system initialization, setting of states of modes, monitoring of computing resources, information assurance (IA), computer network defense and system recovery. Manage Combat System Resources accepts configuration and re-configuration tasking and report resource status. This function provides internal computing support for services such as time keeping, data displays, networking, data transfer, data recording, data storage, etc. This function also provides for computing infrastructure, power, cooling, and maintenance activities that include hardware and computer program updates.

2. Plan Missions

The Plan Missions function generates tactical plans for individual mission areas as well as an integrated tactical plan using operational plan(s) as the foundation and utilizing an array of tactical planning tools and decision aids. Intelligence and reference data obtained from operational command and control systems as well as the status of available tactical resources (e.g. sensors, weapons, communications, and vehicles) are used as inputs to the planning process. The plan is tailored to a particular unit's capabilities and spans multiple mission areas assigned to the unit within operational plans.

3. Ensure Readiness

The Ensure Readiness function assesses combat system readiness to include the system and its operators. Ensure Readiness provides for training to prepare sailors to fight, operate, and win at the tactical level of war and includes the assessment of current combat team capability through training and mission analysis. Ensure readiness controls training conduct and provides for generation and distribution of training scenario data. Ensure Readiness assesses the capability of the combat system equipment to conduct assigned missions through supporting trend line analysis, status monitoring and system testing including, operability and assessment testing, fault detection and isolation (FD/FI), and built-in-tests (BIT).

4. Detect and Track Objects

The Detect and Track Objects function detects objects from received energy and generates tracks and/or lines of bearing. Detect and Track Objects implements settings and constraints (e.g. radiation sector inhibit, frequency limits, etc.) and controls sensors in real-time to support mission tasking. Detect and Track Objects coordinates the use of combat system sensors to simultaneously support individual and multiple sensor tasks. Detect and Track Objects processes detections for the spectrum of active and passive sensor types including radio frequency (RF), infra-red (IR), electro-optical (EO) and acoustic. Detect and Track Objects provides sensor tracks to support both situational awareness as well as engagements with fire control quality data. Detect and Track Objects provides for raid size estimates, track association, track correlation, object classification, and object discrimination at the sensor level.

5. Maintain Situational Awareness

The Maintain Situational Awareness function provides an integrated and coherent Situational Awareness (SA) picture of objects within sensor range of ownship, ownship controlled vehicles and participating platforms to enable successful command and decision actions in support of mission and self-defense objectives. Maintain SA employs track processing of local and remote data to develop that integrated picture including track categorization, numbering, correlation/de-correlation, association and, in some cases, fusion. ID doctrine is processed by the Manage Situational Awareness function to support identification (ID) assignments. Resolution of ID (i.e. ID conflict resolution) is included in the Maintain SA function. Maintain SA provides integrated SA to support ownship tactical assessment of the current situation and tactical decisions and contributes to the shared SA across all cooperating platforms. Maintain SA includes determination of track reportability; e.g. application of tactical data link auto-reporting based upon ID, category, etc. Tactical Data Link (TDL) protocols such as reporting responsibility rules are managed by the Communicate with External Nodes function. Maintain SA provides for the display of tracks, video, overlays, maps, and associated data. Maintain SA also manages alerts and indicators and provides for the playback and display of recorded system data. Maintain SA also provides for the management and distribution of navigational data to include Global Position System (GPS), Inertial Navigation System (INS), and environmental data (e.g. wind speed, water temperature, sea state, ambient noise, bottom type, and bathymetry).

6. Exercise Tactical Command and Control (ETC2)

The Exercise Tactical Command and Control function evaluates the current tactical situation and determines the appropriate tactical actions. ETC2 determines the system configuration based upon tactical plans and system readiness. Once the configuration has been determined, ETC2 issues doctrine, settings, and constraints to combat system elements to include sensors, weapons and communications systems. ETC2 identifies threats and determines tactical action to include engagement orders, maneuver orders and system configuration orders. ETC2 continuously monitors the mission-level effectiveness of ordered actions. ETC2 coordinates resources to achieve mission requirements through sensor tasking, weapon-target pairings, Force Orders, and mission assignments to aircraft under ownship control.

7. Engage Targets

The Engage Targets function reacts to ETC2 ordered actions by providing combat system weapon engagement capabilities. Engage Targets accepts weapon tasks (for both hardkill and softkill), selects weapons, schedules weapons, controls weapons, and generates engagement emissions to include ordnance, illumination, EA, decoys and directed energy. Engage targets provides for the calculation of guidance commands for guided missiles, provides associated missile communications, and provides missile processing of uplink commands (which occurs on the missile itself). Engage Targets is also responsible for status reporting and weapon effectiveness assessment to ensure engagement objectives and weapons safety.

8. Communicate with External Nodes

The Communication with External Nodes (CEN) function controls communications devices within the combat system and accesses external communication services provided by non-combat system nodes within the ship. Communicate with External Nodes receives tasks and settings to establish communications networks. CEN formats incoming and outgoing data to/from the combat system and external nodes. Communicate with External Nodes manages TDL protocols such as terminal initialization, reporting responsibility, etc. Communicate with External Nodes provides for the exchange of ID and tracking communications such as IFF and TACAN. Communicate with External Nodes provides the user interface to the Warfare Area Commander as the primary "user of the system." At this level, combat system operators are considered to be part of the system.

4.1.2 Functional Allocation

The complete functional architecture including Tiers 0, 1, and 2 function names, definitions and activity diagrams are presented in Appendix A. The use cases were mapped into 8 functions that are further decomposed in the functional architecture in Appendix B. The allocation of Tier 3 functions to elements is captured in Appendix C. The allocation of requirements to ACS elements and to ACS element requirements is maintained in the Aegis BL9.C2 DOORS database.

4.1.3 Combat System Elements

The following section provides the identification of Combat System Element and high-level functionality for the Aegis Combat System. The elements and IDs are summarized in Table 4.1-2 below. Elements identified as (Not Used) were previously part of Aegis but retired from current Baselines – e.g. Element 05 was the Guided Missile Launching System (GMLS) – or are not part of Aegis BL10 – e.g., Element 27 IDS (SARTIS), not applicable to Destroyers. Core Aegis Weapon System elements are identified with an asterisk (*).

Table 4.1-2: Aegis BL10 Elements

Element Number (Level Code)	Aegis BL10 Element Name	BL10 Acronym	Major Subsystems Acronyms
01	Radar System*	SPY	AN/SPY-6
02	Command and Decision System*	C&D	C&D, SVS
03	Weapons Control System*	WCS	WCS, KAS
04	Fire Control System*	FCS	Mk 99 FCS
05	(Not Used)		
06	Guided Missiles*	SM & ESSM	SM-2, SM-3, SM-6, ESSM
07	Operational Readiness Test System*	ORTS	ORTS
08	(Not Used)		
09	Surface Search Radar System	SSRS	AN/SPS-73, AN-SPA-25H
10	Identification Friend or Foe System	IFF	AN/UPX-29
11	Electronic Warfare System	EWS	AN/SLQ-32(V)6, SEWTT
12	Underwater Surveillance & Communication System	US&CS	AN/SQQ-89A(V)15, AN/WQC-2A, AN/WQC-6, AN/UQN-4A, AN/BQH-7A(V)2
13	Helicopter Shipboard Equipment	HSE	AN/SRQ-4, AN/ARR-90
14	Navigation System	NAV	AIS, DHYSL, INS-R, NAVSSI, TACAN, WSN-7
15	Exterior Communications System	EXCOM	CDLMS, ADNS, JTT, NAVMACS
16	(Not Used)		
17	Tomahawk Weapon System	TWS	TTWCS, TLAM RGM-109
18	Phalanx Weapon System	PWS	CIWS
19	Underwater Countermeasures System	UCS	SLQ-25C (NIXIE)
20	Underwater Weapon System	UWS	OTSTS, VLA
21	Interior Communications System	ICOM	GEDMS, IADS
22	Logistics Support Equipment	LSS	LSS
23	Combat System Support Equipment	CSSE	CANES
24	Towed Sonar System	TSS	AN/SQR-20
25	Gun Weapon System	GWS	Mk 34 GWS
26	Cryptologic Combat Support System	CCSS	SSEE-E
27	(Not Used)		
28	Cooperative Engagement Capability	CEC	AN/USG-2B
29	Global Command and Control System – Maritime	GCCS-M	GCCS-M

Element Number (Level Code)	Aegis BL10 Element Name	BL10 Acronym	Major Subsystems Acronyms
30	Shipboard Gridlock System	SGS	SGS/AC
31	Countermeasures System (Not Used)		
32	Vertical Launching System*	VLS	
33	Aegis Display System*	ADS	ADS, Tactical Consoles
34	Advanced Training Domain*	ATD	TCP, BFTT, MH-60R Sim, TTC
35	(Not Used)		
36	(Not Used)		
37	Horizon Search Radar System	HSRS	AN/SPQ-9B
38	Naval Fires System	NFS	AN/SYQ-27
39	AWS Computing Infrastructure*	ACI	ACEGIO, ALIS, ASAN, CCS, DDS, DiVDS, Video Wall, TCD, Printer
40	Mission Planner*	MP	MP
41	Vehicle Control Domain	VCD	

4.1.3.1 SPY Radar System (01)

4.1.3.1.1 Purpose

The SPY Radar System (known as SPY) element for each baseline is the primary air and space radar for the AEGIS Combat System and is implemented by the SPY-6 Radar. The SPY-6 Radar is a multi-function phased-array radar capable of search, automatic detection, transition to track, and track of air, space and surface targets located in preselected coverage volumes. Digital control, high power output, and advanced signal processing techniques are used to provide adaptive search and multi-target tracking. The radar, capable of operating in both heavy clutter and Electronic Counter Measures (ECM) environments, has a high track capacity and is effective against a wide spectrum of target characteristics.

In addition to tracking surface and air targets, SPY-6 tracks projectiles fired by the Gun Weapon System (GWS), and provides target fire control track data to the Weapons Control System (WCS). SPY provides a communication link with the Standard Missile (SM) SM-2, SM-3, SM-6 missile and Evolved Sea Sparrow Missile (ESSM) throughout their flight to exchange midcourse guidance commands and missile status messages.

4.1.3.1.2 Requirements Satisfied

The SPY Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 2, Section 3.2.1.

4.1.3.1.3 Description

AMDR is designated as AN/SPY-6(V) when configured on DDG-51 Flt III ships. SPY-6 is functionally partitioned into RSC, RCP, DSPS, PDS, CES, FTS, DBF, Antenna Subsystem, and RTSS.

The SPY element is depicted in Figure 4.1-2.

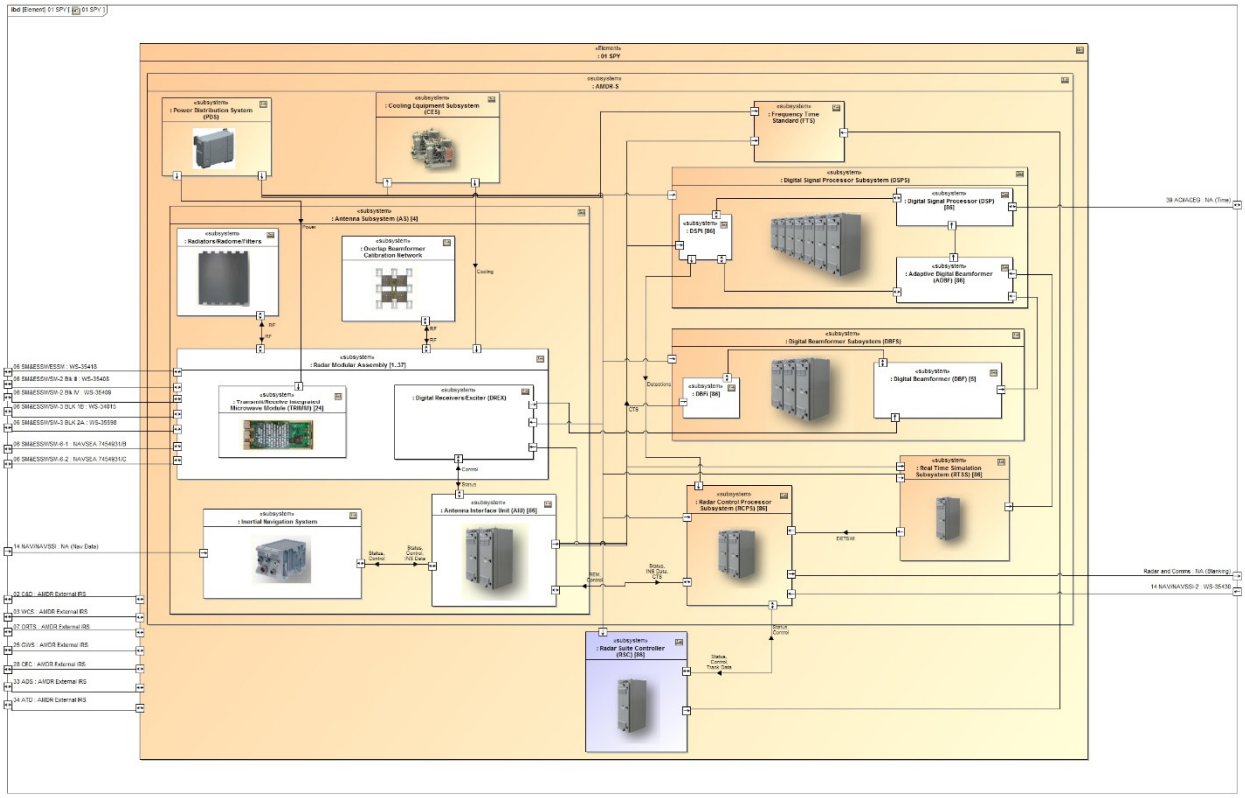

Figure 4.1-2 01 SPY

4.1.3.1.3.1 Power Distribution Subsystem (PDS)

The PDS provides alternating current (AC) and direct current (DC) power distribution to all SPY-6 subsystems.

DC functions are distributed between the DC Power Distribution and Array Power Distribution Units (APDU). The PDS provides the following DC power functions: accept alternate power sources, energy storage, soft start, DC disconnection, safety discharge, transient protection, EMI filtering, interlocks, battleshort, protection of cables, fault detection and status monitoring.

AC functions are distributed between the AC Power Distribution, Uninterruptible Power Supply (UPS), and APDUs. The PDS provides the following AC power functions: UPS to hold up AC power during interruptions, AC disconnection, protection of cables, fault detection and status monitoring.

4.1.3.1.3.2 Cooling Equipment Subsystem (CES)

The primary function of the CES is to cool the radar system components. The CES will provide the means by which heat dissipated from the Antenna and Digital Receiver Subsystems is transferred to the ship's chilled water system. The entire CES contains propylene glycol and water (PGW) coolant which is provided to the AS to dissipate heat to the ship's chilled water system.

The CES consists of two Cooling Equipment Units (CEUs) and the associated piping. Each CEU provides coolant to the AS. Each CEU consists of pumps, piping, a liquid-to-liquid heat exchanger, a filtration system, an embedded controller, power distribution, a heater, a proportioning control valve, a support structure, various valves, various sensors, other items as indicated in this specification, and internal and external electrical and mechanical interfaces.

4.1.3.1.3.3 Frequency Time Standard (FTS)

The FTS has a highly accurate and precise time and frequency reference from which AMDR-S time and frequency services are derived. Time-of-day is aligned with ship's time-of-day.

Based on a time reference signal received from the ship's Combat Management System, the FTS generates and distributed frequency and time reference signals to the radar subsystems and returns the radar time to the ship in turn.

4.1.3.1.3.4 Digital Signal Processor Subsystem (DSPS)

The DSPS accepts fully beamformed digital I&Q data from the DBFS and/or RTSS. These input beams have been formed as commanded by the RCPS. The desired action of the DSP component depends on the type of waveform transmitted, thus RCPS-generated commands are distributed by the DSPI to the DSP to direct appropriate processing of each waveform. The information extracted from the data is output to the RCPS for further processing (e.g. tracking).

4.1.3.1.3.4.1 Adaptive Digital Beamformer (ADBF)

The Adaptive Digital Beamformer performs adaptive processing on fully formed digital beams. ADBF receives simulated post-beamformed data from Real-Time Simulation Subsystem (RTSS) and sums it with live beamformed data.

4.1.3.1.3.4.2 Digital Signal Processor (DSP)

The Digital Signal Processor performs traditional signal processing functions such as pulse compression and target detection.

4.1.3.1.3.4.3 DSPi

DSPi provides an open external interface to the DSPS, hiding implementation details of the internal DSPS components.

4.1.3.1.3.5 Digital Beamformer Subsystem (DBFS)

The DBFS receives asynchronous data packets containing the received echo data from the DREX, equalizes them, and forms beams based on the control of the Radar Control Processing Subsystem (RCPS). DBFS sends this beam-formed digital data in digital data packets to the DSPS for further digital processing.

4.1.3.1.3.5.1 DBFi

The function of the DBFi is to isolate the DBFs from the RCPS, the controlling computer system external to the DBFS. The DBFi software translates command/control from the RCPS to the DF and status from the DBF to the RCPS. It also supports fail-over activities. It does not interact directly with the I/Q signal data at the interfaces with the DREX and DSPS subsystems.

4.1.3.1.3.5.2 Digital Beamformer (DBF)

There are five instances of the DBF. Four are designated as on-line and are assigned one per array face for the four array faces to perform beam formation calculations. The fifth DBF is designated as stand-by and is available to substitute for one of the on-line DBFs in case it fails.

4.1.3.1.3.6 Real Time Simulation Subsystem (RTSS)

The RTSS provides the capability to execute simulated missions in a real-time, hardware-in-the-loop environment by injecting synthetic targets and environments into the radar receive chain. Simulation provides two modes of digital simulation: Detection Simulation (DETSIM) and In-Phase & Quadrature (I&Q) Simulation (IQSIM). DETSIM injects simulated detection reports into the RCPS as if they came from the DSPS. IQSIM injects I&Q returns into the DBFS (following fixed-weight beamforming) for subsequent processing by the DSPS. DETSIM and IQSIM are capable of running either simulated only or over-live. During simulated only operations, detections are comprised solely of simulated injections. During over-live operations, simulated returns are combined with the live returns at the injection point.

4.1.3.1.3.7 Radar Control Processor Subsystem (RCPS)

The RCPS performs key control and processing functions. RCPS controls radar subsystems, implementing functions such as multi-mission planning, pulse scheduling, tracking, BMD discrimination, sensor calibration, sensor registration, fault detection / fault isolation, simulation control, and radar state and mode control. This subsystems also collects and assesses status information from radar subsystems. RCPS processes detection reports from the DSPS to produce track reports.

4.1.3.1.3.8 Radar Suite Controller (RSC)

The RSC is the primary control interface between the AMDR-S and the CMS. The AN/SPQ-9B is directly commanded by the CMS and provides status and track data to the RSC. The RSC provides intra-suite high-level task planning, limited resource balancing, limited coordination and track correlation of the AN/SPQ-9B and AMDR-S. RSC provides for the appropriate interfaces needed for operator control for the AMDR suite from the CMS. The RSC will provide for the appropriate interfaces needed for operator control for the AMDR-S from the CMS.

4.1.3.1.3.9 Antenna Subsystem (AS)

The AS is the hardware subsystem responsible for analog transmit and receive beam amplification and phase steering. In addition it provides on-array power conversion for amplification. The Antenna Interface provides the Open Standard Interface and hides implementation details of the AS.

4.1.3.1.3.9.1 Antenna Interface Unit (AIU)

The AIU provides the control/status processing capability included with each antenna aperture, including beam steering control. The AIU is the physical server and it contains 2 separate software functions, Antenna interface (Ai) and Beam Steering Generator (BSG). The AIU is the interface with the RCPS for accepting Radar Event Messages (REM) and control commands. The interface also conveys INS data and AS/DREX status to the RCPS.

4.1.3.1.3.9.2 Overlap Beamformer Calibration Network

4.1.3.1.3.9.3 Inertial Navigation System

An INS is mounted to each antenna. The INS is a complete GPS aided, 3-axis inertial navigator capable of providing outputs of attitude with true heading, angular rate, position, and linear velocity. The INS also provides angular and linear acceleration. Its outputs provide inertial position data to the RCPS for antenna position determination.

4.1.3.1.3.9.4 Radar Modular Assembly

The radar scales by changing the quantity of RMAs in each antenna aperture. The RMA is the basic building block of each aperture. Each RMA contains the electronic subassemblies for RF waveform transmission into free space and the collection of electromagnetic energy impinging on the face. The RMA uses four types of Line-Replaceable Units (LRUs) for simplifying maintenance and logistics.

4.1.3.1.3.9.4.1 Transmit/Receive Integrated Microwave Module (TRIMM)

The TRIMM is the line replaceable unit is responsible for generating, transmitting, and then receiving the RF energy that will be used to detect the targets. The TRIMM contains the multiple transmit receive modules receive power modules). The TRIMM also contains the control module for the T/R modules as well, local power conditioning and storage, receiver filtering and protection (circulators).

4.1.3.1.3.9.4.2 Digital Receivers/Exciter (DREX)

Each DREX is comprised of subassemblies to support Power Conversion, Digital Control, Receiver, and Exciter functionality. A DREX has one Exciter (Synthesizer) module, one Auxiliary Power and Control Card (APCC) module, and two Receiver (Dual Channel Converter) modules. These four Line Replaceable Unit (LRU) subassemblies that are a DREX are integrated into each RMA that is part of the AS, making it a scalable architecture. The DREX provides all required S-Band Exciter, Receiver signals to an RMA. For each array face, there is one DREX for each RMA, and one DREX to support array DREX alignment and AS calibration.

4.1.3.1.3.9.5 Radiators/Radome/Filters

Radiators are the TRIMM card plugs in using a floating bullet to the RF distribution network which routes the RF energy to be transmitted to the S-band radiating element on the array face. The radiator is the element which sits on the front of the array right behind the radome that is responsible for the transmission and reception of RF energy. Radome is the protective,radar transparent material which covers the radiators (the radiating element) protecting the element from the weather and sea environments. Filters are built or designed into receiver components such as the radiator, Distribution network and TRIMM that is used to reject unwanted signals from entering the receive chain.

4.1.3.1.4 Element Interfaces

Table 4.1-3 SPY Radar System Interfaces

Element	Interface Description	IDS
02 C&D	SPY-6 receives/processes requests from C&D including tasking, doctrine, setting, constraint, mode control, simulated entities, and track identification information. SPY-6 supplies track data, task order responses, task status, resource health and status, doctrine and constraint status and mode information to C&D.	AMDR External IRS
03 WCS	Information exchanged between SPY-6 and WCS includes target and missile interceptor track measurements, Launch Event (LE) data, missile communication data, ownship missile simulation data, and kill assessment data.	AMDR External IRS
06 SM&ESSM/ESSM	SPY-6 supports acquisition and communication with ESSM interceptor missiles via RF data link.	WS-35418
06 SM&ESSM/SM-2 Blk III	SPY-6 supports acquisition and communication with SM-2 Blk III interceptor missiles via RF data link Applicable to SM-2 Blk III, IIIA, and IIIB.	WS-35408
06 SM&ESSM/SM-2 Blk IV	SPY-6 supports acquisition and communication with SM-2 Blk IV interceptor missiles via RF data link.	WS-35409
06 SM&ESSM/SM-3 BLK 1B	SPY-6 supports acquisition and communication with SM-3 Blk 1B interceptor missiles via RF data link.	WS-34015
06 SM&ESSM/SM-3 BLK 2A	SPY-6 supports acquisition and communication with SM-3 Blk 2A interceptor missiles via RF data link.	WS-35598
06 SM&ESSM/SM-6	SPY-6 supports acquisition and communication with SM-6 interceptor missiles via RF data link.	NAVSEA 7454931/B
06 SM&ESSM/SM-6-2	SPY-6 supports acquisition and communication with SM-6 interceptor missiles via RF data link.	NAVSEA 7454931/C
07 ORTS-1	SPY-6 performs readiness self-assessment and provides status and fault and diagnostic data to ORTS. ORTS can request SPY-6 to perform various Fault Detection Tests, which triggers SPY-6 to provide updated readiness data. ORTS provides data such as ephemeris to support SPY-6 array face bias correction.	AMDR External IRS
Radar and Comms	To mitigate co-site interference between SPY-6 and EWS, SPY-6 provides emission schedules to EWS. SPY-6 communicates co-site data to EWS via a one-way single-mode fiber optic link utilizing the Serial Front Panel Data Port (sFPDP) protocol.	AMDR External IRS

Element	Interface Description	IDS
14 NAV/NAVSSI-1	One Inertial Navigation System (INS) with an embedded GPS Receiver is mounted on each of the four faces of the SPY-6. Each array INS receives a consolidated GPS RF signal from NAVSSI (from 1 of 2 ship mounted GPS antennas), which allows the arrays to align to the ship's Own Ship Reference Point (OSRP).	NA (Nav Data)
14 NAVNAVSSI-2	SPY will receive OD22 data from NAVSSI RTS following IDS WS-35430 for ownship location.	WS-35430
25 GWS	SPY-6 receives projectile acquisition cues from C&D (AWSC) to support GWS and it provides in return the associated projectile tracks for use by the gun system. SPY-6 can provide target track data to GWS as well. GWS provides splash data to SPY for splash avoidance.	AMDR External IRS
28 CEC	SPY-6 receives composite track data from CEC based on local and remote sensor inputs. SPY-6 provides air and surface track and measurement data to CEC. SPY-6 also provides missile skin and beacon track data to CEC.	AMDR External IRS
33 ADS	ADS interfaces with the SPY via a network interface to ALIS to provide SPY-6 track data for display. ADS does not interface directly to SPY-6 for tasking. Operator-generated radar service orders are sent to AWSC for processing into Task Orders for SPY-6. The ADS operator controls data recording via an interface supported by ADS with appropriate data recording control messages provided to SPY-6.	AMDR External IRS
34 ATD	The ATD exchanges data with SPY-6 to support both organic and distributed training via ALIS. The ATD provides SPY-6 with training track data, such as simulated aircraft and missiles, as well as simulated environmental data.	AMDR External IRS
39 ACI/ACEG	SPY-6 receives time from ACEG using IEEE 1588-2008 Precision Time Protocol (PTP).	NA (Time)

4.1.3.1.5 Design Approach/Rationale/Constraints

Changes are identified for Aegis BL10 due to SPY-6 integration. SPY-6 is a new radar for DDG Flt III.

4.1.3.2 Command and Decision (02)

4.1.3.2.1 Purpose

The Command and Decision (C&D) Element performs control and integration functions for the ship's Combat System. It is the focal point for the collection, correlation, and analysis of tactical data required to effectively employ the Combat System. The ship's personnel are provided the capability for monitoring the space, air, surface and subsurface environment, and for controlling the ship Combat Systems in support of the ship missions. This is accomplished through the following capabilities:

- Implements tactical doctrine as directed
- Manages and coordinates ship sensors in search, detection, and track
- Integrates and manages local and remote tracks
- Determines track identification and controls IFF
- Evaluates threat
- Selects weapons systems for target engagement or assignment
- Assesses mission effectiveness
- Controls Link 11 and Link 16
- Supports displays for Tactical Operations
- Supports tactical team training
- Control Combat System modes (tactical, training, and test)
- Generates Simulated Entities for SPY-6 to inject into the radar
- Aft/Forward Ship Gyro Selection

4.1.3.2.2 Requirements Satisfied

The C&D Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 2, Section 3.2.2.

4.1.3.2.3 Description

The C&D Element is composed of the Command and Decision (C&D) Computer Program and the Secure Voice System (SVS). The C&D Computer Program coordinates, manages and supports the elements of the Combat System. The SVS provides internal and external voice communications.

The Command and Decision is depicted in Figure 4.1-3.

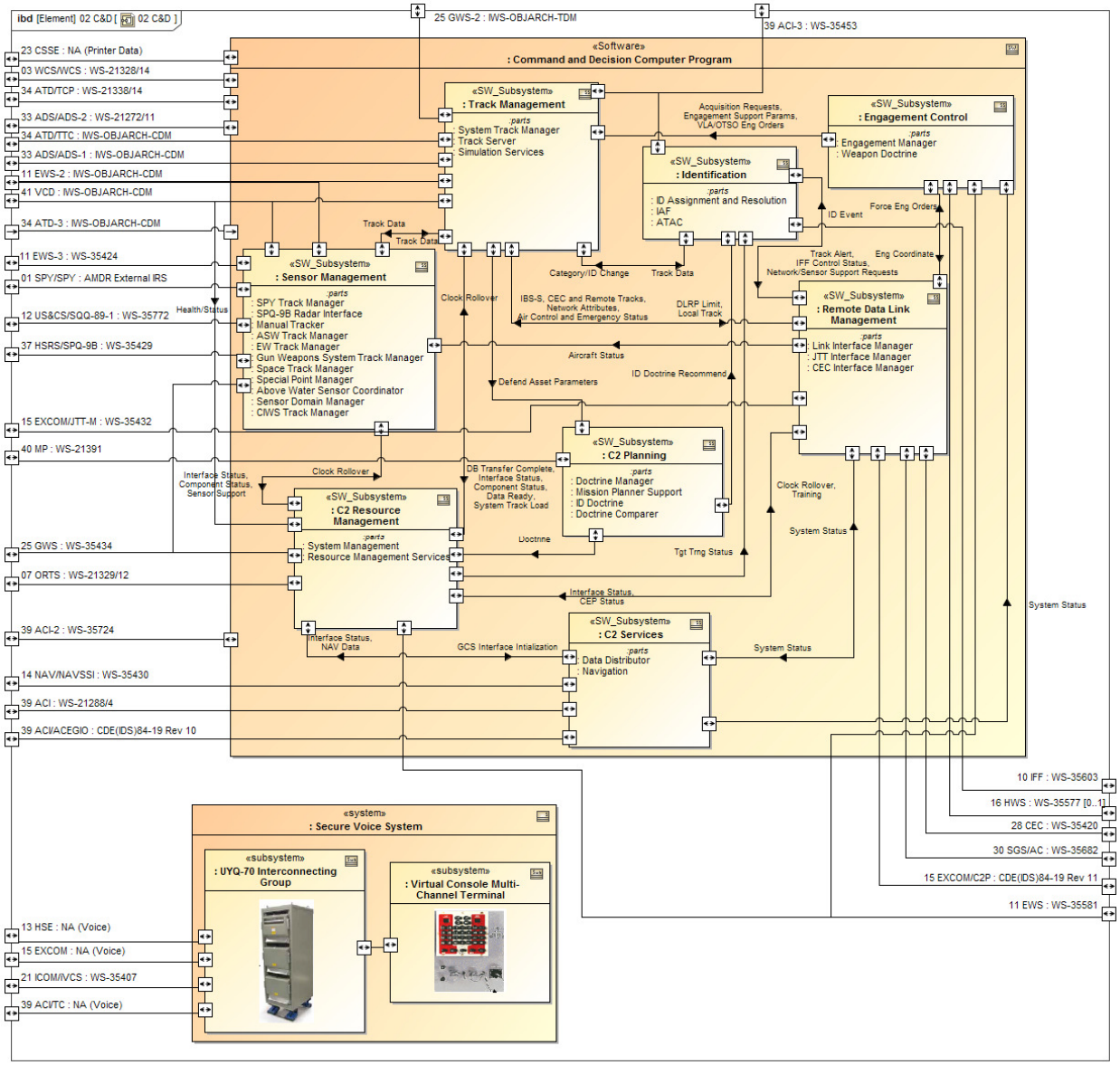

Figure 4.1-3 02 C&D

4.1.3.2.3.1 Command and Decision Computer Program

The C&D computer program is made up of the following functional domains:

- Identification
- C2 Resource Management
- Remote Data Link Management
- Sensor Management
- C2 Planning
- C2 Services
- Track Management
- Engagement Control

4.1.3.2.3.1.1 Identification

The C&D Identification domain collects and maintains the set of identifying parameters for each track in the C&D track file. The Identification Domain is also responsible for requesting Identification Friend or Foe evaluation of tracks from the AN/UPX-29(V).

The Identification software subsystem contains the following software components:

a. ID Assignment and Resolution – The ID Assignment and Resolution (IDA) component develops and maintains the set of identifying parameters for each track in the C&D track file. IDA receives its data from automatic sources and external sources (e.g., Link, CEP, and UWS). ID data can be generated internally by the ID Doctrine (ICF) component. The responsibility of IDA is to assimilate and interpret all the ID-related data received in order to resolve the identity of the track. Provisions are made in IDA to perform this identification process automatically (computer action only), semi-automatically (computer recommendation for operator action), and by operator action according to the current control or doctrinal environment. IDA determines identification based on data consistency and distributes the result, including rationale, to all C&D users. If IDA is unable to automatically resolve the identity, the operator is then required to intervene and resolve the conflict with IDA providing all the necessary data to be displayed in order to allow the operator to resolve the track's identity.
b. Air Tasking Attribute Correlator – The ATAC makes ID recommendation based the correlation of track attributes to Air Tasking Orders (ATO).
c. IFF Interface – The IFF Association Function (IAF) establishes and maintains the interface with the AN/UPX-29 IFF, initiates Popup and Schedule Target Challenge requests, processes target reports, and publishes IFF data for system tracks.

4.1.3.2.3.1.2 C2 Resource Management

The C&D C2 Resource Management domain performs system resource management (system status, mode management), provides a resource management interface to ACI Application Management Services (AMS) on behalf of every C&D process for initialization, state assignments, termination, and recovery via the ACI AMS and initiates interfaces for other System Services including Time Services, Message Services, Data Extraction and Recording Services, ACI Status Tracking Service (STS) and ACI Notification Services.

The C2 Resource Management software subsystem contains the following software components:

a. System Management – The System Management (SMF) component performs system resource management (system status, mode management).
b. Resource Management Services – Services provide a resource management interface to ACI on behalf of every C&D process for initialization, state assignments, termination, and recovery via the ACI AMS and initiates interfaces for other System Services including Time Services, Message Services, Data Extraction and Recording Services, ACI Status Tracking Service (STS) and ACI Notification Services.

4.1.3.2.3.1.3 Remote Data Link Management

The C&D Remote Data Interface Management (RDIM) domain consists of interface managers which support transmission and reception of tracks, and create and manage resultant source tracks with the Track Server. For TDL, the RDIM supports transmission and reception of tracks over Link-11, Link-16, and S-TDL-J via the Command and Control Processor (C2P) interface, maintains TDL status, and orders TDL configuration. For CEC, the RDIM domain receives and processes reception of tracks from CEC, orders CEC acquisitions, and controls DDS silence. For Integrated Broadcast System- Simplex (IBS-S), the RDIM domain receives and processes space track data and special points via the Joint Tactical Terminal- Maritime (JTT-M).

The Remote Data Link Management software subsystem contains the following software components:

a. Link Interface Manager – The Link Management Function (LIF) manages the interface between the C2P and C&D supporting the transmission and reception of track and engagement data via the various link systems.
b. JTT Interface Manager – The JTT Management Function (JTF) manages the interface between JTT (Joint Tactical Terminal) and C&D, supporting the transfer of track data. The JTT provides communication reception of processed space-based sensor data via the Integrated Broadcase System – Simplex (IBS-S).
c. CEC Interface Manager – The CEP Track Manager Function (CEF) manages the interface between the CEP and the C&D systems. This function supports the transfer of engagement data between CEP and C&D, and the reception of CEC data from the CEP.

4.1.3.2.3.1.4 Sensor Management

The C&D Sensor Management Domain (SMD) consists of interface managers that establish and maintain a local database of sensor tracks and sensor control data. These components are responsible for producing source-level track data and providing operator controls of associated features. For SPQ-9B, the SMD will manage and provide SPQ-9B track data in support of engagements. For Space, the SMD will perform local-to-remote association and correlation behaviors and produce Space source tracks (Vehicular and Special Points) for system consumption. For ASW, the SMD monitors non-track ASW messages and provides notifications and controls of ASW behavior. For EW, the SMD provides in SLQ-32(V)6 configuration will provide operator notifications and controls of EW behavior. The SMD coordinates above water sensors.

The Sensor Management software subsystem contains the following software components:

a. SPY Track Manager – SPY Track Manager Function (SPF) supports the interface to the SPY-6 radar system by processing track data.
b. SPQ-9B Radar Interface – Radar Set AN/SPQ-9B Function (QBF) manages the interface and supports the data transfer between C&D and the SPQ-9B radar.
c. IFF Interface – The IFF Association Function (IAF) establishes and maintains the interface with the AN/UPX-29 IFF, initiates Popup and Schedule Target Challenge requests, processes target reports, and publishes IFF data for system tracks.
d. Manual Tracker – Manual Track Management Function (MTF) supports the operator actions to enter, delete, and otherwise modify manual tracks or System Tracks.
e. ASW Track Manager – The Anti-Submarine Warfare Function (ASF) manages the interface between the Underwater Surveillance and Communications System (US&CS) and C&D, supporting the transfer of track data and engagement orders.
f. Electronic Warfare Track Manager – The Electronic Warfare Function (EWF) supports the transfer of data between the Electronic Warfare System with the SLQ-32(V)6 configuration and other C&D components. For all configurations, it also supports the creation of manual electronic warfare tracks by system operators.
g. Gun Weapons System Track Manager – GWS Track Manager Function (GTF) manages track data provided to C&D by the Gun Weapon System for Electro-Optical Sensor System (EOSS) and by SPQ-9B for SPQ-9B data.

h. CIWS Track Manager – The CIWS Track Management Function (CTF) processes track reports from CIWS sensors.
i. Above Water Sensor Coordinator – The Above Water Sensor Coordinator (AWSC) is responsible for coordinating sensor resources for the Above-Water (surface, air, and space) mission areas. AWSC uses current sensor status and the mission plan to issue tasking or similar controls to sensors. It is also responsible for obtaining track data at requested Quality of Service (QoS) to support engagements as well as cueing sensors in support of local and remote operations.
j. Sensor Domain Manager – The Sensor Domain Manager (Sensor DM) manages sensor health, state, mode, settings, and related controls such as power and frequency constraints pertinent to the ship's operating area and mission.

4.1.3.2.3.1.5 C2 Planning

The C&D C2 Planning domain consists of components to enter doctrine, evaluate parameters, and display doctrine statements. The C2 Planning domain also provides an interface with Mission Planner for data collection authorization, weapon doctrine, search doctrine, cued acquisition doctrine, defended assets, plan status, and plan distribution.

The C2 Planning software subsystem contains the following software components:

a. Doctrine Comparer – The Doctrine Comparer Function (DCF) provides an automatic capability to compare the spatial match between C&D AAW Weapon Selection doctrine regions and the SPY AAW operating region, and report the comparison result to ADS for display.
b. Doctrine Manager – The Doctrine Management Function (DMF) supports the activation and deactivation of doctrine statements.
c. Mission Planner Support – The Mission Planner Support (MSF) component provides a common interface between other C&D components and Mission Planner. MSF interfaces with Mission Planner for weapon doctrine, cued acquisition doctrine, defended assets, and plan status.
d. ID Doctrine – The ID Doctrine (ICF) component accepts doctrine parameters, performs track characterization and doctrine statement evaluation for all eligible tracks. ICF is responsible for the qualification of ID, Drop Track and BMD Acquisition Request and Alert doctrine classes.

4.1.3.2.3.1.6 C2 Services

The C&D C2 Services domain provides Navigation, Data Distribution, as well as C&D Common Services that are applicable to all C&D components.

The C2 Services software subsystem contains the following software components:

a. Data Distributor – The Non-Track Data Distributor (DDF) component provides a repository for system status and navigation data based on subscription requests from its clients. All C&D components can retrieve all System Status and Navigation data from the repository. DDF also provides event notifications to clients based on their subscription requests.
b. Navigation – The Navigation (NVF) component maintains current navigational information concerning position and velocity of ownship (O/S) in either normal or independent dead reckoning modes of operation. NVF supports world-wide positioning and relative positioning between two similarly equipped ships. This positioning is provided by the navigation system and ownship motion sensor. NVF supports selection of preferred WSN-7 attitude data (forward or aft).

4.1.3.2.3.1.7 Track Management

The C&D Track Management domain is composed of system-level track managers responsible for all tracks and providing client access to all Source and System Level track data.

The Track Management software subsystem contains the following software components:

a. Track Server – The Enterprise Track Server (TS) provides and maintains the C&D system track repository capability as a hierarchical track file (Source- and System-level track data) and manages relationships between data sets as required to support C&D tasks. Source and System-level track data can be retrieved from the repository for all track data.

b. System Track Manager – The System Track Manager (STM) component establishes and maintains the C&D system track file and is responsible for assimilating track reports from all reporting vehicular tracks, maintaining associations between source and system tracks representing the same object, maintaining composite data on each track, assigning a unique number to each track for use by all ACS elements, and publishing system track data for C&D and other elements as required. Source-level track managers interface with the Track Management software subsystem to provide source tracks.
c. Simulation Services - The Simulation Services receives kinematic parameters, in the form of files, from the Mission Planner, and when prompted by the operator, calculates the trajectory of the simulated entity and sends position, velocity and acceleration vectors periodically to SPY-6 in order to simulate the entity in real time. When prompted by the operator to stop the target, the C&D simulation services sends the appropriate message to SPY-6 to stop and drop the entity.

4.1.3.2.3.1.8 Engagement Control

The C&D Engagement Control domain consists of components supporting all types of engagement orders. The engagement orders are initiated manually via operator actions from warfare coordinators or automatically when the Engagement Management Function (EMF) determines that a track trips an active weapon doctrine. EMF requests acquisition from sensor managers, if required, and forwards the order to the applicable component or ACS weapon system to perform the engagement.

The Engagement Control software subsystem contains the following software components:

a. Engagement Manager – The Engagement Manager (EMF) provides for the coordination of ownship weapon systems between warfare areas and within each warfare area. Additionally, EMF will assist the force coordinators in initiating force weapon orders. The EMF provides the information needed by the operators to make engagement management decisions, monitor and evaluate ongoing engagements, and evaluate the results of engagements.
b. Weapon Doctrine Function – The Weapon Doctrine Function (WDF) accepts Auto and Semi-Auto doctrine parameters and perform doctrine evaluation for all eligible tracks. WDF is also responsible for calculating and providing EMF with parameters that are required to build engagement orders.

4.1.3.2.3.2 Secure Voice System

The SVS ON-740 provides non-blocking Plain (unclassified) voice communications to and between SVS terminals, plain radio equipment, Interior Voice Communications System (iVCS), public address (PA) equipment, record and playback equipment and trunks. The SVS also provides non-blocking secure voice communications to and between SVS terminals, secure radio equipment and record and playback equipment. SVS also provides Virtual Console Multi-Channel Terminal (VCMT) Intercommunication Stations Console back-up communications by interfacing to a sound powered system (a physically separate communication medium) in case of primary communication system failure.

The major elements of the SVS are the ON-740 Interconnecting Group and the user Multi-channel Terminal Group: consisting of the VCMT and Remote Multi-Channel Terminal (RMT) Intercommunication Stations.

4.1.3.2.3.2.1 UYQ-70 Interconnecting Group

All communications, except VCMT backup, are under the control of the Interconnecting Group, which establishes connection paths in response to requests. The Interconnecting Group contains the circuits required for the detection, decoding, processing and distribution of control and indicator signals and provides the Central Processing, Maintenance and Diagnostics, Switching and Power for the Interconnecting Group.

Two independent switches in the Interconnecting Group provide full duplication of functions with built in redundancy to prevent the loss of communications in the event of component or cable failure. These switches communicate with each other; they remain synchronized and are able to independently communicate with Terminating Equipment (TE) using single or dual redundant ports. SVS performs

automatic switchover to redundant cards, and associated circuit re-routing and exhibits a graceful degradation in event of failure.

4.1.3.2.3.2.2 Virtual Console Multi-Channel Terminal

The VCMT digitally encodes and decodes all communications and the digital format is then carried throughout the SVS. The VCMT is the interface that allows SVS operators to talk to each other; to communicate over the sound powered back-up mode, to communicate over radio channels, ship's PA system and with subscribers of the iVCS, or Public Switched Telephone Network (PSTN) trunks.

It gives operators access to maintain any combination of up to four radios, nets, PA, trunks or point-to-point calls including conferencing in any combination of Secure and Plain interfaces. Multiple calls made from the same VCMT on different channels cannot bridge between the channels yet the four-channel spatially separated audio allows the user to perceive channel differentiation. Single Action Calling (SAC) keys are provided on all VCMTs.

These programmed keys initiate an assigned feature stored in the database for direct access to VCMS, iVCS terminals, Radios, Nets, PA systems and trunks.

4.1.3.2.4 Element Interfaces

Table 4.1-4 Command and Decision Interfaces

Element	Interface Description	IDS
01 SPY	The C&D Computer Suite interfaces with SPY via an ALIS Ethernet connection. Radar track data is sent to the C&D Computer Suite from the SPY Computer Suite. The C&D Computer Suite sends acquisition requests, EMCON orders, operating orders and track control data to SPY.	AMDR External IRS
03 WCS	The C&D Computer Suite interfaces with WCS via an ALIS Ethernet connection. C&D sends status information, doctrine, track (local and remote) data, engageability requests, engagement orders, and controlled aircraft/handover data to WCS. WCS sends system status, engagement status, kill assessment, track data requests, controlled aircraft track data, and controlled aircraft/handover commands (for transmission via EXCOM) to C&D.	WS-21328/14
07 ORTS	The C&D Computer Suite interfaces with the ORTS Servers via ALIS for fault detection and digital I/O channels for fault isolation. C&D will provide EW Readiness to ORTS.	WS-21329/12

Element	Interface Description	IDS
10 IFF	The C&D Computer Suite interfaces with the IFF AN/UPX-29 IFF Interrogator Set Processor-Controller CP-1273/UPX-24(V) via an ALIS Ethernet connection. These interfaces provide IFF data (codes) in response to Demand Interrogation requests by the C&D for specific target range and azimuth positions in support of engagements and various track ID IFF interrogation doctrines.	WS-35603
11 EWS-1	The SLQ-32(V)6 interfaces with C&D via ALIS to send EWS element status and softkill engagement status, and to receive controls, C&D status, and C&D ordered softkill engagements. The SLQ-32(V)6 also reports inventory status.	WS-35581
11 EWS-2	The SLQ-32(V)6 provides EW Source Tracks including classification data, associations to the C&D Computer Suite. The C&D Computer Suite provides System Track data to SLQ-32(V)6.	IWS-OBJARCH-CDM
11 EWS-3	The SLQ-32(V)2/3 interfaces with C&D via NTDS to send EWS element status and EW sensor data, and to receive wind/gyro and GMT data. For ships equipped with AN/SLQ-32 (V)2 or 3, C&D sends MH-60R ALQ-210 status and EW emitters to SLQ-32.	WS-35424
12 US&CS/SQQ-89-1	The C&D Computer Suite system interfaces with SQQ-89 via DDS Pub/Sub over ALIS. The C&D Computer Suite sends engagement orders, and doctrine to the UCFS. UCFS sends torpedo alerts, system status and engagement status to the C&D Computer Suite.	WS-35772
12 US&CS/SQQ-89-2	The C&D Computer Suite system interfaces with SQQ-89 via DDS Pub/Sub over ALIS. The C&D Computer Suite exchanges track and special point data with the UCFS. UCFS provides ASW Source Track data to C&D. C&D provides System Track data to US&CS.	IWS-OBJARCH-CDM
13 HSE	Radio communications between C&D and the helicopter are facilitated by the C&D Secure Voice System via the ICOM element. Operators utilize the C&D Secure Voice System to conduct all radio communications exterior to the ship.	NA (Voice)
14 NAV/NAVSSI	The C&D Computer Suite receives and processes ownship attitude, speed, and environmental data from the NAVSSI via Nav System element.	WS-35430

Element	Interface Description	IDS
15 EXCOM	The Secure Voice System in Command and Decision interfaces with the EXCOM systems to provide secure exterior voice communication (including MH-60R) to operators at the display consoles.	NA (Voice)
15 EXCOM/C2P	The C&D Computer Suite interfaces with the C2P via NTDS for Link 11 and Link 16 tactical data. The C2P computer translates the Link 11 and Link 16 data into a Link 16 based normalized format (N-series) before being sent to C&D. This interface provides ownship local and remote datalink track and engagement status information exchange for coordination among battlegroup participants via Link 11 and/or Link 16.	CDE(IDS)84-19 Rev 11/Chg3
15 EXCOM/JTT-M	The C&D Computer Suite, via ALIS, interfaces with the Joint Tactical Terminal - Maritime (JTT-M) AN/USQ-151 to support the reception of Integrated Broadcast System – Simplex (IBS-S).	WS-35432
18 PWS/CIWS	The C&D Computer Suite, via ALIS, interfaces with the Phalanx Mk 15 Block IB Baseline 2 to receive CIWS radar tracks and sensor status/coverage. C&D sends sensor control and EMCON orders.	IDD-PHA.2008-0503
21 ICOM/iVCS	The Integrated Voice Communications System interfaces with the Secure Voice System in Command and Decision to provide interior voice communication to operators at the display consoles.	WS-35407
23 CSSE	The CSSE printers provide hardcopy data of the C&D computer program data reduction.	NA (Printer Data)
25 GWS	The C&D Computer Suite interfaces with the Gun Computer System Cabinets (GCSC) via Fast Ethernet interfaces to provide engagement orders and data on targets to be engaged. The GWS provides target engagement status, equipment status, and kill evaluation of surface engagements back to the C&D Computer Suite.	WS-35434
25 GWS-2	GWS receives track inputs from STM/TS for background track data for shore bombardment and deconfliction.	IWS-OBJARCH-TDM
28 CEC	(FOUO) C&D interfaces with CEC via ALIS to allow C&D to receive periodic updates on CEC composite tracks that are composed of data from both on and off board sensors. Classified as FOUO by CEC SCG [OPNAVINST S5513.3B-(119.10)]	WS-35420

Element	Interface Description	IDS
30 SGS/AC	The C&D Computer Suite interfaces with SGS/AC via ALIS to provide system controls, ownship navigation data, ownship tracks, and correlation/deorrelation/PAD controls for SGS/AC. SGS/AC provides TDL Track normalization services, status, correlation/decorrelation recommendations, and PADs to C&D. The SGS receives TDL data via C&D to receive remote Link track reports in order to compute PADs and to determine correlation and decorrelation recommendations. This interface provides ownship local and remote datalink track and engagement status information exchange for coordination among battlegroup participants via Link 11 and/or Link 16.	WS-35682
33 ADS-1	The C&D source and system-level track managers publish Track Data Messages as defined in the track data model to the ADS.	IWS-OBJARCH-CDM
33 ADS-2	The C&D Computer Suite interfaces with the ADS via network interfaces to ALIS. Track file data, tactical situation data, status data and operational readiness data are sent from C&D to ADS. ADS sends engagement orders, manual tracks, operator actions (e.g., ID), controls (e.g. Doctrine), and status to C&D. ADS will also forward HDR requests from C&D to SPQ-9B and HDR responses from SPQ-9B to C&D.	WS-21272/11
34 ATD/TCP	The C&D Computer Suite interfaces with the Advanced Training Domain processes housed in the CCS or MCE cabinets, via ALIS to provide for training functions. C&D controls entry and exit into and out of the Tactical Team Coordination Training (TTCT) configuration. The primary ATD function during TTCT is to provide training control data and training track data to C&D.	WS-21338/14
34 ATD/TTC	The C&D Computer Suite provides System Track data to the ATD.	IWS-OBJARCH-CDM
37 HSRS/SPQ-9B	C&D interfaces with SPQ-9B via the ALIS network. C&D provides High Data Rate (HDR) requests to SPQ-9B through ADS, and produces source tracks from SPQ-9B data. SPQ-9B provides track data and radar status to C&D.	WS-35429

Element	Interface Description	IDS
39 ACI	This interface provides ship's attitude data, wind speed, wind direction, fathometer data, and ship's speed data to C&D. The VL/EDP also commands the Battleshort Alarm Circuit as requested by C&D. For message details, reference WS-21288/4.	WS-21288/4
39 ACI-2	The C&D Computer Suite interfaces with ACI via ALIS to provide navigation data and system mode change data in support of the ACI instantiation of the objective architecture component framework.	WS-35724
39 ACI-3	The ACI provided instantiation of the IWS objective architecture component framework application programmers interface.	WS-35453
39 ACI/ACEGIO	Provides ownship local and remote datalink track and engagement status information to C&D via ALIS.	CDE(IDS)84-19 Rev 11/Chg3
39 ACI/CSBD/CS DDTS	The C&D Computer Suite provides System track data to the ACI for provision through the CS DDTS to CSSE.	IWS-OBJARCH-CDM
39 ACI/TC	The Tactical Consoles interfaces with the Secure Voice System in Command and Decision to provide secure voice communication to operators.	NA (Voice)

4.1.3.2.5 Design Approach/Rationale/Constraints

Changes are identified in Aegis BL10 due to SPY-6 integration, Mk 160 Upgrades, CIWS Sensor Integration, and J3.4 integration.

C&D handles the primary connections to the SPY-6 radar for settings, constraints, doctrine and tasking. C&D handles sensor reports and generates source and system tracks for SPY-6 tracks. C&D interfaces with Mission Planner for overall plan control in the combat system for the SPY-6 sensor.

CIWS Sensor integration impacts C&D for sensor data integration for source and system tracks.

J3.4 integration impacts C&D as C&D is the interface to EXCOM. C&D forwards data to US&CS.

C&D is impacted by Mk 160 upgrades as C&D is the control interface for the GWS for engagement and tracks.

4.1.3.3 Weapons Control System (03)

4.1.3.3.1 Purpose

The Weapons Control System (WCS) directs and controls engagement of threat targets as identified and ordered by Combat System operators and software functions within the Combat System elements of the AEGIS combat system.

4.1.3.3.2 Requirements Satisfied

The WCS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 2, Section 3.2.3.

4.1.3.3.3 Description

The Weapon Control System (WCS) Element is composed of the Kill Assessment System and a set of software functions (WCS Software Components) which provide threat engageability evaluation and the control and guidance data to prosecute air, space, and surface target engagements as ordered by command functions within the combat system. WCS software functions also provide kill assessment information to support engagement resolution by command functions.

The Weapons Control System is depicted in Figure 4.1-4.

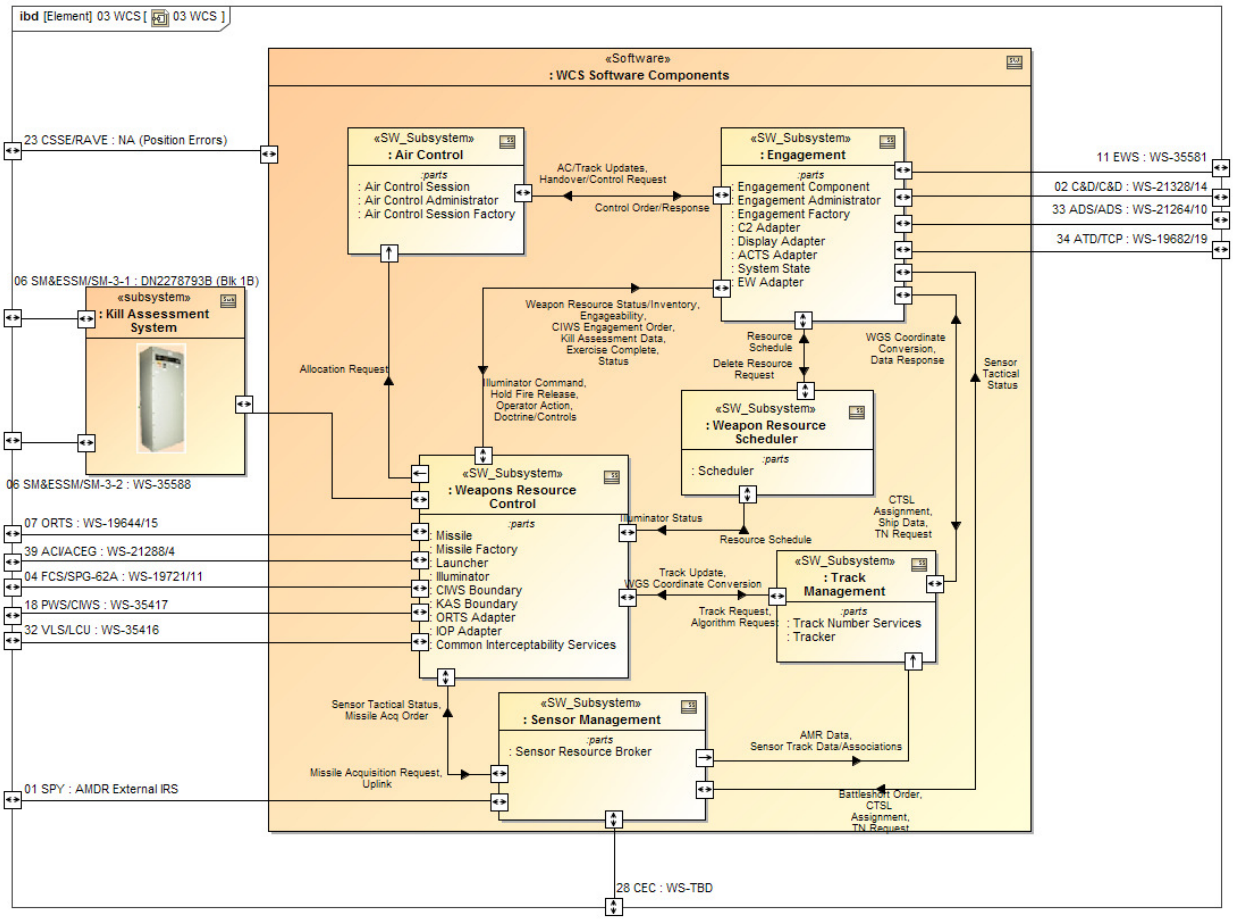

Figure 4.1-4 03 WCS

4.1.3.3.3.1 WCS Software Components

The WCS Mk 9 translates weapon engagement orders and related assignments from Command and Decision (C&D) into commands for the control and management of engagements with Standard Missiles (SM-2, SM-3, and SM-6), ESSM, and other Combat Systems weapons (air interceptors and Anti-Submarine Warfare (ASW) aircraft). WCS computes threat engageability as applicable to the specific weapon and schedules; controls and monitors engagements; carries out kill assessment; and provides timing data for the Combat System. Using local and remote target and missile track data, WCS generates SM and ESSM missile initialization data, controls missile firing via VLS, and generates and forwards SPY midcourse guidance commands. WCS assigns a Fire Control System (FCS) director to illuminate the target during the missile terminal homing phase of flight during AAW/BMD Endo engagements and for IR KW telemetry data collection during BMD engagements. The WCS functions involve receptions of target-track data, pre-launch, missile initialization, second and third stage missile guidance, target designation, and kill assessment.

WCS components provide SM and ESSM engagement control, and air interceptor control in accordance with engageability parameters, threat values, and engagement doctrine. During SM-2, SM-6 and ESSM engagements, WCS generates mid-course guidance and seeker commands for uplink through SPY and monitors the missile in flight by using status messages downlinked through SPY. For IFC engagements using SM-6, WCS provides missile guidance to the point of handover. WCS designates target "leakers" for engagement with the ESSM or the Phalanx Weapon System, aka CIWS. During SM-3 engagements, WCS generates mid-course guidance commands and target/missile state data for uplink through SPY and monitors the missile in flight by using status messages downlinked through SPY. WCS schedules, controls, and monitors air and surface engagements by using assigned interceptor, strike, and ASW aircraft.

WCS software functions provide pre-launch, missile initialization, second and third stage missile offset guidance, target designation, and kill assessment. The WCS supports Combat Information Center (CIC) operators with weapon and target engagement data and controls weapon related submode operations via the Combat System Display. WCS can designate to and receive information from the Close-in Weapon System (CIWS).

4.1.3.3.3.1.1 Weapon Resource Scheduler

The Weapon Resource Scheduler software subsystem contains the Weapons Resource Scheduler component that receives requests for Anti-Air Warfare (AAW), ASUW, and/or BMD resources from individual Engagement instances and generate illuminator and launcher schedules. The Scheduler Component selects the missile type to be scheduled and resolves any conflicts among available resources to support a missile from launch through intercept. The Weapons Resource Scheduler Component will also allocate resources to support Special Illuminator Assignments and CIWS engagements. In addition, the Scheduler Component will reallocate in response to equipment failure. The results of this process are reported to the Engagement Component, the Launcher Component and the CIWS Boundary Component.

4.1.3.3.3.1.2 Engagement

The Engagement software subsystem contains the following software components:

a. Engagement Component – The Engagement Component manages execution of an engagement against one specific target for the lifetime of the engagement. The Engagement Component can support AAW, ASUW, NIFC-CA and BMD missions.
b. Engagement Administrator – The Engagement Administrator Component coordinates all engagements and acts as a throttle when system engagement capacity limits are met. The Engagement Administrator Component performs validations on the initial Engagement Order and its subsequent Engagement Order Updates.
c. Engagement Factory – The Engagement Factory component instantiates the Engagement Component instance from a pool of engagements on its node at startup. The Engagement Factory component allocates and/or de-allocates engagements as instructed by the Engagement Administrator component. The Engagement Factory component monitors and reports statistical

information about the engagements allocated to the node and its relevance to resource management and Engagement Administrator.

d. C2 Adapter – The C2 Adapter Component is responsible for interfacing the external Command and Decision System (C&D) with the internal WCS components (Engagement Administrator, Engagement, Launcher, CIWS Boundary, Sensor Resource Broker, Tracker, and System State for SM; Air Admin, Session Factory and Session for Air Control). It also provides compatibility between C&D and WCS internal components by performing the necessary unit conversions as required and directing the messages to the appropriate WCS components.
e. Display Adapter – The Display Adapter component is the boundary component that interfaces the external Aegis Display System (ADS) with the internal Weapons Control System (WCS) components to support the control of display consoles operating in Weapons Control submodes.
f. ACTS Adapter – The ACTS Adapter Component is the boundary component that interfaces the external Training Control Program (TCP) with internal Weapons Control System (WCS) components.
g. System State – The System State component updates and maintains the static and dynamic system configuration data and enables other WCS components to access the current system state data.
h. EW Adapter – The EW Adapter Component is the boundary component that interfaces the external Electronic Warfare System (EWS) with internal Weapons Control System (WCS) components.

4.1.3.3.3.1.3 Air Control

The Air Control software subsystem contains the following software components:

a. Air Control Session – The Air Control Session component is mainly responsible for maintaining individual controlled aircraft information. It also maintains the database for local and remote sonobuoys.
b. Air Control Administrator – The main responsibility of the Air Control Administrator Component is to maintain and manage the rest of the Air Control Components as well as maintaining and managing specific information for the rest of the components to utilize during their validity evaluations and processing.
c. Air Control Session Factory – The Session Factory component is responsible for the allocation and de-allocation of air control sessions and the management of Trial Track processing.

4.1.3.3.3.1.4 Sensor Management

The Sensor Management software subsystem contains the Sensor Resource Broker (SRB) component which provides a single interface for request and receipt of track and track-related data for WCS consumers. Requests from multiple consumers for the same track data are consolidated and managed. Adapters are currently provided for SPY-6 sensor and TDL-J network interfaces and accommodations exist for additional adapters for future sensors and/or networks that will register with the SRB. A specialized sensor interface is provided for the missile RF communication link consisting of uplink, downlink, and acquisition processing as well as processing specialized for reacquisition of missiles after a sensor computing suite recovery. Sensor status is also maintained and provided to consumers.

The Sensor Management software subsystem contains the following software components:

a. Sensor Resource Broker – The Sensor Resource Broker (SRB) component provides a single interface for request and receipt of track and track-related data for WCS consumers. Requests from multiple consumers for the same track data are consolidated and managed. Adapters are currently provided for SPY-6 sensor and TADIL-J network interfaces and accommodations exist for additional adapters for future sensors and/or networks that will register with the SRB. A specialized sensor interface is provided for the missile RF communication link consisting of uplink, downlink, and acquisition processing as well as processing specialized for re- acquisition of missiles after a sensor computing suite recovery. Sensor status is also maintained and provided to consumers.

4.1.3.3.3.1.5 Track Management

Track Management incorporates Track Number Services (TNS) and Tracker components.

The Track Management software subsystem contains the following software components:

a. Track Number Services – Track Number Services – Track Number Services (TNS) - The TNS component is responsible for providing ID numbers for WCS consumers, specifically engagement numbers and target and missile track numbers from WCS unique sets as well as missile track numbers from a reserved set of SPY-1 sensor track numbers. For SPY-6, WCS provides an engagement index which is used to pair target and missile tracks.
b. Tracker – The Tracker component is responsible for providing distributed target and missile streaming track services for WCS consumers as well as a library of track-related algorithms for general use by consumers. For streaming data, the Tracker requests track data from the SRB, performs kinematics or other track estimation algorithms and provides processed track data to the consumer.

4.1.3.3.3.1.6 Weapons Resource Control

The Missile Factory component manages the allocation, de-allocation, and resource IDs of Missile components. In addition, the Missile Factory component provides missile type dependent services, such as missile T2, to other components. The Launcher determines launcher assignments by examining the Launch Schedule List (LSL) received from the Scheduler Component. It controls the launch sequence by sending commands to VLS, including missile (SM-2/3/6 or ESSM) select and initialization orders, and missile (SM-2/3/6) battery activate orders. The Launcher Component monitors the launch sequence and reports status to the Engagement and Missile Components. The CIWS Boundary component serves as a boundary between other WCS components and the Phalanx Weapon System (PWS). The CIWS Boundary designates to and receives information from PWS. The CIWS Boundary calculates and provides CIWS engageability results, blockage data, and interference status to the Engagement Component. In addition, the CIWS Boundary provides Mount Availability status to the Scheduler Component.

The Missile component calculates the missile initialization message for SM-2, SM-6, ESSM, and SM-3 missiles. It then provides this message to the Launcher component. Post-acquisition, the Missile component processes downlinks from the missile. The Missile component calculates the midcourse guidance acceleration commands, seeker pointing commands, and supervisory commands. It then generates uplinks which are sent to the missile via the Tracker component and sensor. The Illuminator Component (IC) is a boundary component between WCS components and the FCS Program. IC communicates primarily with Engagement Component, Display Adapter, IOP Adapter, and System State. There are also brief interactions with Scheduler Component and ORTS Adapter. IC’s main functions are to control illumination and calculate illuminator blockage areas via FCS.

The Weapons Resource Control software subsystem contains the following software components:

a. Missile – The Missile component calculates the missile initialization message for SM-2, SM-6, ESSM, and SM-3 missiles. It then provides this message to the Launcher component. Post-acquisition, the Missile component processes downlinks from the missile. The Missile component calculates the midcourse guidance acceleration commands, seeker pointing commands, and supervisory commands. It then generates uplinks which are sent to the missile via the Sensor Resource Broker component and sensor.
b. Missile Factory – The Missile Factory component manages the allocation, de-allocation, and resource IDs of Missile components. In addition, the Missile Factory component provides missile type dependent services, such as missile T2, to other components.
c. Launcher – The Launcher component determines launcher assignments by examining the Launch Schedule List (LSL) received from the Scheduler Component. It controls the launch sequence by sending commands to VLS, including missile (SM-2/3/6 or ESSM) select and

initialization orders, and missile (SM-2/3/6) battery activate orders. The Launcher Component monitors the launch sequence and reports status to the Engagement and Missile Components.

d. Illuminator – The Illuminator Component is a boundary component between WCS components and the FCS Program. Illuminator communicates primarily with Engagement Component, Display Adapter, IOP Adapter, and System State. There are also brief interactions with Scheduler Component and ORTS Adapter. Illuminator's main functions are to control illumination and calculate illuminator blockage areas via FCS.
e. CIWS Boundary – The CIWS Boundary component serves as a boundary between other WCS components and the Phalanx Weapon System (PWS). The CIWS Boundary designates to and receives information from PWS. The CIWS Boundary calculates and provides CIWS engageability results, blockage data, and interference status to the Engagement Component. In addition, the CIWS Boundary provides Mount Availability status to the Scheduler Component.
f. KAS Boundary – The KAS Boundary component is responsible for providing a boundary between the WCS components and the Mk 78 Mod 1 Warhead Data Receiving Cabinet (WDRC). KAS Boundary's functions include assigning the WDRC for tactical engagements and equipment testing, receiving decrypted data from the WDRC to perform IR Kill Assessment and forwarding the overall kill assessment (received from Engagement component) and KW IR image to Display Adapter.
g. ORTS Adapter – The ORTS adapter has the responsibility to provide a boundary between the internal WCS components and the Operation Readiness and Test System (ORTS) program. It provides the compatibility with the ORTS /WCS IDS and the rest of the WCS CP.
h. IOP Adapter – The IOP Adapter is responsible for changing the format of messages into a legacy format for messages used by the Element Resource Manager (ERM). This format is the Aegis Reusable Components (ARC) Inter-process Communication (IPC). There are a few specific tactical statuses that are needed by the ERM that also need to be sent so that the ERM can perform its function. The ERM and the Local Resource Manager (LRM) are legacy processes that run on the WCS IOP's.
i. Common Interceptability Services – Provides services for interceptability calculations for SM2 and SM6 weapons. Interceptability is calculated based on user input and provided as an output to the user. This functionality is provided for AAW.

4.1.3.3.3.2 Kill Assessment System

Kill Assessment System (KAS) provides an evaluation of the intercept for an SM-3 ballistic missile engagement. The WDRC and the KAS WCS Computer Suite are responsible for SM-3 Kinetic Warhead (KW) video downlink reception, and frame synchronization. KAS Boundary is the KAS WCS Computer Suite functionality. KAS Boundary is responsible for the IR/KA decision processing, and KA display generation. The frame synchronized SM-3 images are sent to the WCS Blade Servers. The KAS data is stored on Network Attached Storage in the Common Processing Suites.

4.1.3.3.4 Element Interfaces

Table 4.1-5 Weapons Control System Interfaces

Element	Interface Description	IDS
01 SPY/RCP	The SPY computer program sends target track data to WCS via ALIS where target engagement algorithms are applied. It also provides smoothed missile track and downlink data to WCS. The WCS Computer Suite sends SM-2, SM-3, SM-6 and ESSM uplink commands to the SPY Computer Suite.	AMDR External IRS
02 C&D	The WCS Computer Suite receives weapon engagement orders, local and remote fire control track data, console actions, controlled aircraft data and status data track file information, doctrine information, and engageability requests from the combat system via ALIS. WCS sends engagement and equipment status to C&D and target track requests. C&D will provide alert status of a Kill Assessment (KA) determination during BMD missions.	WS-21328/14
04 FCS/SPG-62A	The WCS Blade Servers interface with the FCS Single Board Computers to provide data for FCS to assign illuminators to targets. FCS will provide SM-3 KW data via Infrared (IR) imagery to the Warhead Data Receiver Cabinet (WDRC) for decryption and kill evaluation processing.	WS-19721/11
06 SM/ESSM-1	The KAS receives IR data from the SM-3 Block IB missile to support kill assessment.	DN2278793B
06 SM/ESSM-2	The KAS receives IR data from the SM-3 Block IIA missile to support kill assessment.	WS-35588
07 ORTS	The WCS Blade Servers interface with the ORTS Blade Servers via ALIS for fault detection and digital I/O channel for fault isolation. ORTS sends fault detection messages to the WDRC via commands sent to the Kill Assessment System (KAS). These commands order the KAS Monitor to run a set of self-diagnostics and report health and status information back to the KAS, and eventually to ORTS.	WS-19644/15
11 EWS	EWS provides survive assessment data to WCS via ALIS. WCS sends survive assessment requests to EWS to support Kill Evaluation assessment.	WS-35581

Element	Interface Description	IDS
18 PWS/CIWS	PWS receives target/designation data for each Remote Control Panel via digital channels (normal and alternate) from WCS. PWS also provides engagement and mount status to WCS.	WS-35417
23 CSSE/RAVE	Equipment (RAVE) System for verification of selected director position errors during dockside alignment verification tests. The Vertical Launch System Processor (VLP) within the WCS AEGIS Conversion Equipment Group (ACEG) cabinet sends vent closure commands to the Vent Closure Control Panels (Fwd and Aft) of CSSE upon receipt of logic commands from WCS.	NA (Position Errors)
28 CEC	(FOUO) WCS interfaces with CEC via ALIS to obtain measurement data for remote tracks to support engagements.	WS-TBD
32 VLS/LCU	Each VLS LCU computer interfaces with the WCS/FCS IOPs to receive SM/ESSM missile initialization data and select/activate commands and to provide missile and VLS status. The WCS Computer Suite provides VLS with Block IB KW frequency and crypto variable for SM-3 missile initialization.	WS-35416
33 ADS	The WCS provide alerts, display data (engagements, doctrines, contours, etc.) and window data to the ADS via ALIS.	WS-21264/10
34 ATD/TCP	The AdvancedTraining Domain interfaces with the WCS processor via ALIS. WCS processes simulated orders, supports simulation of controlled aircraft, controls the state of VLS and PWS, and inhibits transmission of non-training engagement orders during Tactical Team Coordination Training (TTCT) exercises.	WS-19682/19
39 ACI/ACEG	The Conversion Equipment Cabinets provides WDRC with resets. WCS also interfaces with the Remote Launch Enable panels in 32 VLS and the Vent Closure Control circuits 23 CSSE via the Vertical Launch Processor (VLP) in ACEG. All ACI interfaces are routed via ALIS.	WS-21288/4

4.1.3.3.5 Design Approach/Rationale/Constraints

Changes are identified in Aegis BL10 due to SPY-6 integration.

SPY-6 integration impacted WCS for a new radar interface and a new interface to CEC.

4.1.3.4 Fire Control System (04)

4.1.3.4.1 Purpose

The Fire Control System(FCS) Mk 99 provides X-Band Continuous Wave Illumination (CWI) energy for target illumination during the Standard Missile (SM-2 and SM-6 only) and Evolved Sea Sparrow (ESSM) Missiles' semi-active terminal guidance phase. The FCS on Destroyers has three guidance illuminator systems that control the CWI transmitters and directors. WCS generates target kinematics based on SPY, SPQ-9B, and remote sensor data, which is sent to the FCS Data Processing Set for director control. WCS determines at what time before intercept a guidance illuminator should be positioned to illuminate the target with CWI energy for the terminal guidance phase. This illuminator scheduling is dynamic in function and is based on any change in target parameters.

4.1.3.4.2 Requirements Satisfied

The FCS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 2, Section 3.2.4.

4.1.3.4.3 Description

The FCS on Destroyers contains three illuminators. Each illumination channel consists of a director group, director control, radar transmitter and one-half of a data converter cabinet. There are two data converter cabinets; one for the forward illuminator and the second for the aft illuminators.

The Fire Control System is depicted in Figure 4.1-5.

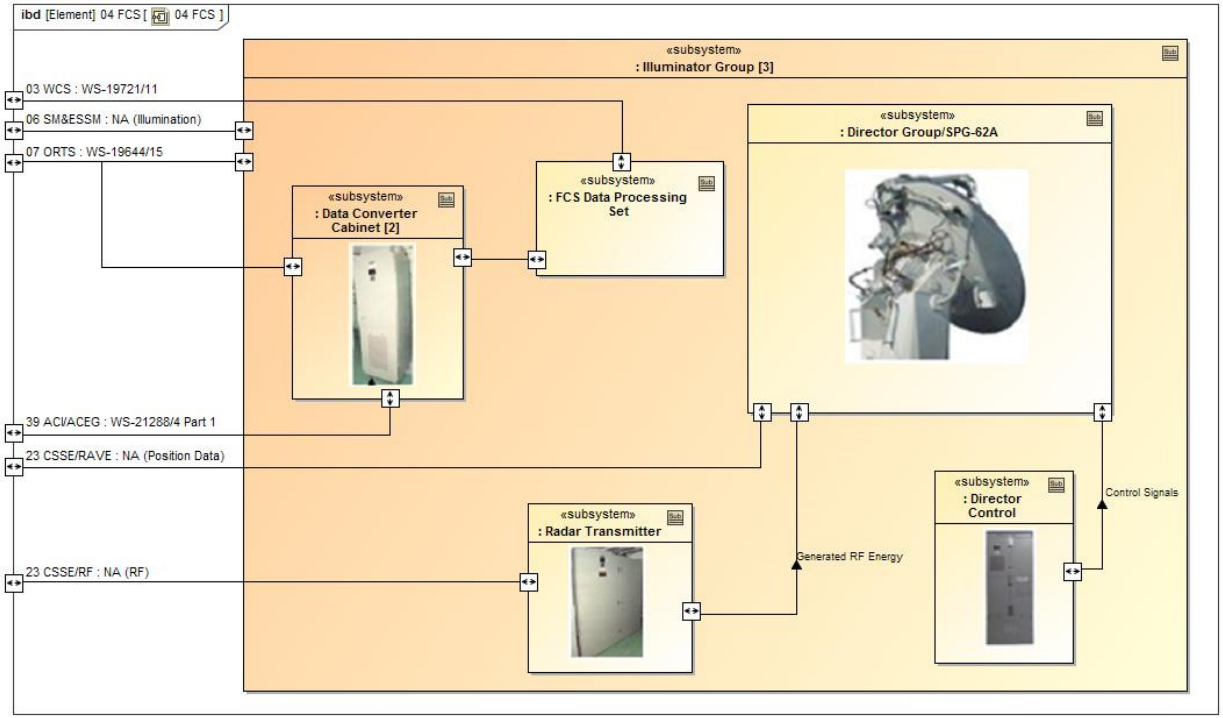

Figure 4.1-5 04 FCS

4.1.3.4.3.1 Illuminator Group

The FCS contains three illuminators. Each illumination group consists of a director group, director control, radar transmitter and one-half of a data converter cabinet. There are two data converter cabinets; one for the one forward illuminator and the second for the two aft illuminators.

4.1.3.4.3.1.1 Director Control

The Director Control Mk 200 houses the elevation and train servo-amplifiers for the associated director. The Director Control receives elevation and traverse commands from the Data Converter Cabinet, which is controlled by the three FCS I/O Processors. Within the Director Control, solid-state servo-amplifiers provide the servo drive signals that position the director to the desired target position. Gyros provide elevation and traverse rates of director motion to the appropriate servo amplifiers for stabilization.

4.1.3.4.3.1.2 Director Group/SPG-62A

The Director Group/SPG-62A is consisted of the following subsystems:

Gun and Guided Missile Director Mk 82 - The director has two axis of motion and is used to position the antenna assembly to the commanded position in space. On-mount gyros provide space stabilization for the antenna. The director has slip rings and a dual RF rotary joint to allow unlimited rotation in train. The director is controlled in train and elevation from control signals provided via the Director Control Mk 200 The Mk 82 is modified to include a dual band rotary coupler to provide both S-band and X-Band transmissions.

Antenna AS-3444/SPG-62 - The Antenna Assembly consists of an X-Band, dish-type antenna mounted on the director. The X-Band reflector is a solid wire grid in a cut parabola configuration. Two feed horns are used; one for the main X-Band illumination of the target vehicle and one for the wide aperture X-Band field for SM-2 missile rear reference. The AS-3444/SPG is modified to include an S-band feed horn assembly in addition to the X-Band feed horn.

Antenna Disable Switch - This switch is used by maintenance personnel to disable the Antenna and inhibit transmission when carrying out topside maintenance.

4.1.3.4.3.1.3 Radar Transmitter

The transmitter T-1348/SPG receives operating commands and frequency selection codes from the Data Converter Cabinet (DDC) Mk 15. The transmitter generates RF energy at selectable X-Band frequencies and supplies this X-Band frequency at nominal power to the Director Group Mk 81 for target and missile illumination. Command responses and status are generated within the transmitter and sent back to the DDC.

4.1.3.4.3.1.4 FCS Data Processing Set

The FCS computer programs runs on single board computers located in the WCS/FCS IOP. The FCS Data Processing Set receives commands from WCS and forwards them to the Data Converter Cabinet, and provides status in return.

4.1.3.4.3.1.5 Data Converter Cabinet

The Guidance Data Converter Cabinet Mk 15 contains two slaved Illuminator Data Converters. One Converter Cabinet serves the forward Director channels and a second serves the two aft Director channels. Each Data Converter provides the interface between the WCS/FCS Input/Output Processor (IOP) and the Radar Transmitter and Director Group by converting digital command data to the form required by the equipment.

4.1.3.4.4 Element Interfaces

Table 4.1-6 Fire Control System Interfaces

Element	Interface Description	IDS

Element	Interface Description	IDS
03 WCS	The FCS Single Board computers interface with the WCS Blade Servers to receive data for FCS to assign illuminators to targets. FCS will provide SM-3 KW data via Infrared (IR) imagery to the Warhead Data Receiver Cabinet (WDRC) for decryption and kill evaluation processing.	WS-19721/11
06 SM&ESSM	The FCS Illuminators provide X-Band CWI for target illumination during the missile's terminal homing phase. For BMD missions, Kill Assessment System (KAS) points the Mk99 illuminator at the ownship SM-3 missile, and receive an S-band signal, which will then be used to provide a real-time Kill Assessment (KA). The FCS Illuminators provide X-Band CWI for target illumination during ESSM terminal homing phase.	NA (Illumination)
07 ORTS	DACs in the Data Converter Cabinet, the CWI Transmitter, and the Director Control units interface with the ORTS data buses for checkout of operational characteristics.	WS-19644/15
23 CSSE/RAVE	The FCS Mk 82 Director interfaces with the TV Control Unit of the RAVE Kit to provide means of checking FCS Director alignment with respect to position data.	NA (Position Data)
23 CSSE/RF	The FCS Radar Transmitters interface with the CSSE CWI Monitors via a Waveguide Switch Assembly to receive RF samples of X Band CWI transmitter energy for purposes of AM/FM noise measurements.	NA (RF)
39 ACI/ACEG	The WCS/FCS IOPs receive Net Time Protocol time data from the FWD and AFT ACEG cabinets via ALIS. The source of the time data for the FWD and AFT ACEG cabinets is the IRIG-B time code from the FWD and AFT NAVSSI RTS.	WS-21288/4 Part 1

4.1.3.4.5 Design Approach/Rationale/Constraints

No changes are identified for Aegis BL10. However, any changes determined to be needed during detailed design will be included in a future version of the SSDD.

4.1.3.5 Not Used (05)

The number was previously used for the Guided Missile Launching System (GMLS). GMLS no longer part of Aegis.

4.1.3.6 Standard Missile and Evolved Sea Sparrow Missile (06)

4.1.3.6.1 Purpose

The Standard Missile (SM) is the primary surface-to-air weapon, primary BMD weapon, and secondary surface-to-surface weapon for the AEGIS class ships. As part of the highly integrated AEGIS Weapon System (AWS), the SM provides a rapid fire air-intercept capability for multiple, high speed, high threat target engagements including short to intermediate-range ballistic missile threats. SM employs an electronic countermeasures-resistant monopulse receiver. The SM receives midcourse guidance commands and other commands from WCS via SPY uplink. For SM-2 semi-active terminal homing, the onboard seeker requires MK99 illumination of the target. SM is launched from the Mk 41 Vertical Launching System (VLS). The SM can also be used against surface targets.

The RIM-162 Evolved Sea Sparrow Missile (ESSM) is a short range missile intended to provide self-protection for surface ships through the ability to engage a variety of antiship cruise missiles and aircraft to support self defense.

4.1.3.6.2 Requirements Satisfied

The SM&ESSM Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 2, Section 3.2.5.

4.1.3.6.3 Description

All SM-2, SM-3 and SM-6 missiles are delivered, loaded, and stored in the VLS in storage canisters. ESSM missiles are stored, carried, and launched from the VLS. The ESSM missiles are delivered in a VLS-compatible four-packed (Quad-Pack) Mk 25 canisters that are loaded directly into VLS. Missiles are delivered as All-Up-Rounds (AUR) and are not serviced on the ship. The missiles are downloaded into the VLS Launcher ready for use.

- The ESSM is a variant of the original NATO Sea Sparrow missile. The ESSM is employed to intercept and destroy threats as a short-range ship self-defense weapon.
- The SM-2 version of the SM is deployed in several different configurations ranging from the SM-2 Block III up through SM-2 Block IV [SBT].
- The SM-3 is part of the US Navy's sea-based Ballistic Missile Defense (BMD) system and will provide theater-wide defense against short to intermediate-range ballistic missile threats. SM-3 is deployed in two configurations on Flight III ships: Block IB and Block IIA.
- The SM-6 along with Naval Integrated Fire Control - Counter Air (NIFC-CA) is part of the US Navy's plan to extend the AEGIS Anti-Air Warfare (AAW) battlespace against high altitude and long range threats. There are four variants of the SM-6: SM-6 Block I, SM-6 Block IA, SM-6 Dual I, and SM-6 Dual II. SM-6 Dual I and Dual II can be used as SBT missiles as well.

The Standard Missile and Evolved Sea Sparrow Missile is depicted in Figure 4.1-6.

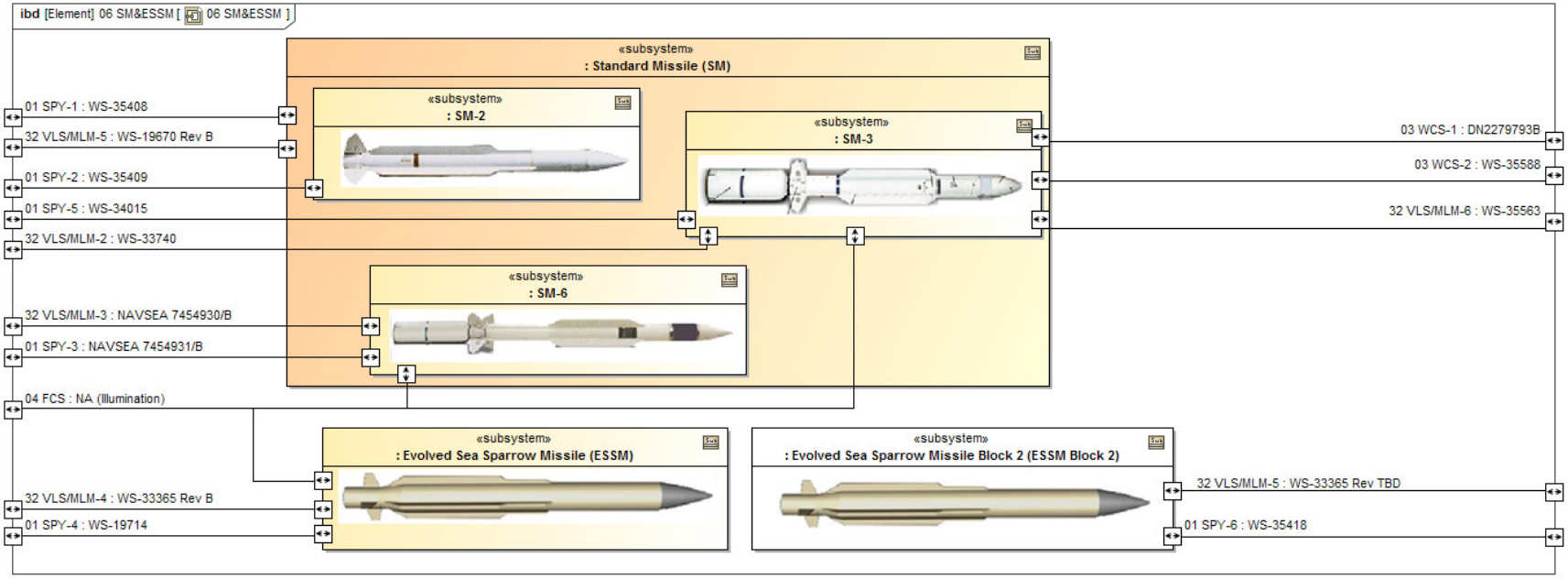

Figure 4.1-6 06 SM&ESSM

4.1.3.6.3.1 Standard Missile (SM)

4.1.3.6.3.1.1 SM-2

The SM-2 is a solid propellant-fueled, tail-controlled, surface-to-air missile equipped with both proximity and contact fusing, which carries and delivers a conventional blast fragmentation warhead. The missile contains five major functional groups.

- Guidance Section - The guidance section consists of an integrated assembly of a radome antenna system, terminal homing guidance system, S-band missile/ship communication system, and RF seeker head assembly. At or during Prelaunch, the guidance section receives initialization data via the Vertical Launching System (VLS) as part of the prelaunch sequence of events. In-flight, the guidance section receives control message and midcourse guidance commands, uplinked from the SPY-6 radar, while returning missile in-flight status via downlinks. During the terminal portion of flight, the missile acquires the target by locking on to ship-provided RF illumination with its seeker head. The guidance section then commands the missile with terminal homing guidance commands to intercept.
- Ordnance Section -The ordnance section consists of a high-explosive warhead, proximity fuse, contact fuse, safety and arming device, fuse booster, flight termination system, and their containing structure.
- Autopilot/Battery Section - The autopilot/battery section provides the internal missile electrical power and also provides missile flight control with an Inertial Reference Unit (IRU).
- Propulsion Section- The propulsion section of the missile is the Mk 104 Dual Thrust Rocket Motor. It uses two separate propellant grains: a cylindrical perforated boost grain, and an end-burning sustain grain. At ignition, both propellants burn, providing a short-duration, high-level thrust boost phase. When the boost grain burns off, the sustain grain continues to burn, providing a low thrust level sustain phase until burnout. In addition to the motor, the propulsion section contains the dorsal fin assembly and the arm and fire device.
- The Steering Control - The steering control section provides support and operation of the aerodynamic control surfaces (fins), and also provides for the missile's electrical interface with the launching system.

The SM-2 is deployed in several configurations, including the SM-2 Blk III/IIIA/IIIB medium range missiles, and the SM-2 Blk IV long-range missile. The SM-2 Blk III provides enhancements to the SM-2 against low altitude threats through modifications to guidance and ordnance. The SM-2 Blk IIIA includes a directional warhead, increasing lethality over the Blk III. The SM-2 Blk IIIB adds dual-mode homing to the Blk IIIA by inclusion of an infrared (IR) seeker. The SM-2 Blk 4 is an upgraded version of the SM-2 Blk IIIA, adding a seperatable booster increasing the range and altitude capabilities. The SM-2 Blk 4 is also referred as the SM-T for certain missions.

4.1.3.6.3.1.2 SM-3

The SM-3 is part of the Ballistic Missile Defense (BMD) program. The BMD system integrates SM-3 with the AWS aboard Navy Destroyers in order to provide an umbrella of protection against Short Range, Medium range, and Intermediate Range ballistic missile threats. The SM-3 is based on the SM-2 Block IV airframe and propulsion stack, but incorporates a Third Stage Rocket Motor, a Global Positioning System/Inertial Navigation System (GPS/INS) Guidance Section, and the SM-3 Kinetic Warhead (KW). The SM-3 is deployed in several variants including Blk IA, Blk IB, and Blk IIA.

SM-3 uses the same booster and dual thrust rocket motor as the Block IV missile for the first and second stages and the same steering control section and midcourse missile guidance for maneuvering in the atmosphere. To support the extended range of an exo-atmospheric intercept, additional missile thrust is provided in a new third stage for the SM-3 missile, containing a dual pulse rocket motor for the early exo-atmospheric phase of flight and a KW for the intercept phase. Upon second stage separation, the first pulse burn of the Third Stage Rocket Motor (TSRM) provides the axial thrust to maintain the missile’s trajectory into the exo-atmosphere. Upon entering the exo-atmosphere, the third stage coasts. The TSRM’s attitude control system maneuvers the third stage to eject the nosecone, exposing the KW’s Infrared (IR) seeker. If the third stage requires a course correction for an intercept, the rocket motor begins the second pulse burn. Upon completion of the second pulse burn, the IR seeker is calibrated and the KW ejects. The KW possesses its own attitude control system and guidance commands are acted upon by a solid divert propulsion system. The IR seeker acquires the target. Tracking information is continuously transmitted to the guidance assembly which controls the divert propulsion system.

4.1.3.6.3.1.3 SM-6

The SM-6 Blk I is an extended range active missile capable of seeking and destroying either an air or surface target depending upon its selected mode of operation. The SM-6 Block I is an upgraded version of the current SM-2 Block IV missile, adding the active radar homing seeker from the Advanced Medium-Range Air-to-Air Missile (AMRAAM). The SM-6 utilizes the FCS illuminators for high altitude intercepts. SM-6 coupled with NIFC-CA, extends the AEGIS defendable battlespace by projecting naval power over land and other strategic defense regions. This is accomplished by the SM-6 active seeker, which allows for maximum kinematics range, providing the SM-6 with Over the Horizon (OTH) capability and engagement on remote data from any appropriate sensor through Cooperative Engagement Capability (CEC). The SM-6 is deployed in different variants including Blk I, Blk IA, Dual I, and Dual II.

4.1.3.6.3.2 Evolved Sea Sparrow Missile (ESSM)

The RIM-162 ESSM is a short range missile intended to provide self-protection for surface ships. It will provide each ship with the capability to engage a variety of antiship cruise missiles and aircraft to support self-defense. The ESSM is also capable of limited surface warfare capabilities for ship self-defense against small craft.

The ESSM Block 2 missile is an enhancement to the existing ESSM to provide advanced self-protection for surface ships. It will provide improved capability against a variety of antiship cruise missiles and aircraft. This upgrade consists of a dual mode (active and semi-active) X-Band terminal guidance seeker in an all 10 inch diameter airframe. The ESSM Block 2 retains the capability to be fired using the existing ESSM missile initialization and RF interfaces for functional capability utilizing the semi-active capability of the seeker and will incorporate advancements to the interfaces to take full advantage of the active seeker capabilities.

4.1.3.6.4 Element Interfaces

Table 4.1-7 Standard Missile and Evolved Sea Sparrow Missile Interfaces

Element	Interface Description	IDS
01 SPY-1	An RF interface provides a communication link throughout the missile's flight to exchange midcourse guidance commands and missile status messages. The Radar's Target Data Processor provides downlink information to the WCS Computer Suite via the SDP and the SPY-6 Control Group Computer. The WCS provides the SPY-6 computer with uplink commands, which are transmitted to the missile. Applicable to SM-2 Blk III, IIIA, and IIIB.	WS-35408
01 SPY-2	An RF interface provides a communication link throughout the missile's flight to exchange midcourse guidance commands and missile status messages. The Radar's Target Data Processor provides downlink information to the WCS Computer Suite via the SDP and the SPY-6 Control Group Computer. The WCS provides the SPY-6 computer with uplink commands, which are transmitted to the missile. Applicable to SM-2 Blk IV.	WS-35409

Element	Interface Description	IDS
01 SPY-3	An RF interface provides a communication link throughout the missile's flight to exchange midcourse guidance commands and missile status messages. The Radar's Target Data Processor provides downlink information to the WCS Computer Suite via the SDP and the SPY-6 Control Group Computer. The WCS provides the SPY-6 computer with uplink commands, which are transmitted to the missile. Applicable to SM-6.	NAVSEA 7454931/B
01 SPY-4	An RF interface provides a communication link throughout the missile's flight to exchange midcourse guidance commands and missile status messages. The Radar's Target Data Processor provides downlink information to the WCS Computer Suite via the SDP and the SPY-6 Control Group Computer. The WCS provides the SPY-6 computer with uplink commands, which are transmitted to the missile. Applicable to ESSM.	WS-35418
01 SPY-5	An RF interface provides a communication link throughout the missile's flight to exchange midcourse guidance commands and missile status messages. The Radar's Target Data Processor provides downlink information to the WCS Computer Suite via the SDP and the SPY-6 Control Group Computer. The WCS provides the SPY-6 computer with uplink commands, which are transmitted to the missile. Applicable to SM-3 BLK 1A and 1B.	WS-34015
03 WCS-1	The SM-3 Blk IB transmits IR data to the KAS of WCS to support kill assessment.	DN2278793B
03 WCS-2	The SM-3 Blk IIA transmits IR data to the KAS of WCS to support kill assessment.	WS-35588
04 FCS	The FCS Illuminators provide X-band CWI for target illumination during the SM-2, SM-6, and ESSM terminal homing phase. For BMD missions, Kill Assessment System (KAS) points the Mk99 illuminator at the ownship SM-3 missile, and receive an S-band signal, which will then be used to provide a real-time Kill Assessment (KA). The FCS Illuminators provide X-band CWI for target illumination during ESSM terminal homing phase.	NA (Illumination)
32 VLS/MLM-1	VLS interfaces with the Standard Missiles to provide initialization and launch data and to receive missile status. Applicable to SM-2, SM-3, and SM-6.	WS-19670 Rev B

Element	Interface Description	IDS
32 VLS/MLM-2	On SM-3 equipped ships, the VLS MLM interfaces with SM-3 to provide GPS satellite data for GPS Hot Start.	WS-33740
32 VLS/MLM-3	The VLS interfaces with the SM-6 missile to provide initialization data in support of organic and IFC engagements.	NAVSEA 7454930/B
32 VLS/MLM-4	VLS interfaces with the ESSM to provide initialization and launch data, and to request Built-In-Test (BIT) data from the ESSM in response to commands from WCS. The ESSM provides status and BIT responses to VLS. All communication is serial in accordance with MIL-STD-1553B.	WS-33365 Rev B

4.1.3.6.5 Design Approach/Rationale/Constraints

No changes are identified for Aegis BL10. However, any changes determined to be needed during detailed design will be included in a future version of the SSDD.

4.1.3.7 Operational Readiness Test System (07)

4.1.3.7.1 Purpose

4.1.1.1.1

The Operational Readiness Test System (ORTS) is used by ship's personnel to assist in the determination of the overall operational status of the AEGIS Combat System (ACS) and to assist in the performance of ACS system maintenance. This is accomplished by interrogating the various elements and components for their current status and configuration, by executing Fault Detection (FD) and Fault Isolation (FI) tests to update and maintain overall status, displaying the overall status to the operator, and by performing system initialization.

In performing its mission, ORTS interfaces with other AEGIS Weapon System (AWS) and ACS systems via Local Area Networks (LANs) and discrete wire interfaces. The AWS systems include: SPY-6, C&D, WCS, FCS, ADS, ATD, ACI (including ACEG, System Management (SM) Services, and DiVDS), VCD, and MP. The ACS systems include: Command and Control Processor (C2P)/Common Data Link Management System (CDLMS), Undersea Warfare System (UWS), US&CS, Horizon Search Radar System (HSRS)/SPQ-9B, Gun Weapon System (GWS), Global Command and Control - Maritime (MTC2), and Electronic Warfare System (EWS).

4.1.3.7.2 Requirements Satisfied

The ORTS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 2, Section 3.2.6.

4.1.3.7.3 Description

The ORTS element is automatic in operation and is controlled by the computer program hosted in the Control Process Servers. ORTS is monitored and controlled from Combat System Maintenance Central by the ORTS operator. In addition to the equipment used in Maintenance Central, ORTS equipment is located in various Combat System Equipment Rooms to allow maintenance technicians to rerun tests to verify operability following maintenance actions.

ORTS has multiple color Thin-Client Displays (TCDs) supplied via the ACI for operator interaction. By manipulating a series of high resolution color graphics images, icons and menus, the operator can solicit status, perform tests, review test results, verify repair actions and ascertain system performance. Each console also provides a continuous display of the "overall" status of the ACS and provides visual alerts of critical changes in system status. On-line communications is supported by an interior voice communications system, which is not part of the ORTS, enabling voice communications among ACS Combat Information Center (CIC), ORTS maintenance supervision, and ACS maintenance technicians in assigned spaces. Hardcopy of any display is obtainable from an ORTS printer.
ORTS will provide a mechanism for operator initiated transfer of data to shore for use in troubleshooting efforts and vice versa.

The Operational Readiness Test System is depicted in Figure 4.1-7.

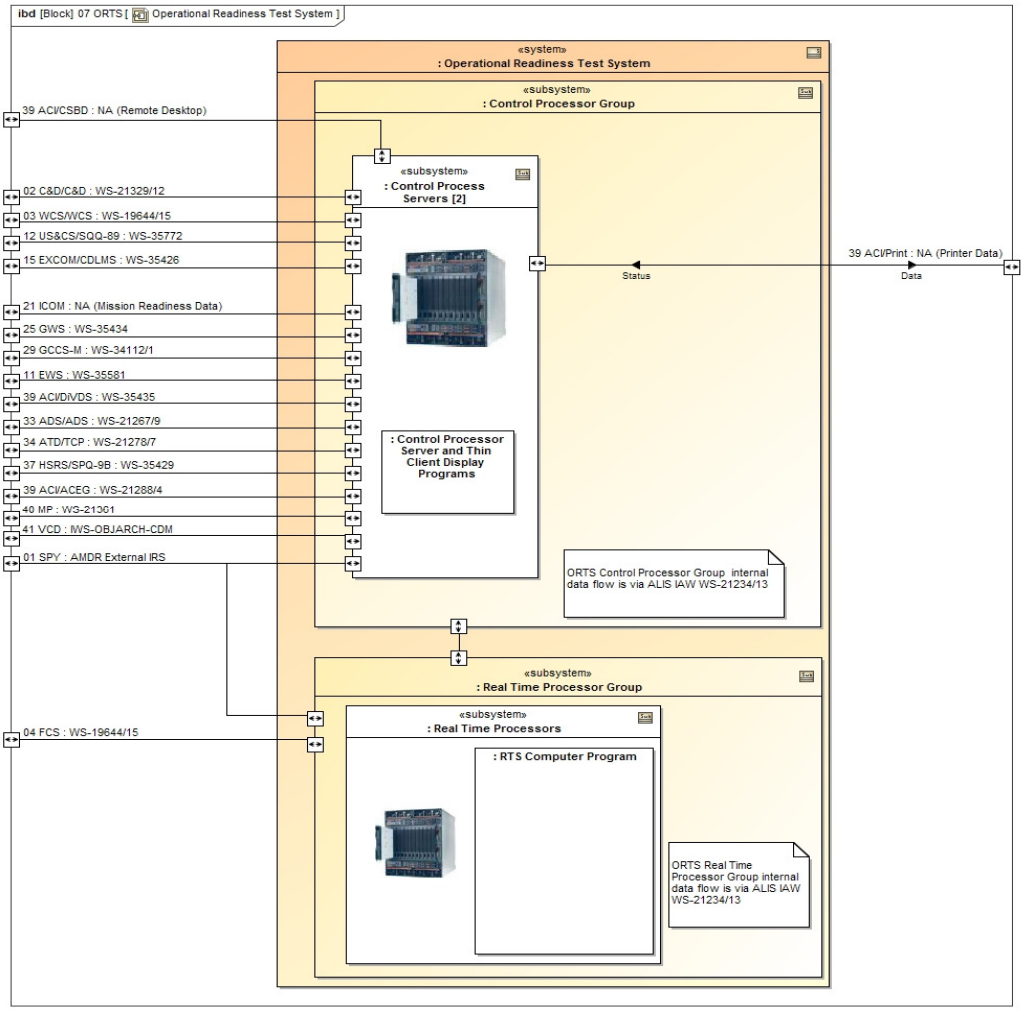

Figure 4.1-7 07 ORTS

4.1.3.7.3.1 Operational Readiness Test System

The ORTS Mark 10 consists of a set of Servers, printer, and associated computer programs which provides support to the ACS in fulfilling its readiness assessment functions. ORTS also supports ACS element initialization and supports the maintenance of ACS. ORTS is composed of two major processing components: the Control Processor Group (CPG) and Real Time Processor Group (RTPG).

4.1.3.7.3.1.1 Real Time Processor Group

The RTPG is responsible for those ORTS functions that must be performed in real time such as Data Channel Set (DCS) access. The RTPG consists of the Real Time Processor (RTP) and the DCS.

4.1.3.7.3.1.1.1 Real Time Processors

The RTP interfaces via the ALIS, with the CPG, and AWS elements and equipment. The RTP in conjunction with the ACEG, performs real time functions, such as Test point Control access for ORTS and other AWS elements, and controls I/O activity. The RTP executes the RTP computer program and interfaces with the ORTS CPG and AWS element computers.

4.1.3.7.3.1.1.1.1 RTP Computer Program

The RTP computer program is responsible for all RTP functions and the management of RTP interfaces. The RTP processor, located in the Mission Critical Enclosure (MCE) cabinets, utilizes active and standby processors. The RTP processor is responsible for initiating and maintaining communications with the ALIS, ORTS CP and DXR LAN as well as maintaining status of all communications and reporting

communications status changes to the ORTS CP. The RTP processor is also responsible for evaluating some specific test point responses and prioritizing test point read messages.

4.1.3.7.3.1.2 Control Processor Group

The CPG consists of the Control Processor Servers, printer, and supporting computer programs. The CPG is responsible for all control functions of the ORTS. These functions consist of the collection, processing and maintenance of ACS configuration and status information; the control and execution of operation and maintenance tests and maintaining their results; the control of ACS element initialization; the control of the ORTS Human/Machine Interface (HMI), operator command processing, and the generation of printouts; and the collection and recording of the ORTS operational information.

The CPG interfaces directly with the RTP and AWS elements, issuing and managing message requests and processing message responses. The CPG coordinates the activities of multiple operators who may be working simultaneously with the ORTS independently of each other.

The CPG is responsible for all ORTS internal FD/FI testing and both Control Processor Test Group (CPTG) and real Time Processor Test Group (RTPG) initialization.

4.1.3.7.3.1.2.1 Printer

ORTS has the capability to print to a commercial off-the-shelf (COTS) laser printer that provides hardcopy status and display information output. The printer is part of the ACI element and interfaces with the Active and Standby Fileservers via a Fast Ethernet interface to AEGIS LAN Interconnect System (ALIS).

4.1.3.7.3.1.2.2 Control Process Servers

The ORTS CPG servers/processors located in the Mission Critical Enclosure (MCE) cabinets provide memory and I/O capabilities to execute the Control Processor (CP) computer programs. Two servers (primary and redundant) operate in an Active/Standby relationship. The Active Server executes the basic ORTS computer program and ACS interface function, with the Standby Server capable of taking over these functions in the event of server switchover. All TCDs, located in various equipment spaces, are connected to the servers via the ALIS and require the processing capabilities of a server for full operation. Both servers interface directly with all ORTS TCDs via ALIS. ORTS can also be operated from Common Display Subsystem (CDS) displays in CIC.

The Control Process Servers software subsystem contains the following software components:

a. ORTS Common Services – ORTS Common Services represents services common to all ORTS components. These include the following:
   • Infrastructure for non-domain specific generic services
   • Infrastructure Framework for common publish/subscribe messaging
   • Resource Adapter interface for sending and receiving messages from external elements
   • Message Templating to read and write message fields of external messages
   • System Services for data recording and time
b. Element Conducted Test – The Element Conducted Test (ECT) component performs Fault Detection (FD) and Fault Isolation (FI) on AWS equipment and reports faults down to the Line Replaceable Unit (LRU). ECT analyzes a combination of status, fault codes, and test vectors from the AWS elements.
c. Test Scheduler – The ORTS Test Scheduler component functions as a test resource scheduler. It orchestrates and manages all test types (CAT, ECT, OCT, EM, etc.) depending on the incoming requests and available resources. It also manages periodic tests, either manually requested or automatic. Furthermore, Test Scheduler maintains a list of all tests that have been queued and their status.
d. Operator Support Global Alerts – The Operator Support Global Alerts (OSGA) component provides support for operator activities. These activities include requesting the Master Console and managing the alert queue.
e. Main Display – Main Display is a generic display that appears on all ORTS thin-client displays and provides the Graphical User Interface (GUI) of ORTS. It is a medium for the user to interact with all the other subsystem of ORTS, directly and indirectly. It displays various ORTS component specific displays through calls to the other components. Main Display is responsible for keeping track of and maintaining all user displays.

f. Equipment FD/FI – The Equipment FD/FI component provides fault detection and fault isolation services for AWS component equipment. ORTS Conducted Tests (OCT) evaluate the health of the equipment and isolate faults.
g. Application Management – The Application Manager constructs a dynamic data model based on data provided by OASM, Status, Tracking and the Element Status Response (MT-2344) WCS. The provided data is decoded so that it can be integrated into the ORTS HMI. The ORTS computer program and remote load displays update automatically based on the Application Management data model. The Application Manager also handles remote load actions initiated by the ORTS operator and OASM specific operator initiated tests.
h. Equipment Management – The Equipment Management component receives alarms, operability, and network connection status from the OASM Equipment Management Service (OASM-EM) via the OASM Adapter. Asynchronous status changes are also received and processed. The received data is decoded and validated before results are set/unset and status values updated in the database by the Status Handler. The Equipment Management component handles OASM specific operator initiated tests.
i. Status Handler – The Status Handler provides methods to allow other components to set and query the status of equipment and the AEGIS elements. It provides methods to report changes in status and allow other components to get data such as applicable tests for a piece of equipment. Additionally, it manages all data that changes during ORTS CP program execution that must be persisted when the blades that host the ORTS CP program are restarted.
j. Resource Adapter – The Resource Adapter component provides the framework and interfaces (adapters) to the other AEGIS elements (SPY, C&D, WCS, etc.) in order for ORTS to communicate with them. The Adapters provide all of the specific functionality to ensure proper establishment of a connection to each element. All messages going into and coming out of ORTS are handled by the Resource Adapter component.
k. OASM Adapter – The OASM Adapter component serves as the primary interface to receive application and equipment management status messages from Open Architecture System Management (OASM). OASM Adapter interfaces to an OASM Client Application (via Resource Adapter) that connects it to the OASM Application Management (AM) and Equipment Management (EM) Services that receive status data from the AWS tactical elements. OASM Adapter subscribes to OASM data messages which are then converted to objects and sent to the ORTS Application Management and Equipment Management components, as applicable.

4.1.3.7.3.1.2.2.1 Control Processor Server and Thin Client Display Programs

The CP Server and TCD Program include: CP Computer Program, CP Operating System, TCD Computer Program, and TCD Operating System.

The Control Processor Server and Thin Client Display Programs software subsystem contains the following software components:

a. CP Computer Program – The CP computer program is responsible for all CPG functions and the management of all CPG equipment. The CP computer program executes in the CP Server under the CP operating system.
b. CP Operating System – The CP operating system is considered a NDI and provides basic services which are utilized by the CP program. These basic services fall into the following categories: basic operating system services, windowing system services, input and output management of the keyboard, trackball and screen between the CP and TCDs.
c. TCD Computer Program – The TCD computer program provides for initialization of the TCD and the establishment of communications with the CP.
d. TCD Operating System – The TCD computer program is considered NDI and provides basic services used by the TCD such as input and output management of the operator keyboard and trackball commands for transmission to the CP and windowing system services for processing display commands from the CP.

4.1.3.7.4 Element Interfaces

Table 4.1-8 Operational Readiness Test System Interfaces

Element	Interface Description	IDS
01 SPY	ORTS interfaces with the SPY Computer Suite via network interfaces to ALIS to receive SPY readiness/assessment data and perform fault detection fault isolation tests upon request.	AMDR External IRS
02 C&D	ORTS interfaces with the C&D Computer Suite via network interfaces to ALIS to receive C&D readiness/assessment data.	WS-21329/12
03 WCS	ORTS interfaces with the Weapon Control System (WCS) Computer Suite via network interfaces to ALIS to receive WCS readiness/assessment data. WCS provides ORTS with readiness/assessment with the WCS DAP (p/o the ACEG cabinet) for interrogation of equipment test points upon computer request. ORTS interfaces via WCS with VLS to receive readiness/assessment data.	WS-19644/15
04 FCS	Checkout of FCS operational characteristics is performed by utilizing the DACs in the FCS Data Converter Cabinet, CWI Transmitter, and Director Control, interfacing with the DAP in the ACEG cabinet of WCS for subsequent transmittal to the ORTS computer.	WS-19644/15
11 EWS	EWS provides readiness data to ORTS via ALIS.	WS-35581
12 US&CS/SQQ-89	ORTS interfaces via network interfaces with SQQ-89 to receive readiness/assessment data.	WS-35772
15 EXCOM/CDLMS	ORTS interfaces via network interfaces to ALIS with CDLMS to receive readiness/assessment data.	WS-35426
21 ICOM	ORTS has a pair of 10 base-2 interfaces from DMS to the DTS-B Remote NO. 1 9-port 10base-2 switch for sharing of Integrated Survivability Management System (ISMS) Data.	NA (Mission Readiness Data)
25 GWS	The ORTS system sends element heartbeat to GWS and displays system status.	WS-35434
29 GCCS-M /MTC2	ORTS interfaces to GCCS-M via ALIS and the CANES. GCCS-M provides web services to ORTS in order for ORTS to receive satellite data (Two Line Element (TLE) and Satellite Situation Report (SSR), and satellite ephemerides data) required for SPY to perform Sensor Calibration using Satellites (SCUS).	WS-34112/1

Element	Interface Description	IDS
33 ADS	ORTS interfaces with the AEGIS Display System (ADS) housed within the DCS Cabinets via network interfaces to ALIS to receive ADS readiness/assessment data.	WS-21267/9
34 ATD/TCP	ORTS interfaces with ATD processes running in the CCS or MCE cabinets via network interfaces to ALIS to receive ATD component readiness/assessment data.	WS-21278/7
37 HSRS	ORTS interfaces via network interfaces to ALIS with HSRS to receive SPQ-9B readiness/assessment data.	WS-35429
39 ACI/ACEG	ORTS interfaces with the DAP in the ACEG cabinets to receive readiness/assessment data.	WS-21288/4
39 ACI/CSBD	ORTS initiates a display with the CSBD components to support configuration (e.g. policy, filters, rules) through a GUI. In addition, ORTS will manage the CSBD software components (CS DDTS and CS BDTS) through AM	NA (Remote Desktop)
39 ACI/Printer	ORTS has the capability to print to a commercial off-the-shelf (COTS) laser printer that provides hardcopy status and display information output. ORTS interfaces with the printer via network interfaces to ALIS.	NA (Printer Data)
39 ACI/DiVDS	ACI provides DiVDS video and TCDs to the ORTS system via ALIS.	WS-35435
40 MP	ORTS interfaces with MP to receive readiness/assessment data and provides the capability to reset MP.	WS-21361
41 VCD	ORTS interfaces with VCD to receive readiness data.	IWS-OBJARCH-CDM

4.1.3.7.5 Design Approach/Rationale/Constraints

Changes are identified in Aegis BL10 due to SPY-6 integration and cybersecurity.

SPY-6 integration with ORTS requires updates on ORTS's ordering of tests against the radar system for operational readiness.

ORTS will interact in the cybersecurity domain for downloading and uploading for files coming into the ship.

4.1.3.8 Not Used (08)

This number was previously used for the Air Search Radar System (ASRS), AN/SPS-49. The ASRS was removed by SHIPALT CG 47-00745K.

4.1.3.9 Surface Search Radar System (09)

4.1.3.9.1 Purpose

The Surface Search Radar System (SSRS) is comprised of the AN/SPS-73V(12) navigation radar. The SPS-73 supports navigation, piloting, station keeping, low speed target detection, and collision avoidance.

4.1.3.9.2 Requirements Satisfied

The SSRS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.1.

4.1.3.9.3 Description

The SPS-73 (X-band) provides detection and tracking capability against most surface and some low elevation air contacts. Unlike other ship radars, the SPS-73 is compliant with International Maritime Organization (IMO) interference standards and is thus operable in port. The AN/SPS-25H Indicator Group, used by the ship's Surface Radar Operator (SRO), performs electronic plotting and automatically calculates target data for display. The Integrated Bridge System (IBS) performs similar functions with its SPS-73 radar input.

The Surface Search Radar System is depicted in Figure 4.1-8.

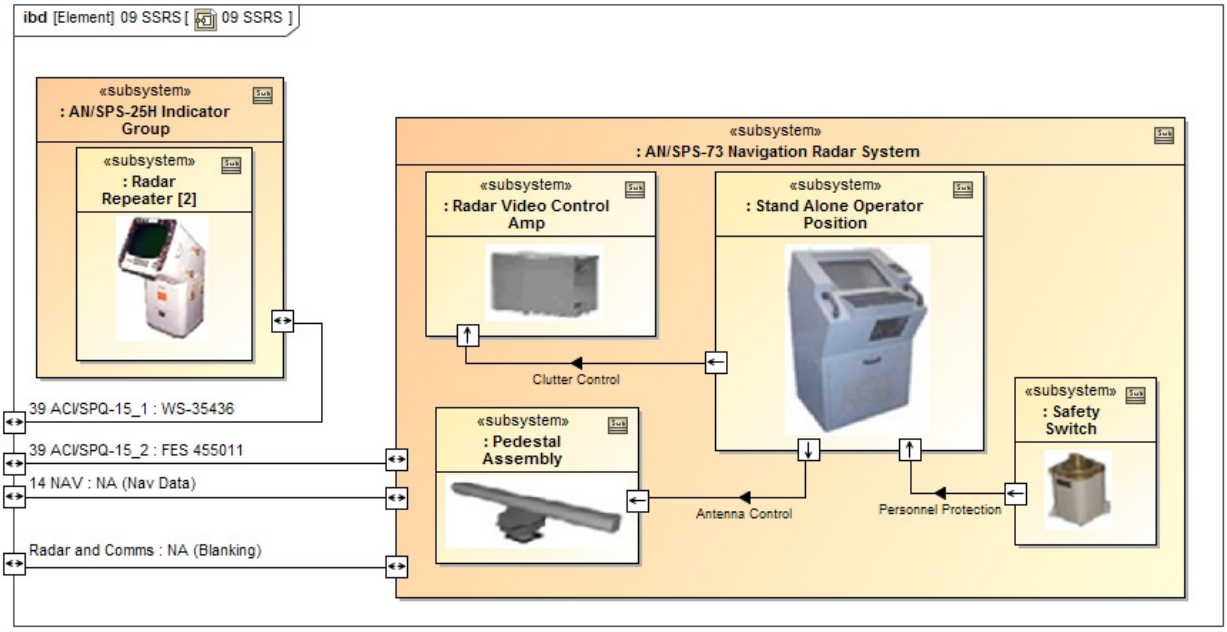

Figure 4.1-8 09 SSRS

4.1.3.9.3.1 AN/SPS-25H Indicator Group

The AN/SPA-25H Indicator Groups contains two radar repeaters or azimuth-range indicators, one in the Pilot House and one in Combat Information Center (CIC).

4.1.3.9.3.1.1 Radar Repeater

Indicator Groups connect to the Switchboard/Converter units that are part of the Digital Video Distribution System (DiVDS). With the interface to the Aegis Advanced Sensor Distribution System (AASDS), an indicator can display video from the SPS-73.

4.1.3.9.3.2 AN/SPS-73 Navigation Radar System

The AN/SPS-73(V)12 surface search radar supports navigation, piloting, station keeping, low speed target detection, and collision avoidance. It is a low-power, short-range, two-dimensional pulsed radar primarily designed for surface search and navigation. The system takes advantage of the Versa Module Eurocard (VME) basis open system architecture for its hardware, module, and electronic configuration.

4.1.3.9.3.2.1 Safety Switch

The safety switch provides personnel protection from radiation exposure, and antenna rotation, while working on the antenna group.

4.1.3.9.3.2.2 Pedestal Assembly

The pedestal assembly includes an X-Band rotating antenna (AS-4473/SPS-73(V)), a Pedestal/Scanner (AB-1399A/SPS-73(V)) that contains control electronics, and Receiver/Transmitter. The antenna (a.k.a. the scanner) has an end fed, slotted array with horizontal polarization. All the required signals and power to the antenna are carried over one multi-conductor cable to the Stand Alone Operator Position (SAOP) located in the Pilot House.

4.1.3.9.3.2.3 Stand Alone Operator Position

The AN/SPS-73(V)12 radar includes a Main Console Group OJ-727(V)9/SPS-73(V) assembly that operates as a Stand Alone Operator Position (SAOP). The radar processor interfaces with the antenna pedestal electronics for sending commands and receiving track data. The SAOP is located in the Pilot House, links directly to the pedestal to source high voltage to the transmitter and to receive target echoes and provide pedestal control. Ownship navigation data including heading, speed and Global Positioning System (GPS) are supplied to the SAOP from the NAV Element 14.

4.1.3.9.3.2.4 Radar Video Control Amp

The Radar Video Control Amplifier (RVCA) accepts video and trigger from the SAOP and provides the operator with clutter rejection control to improve the presentation of the radar return on the displays in CIC.

4.1.3.9.4 Element Interfaces

Table 4.1-9 Surface Search Radar System Interfaces

Element	Interface Description	IDS
14 NAV	Antenna bearing is provided to NAVSSI via DMS. SSRS receives synchro navigation data (OSS and OSH) from the WSN-7 through the DMS, and GPS for time and position from the NAVSSI. The GPS derived time is displayed on the radar display. GPS position data attaches to the cursor on the PPI display.	NA (Nav Data)
39 ACI/SPQ-15_1	The AN/SPA-25H interfaces with the AN/SPQ-15(V) to receive analog video for display on the SPA-25H or IBNS.	WS-35436
39 ACI/SPQ-15_2	The AN/SPS-73 interfaces with the AN/SPQ-15(V) to provide radar video and true bearing.	FES 455011

Element	Interface Description	IDS
Radar and Comms	The radars and communications systems within the ACS send blanking triggers to the EWS to prevent co-site sensor interference	NA (Blanking)

4.1.3.9.5 Design Approach/Rationale/Constraints

No changes are identified for Aegis BL10. However, any changes determined to be needed during detailed design will be included in a future version of the SSDD.

4.1.3.10 Identification, Friend or Foe System (10)

4.1.3.10.1 Purpose

The AN/UPX-29(V) Combat Identification, Identification, Friend or Foe (IFF) system provides the capability to instantaneously identify air and surface tracks at any range and azimuth. The shipboard IFF system consists of a Transponder Group, an Interrogator Group, and a Radar Test Set. It transmits interrogations, detects transponder replies, and processes the resulting information for use by a ship's operators and combat system computers. The system provides unique display of synthetic symbology and IFF control to up to 22 operators. It also provides users with real-time Selective Identification Features (SIF) and secure Mode 4 and Mode 5 IFF information.

4.1.3.10.2 Requirements Satisfied

The IFF Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.2.

4.1.3.10.3 Description

IFF system consists of two independent equipment groups, the transponder group and interrogator group. The interrogator group is used to query transponders on aircraft or ships. The transponder group responds to off-ship interrogations. The IFF System has a secure mode for wartime application. There are three basic modes of interrogation/response. The response is a coded message. The interrogator determines range and bearing and has the ability to sort returns and discriminate against unsynchronized returns.

The interrogator group is an independent IFF System, which includes an electronically steered array, an interrogator set, and a central processor. The interrogator group has the ability to provide 360 degree coverage in azimuth and up to 60 degrees of elevation. The processor generates interrogation commands, processes returns, and has the ability to store a number of complete IFF target reports. Contact IFF reports are usually received through continuous interrogator electronic fixed array antenna scan or mechanical rotating antenna scan; selected target reports are available to the combat system on an operator demand or system priority basis for correlation with combat system track reports. The system also supplies IFF video to the display consoles for operator use. The transponder group allows entry of assigned ownship SIF/Mode 4/Mode 5 code, and provides off-ship interrogators with ownship SIF/Mode 4/Mode 5 code and requested IFF information.

In operational use, the transponder subsystem is sometimes secured and only the interrogator is used to allow for identification of contacts without providing an ownship IFF transponder “beacon” that can be used by an opponent for USN ship identification and counter targeting.

The Identification, Friend or Foe System is depicted in Figure 4.1-9.

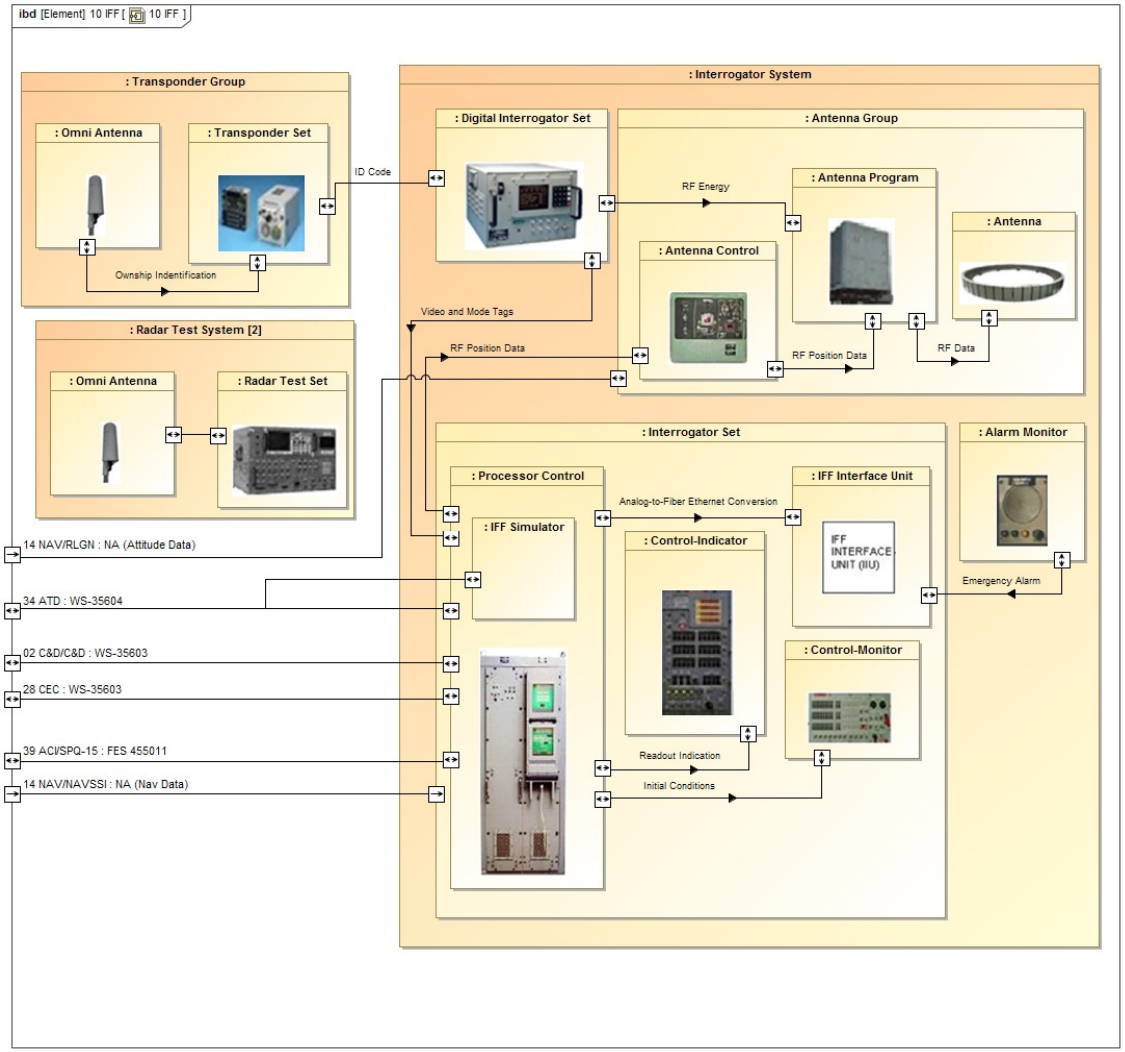

Figure 4.1-9 10 IFF

4.1.3.10.3.1 Transponder Group
The AN/APX-123(V)1 transponder group (CXP with Mode 5) responds to interrogation requests from off-ship sources. It supports all Military Modes as well as civilian Mode S.

4.1.3.10.3.1.1 Omni Antenna
The Antenna AS-177B/UPX omnidirectional antenna is used as the receiving and transmitting antenna for the transponder set to provide ownship identification.

4.1.3.10.3.1.2 Transponder Set
The Transponder Set consists of a Transponder RT Assembly, Electrical and Communications Equipment Case, and a Transponder Control Transmitter Radar. Transponder RT Assembly with junction box receives and decodes interrogations and provides the appropriate ID code and IFF information response for ownship. Electrical Communication Equipment Case CY-8882/APX - The case provides a means for mounting the C-12720/APX Radar Control Transmitter and serves as a connection box for interconnecting to the RT-1912/APX-123(V)1 Transponder Set. Transponder Control Transmitter Radar C-12720/APX- The operating controls and indicators that make up the Radar Control Transmitter are: Master Switch; Operating Mode Selection; Reply Code Selection; Identifier Pulse Selection; Test Provisions; Mode 5 Controls; and Indicator Lights. These operating controls and indicators are used to control transponder set operation and are housed in CY-8882/APX.

4.1.3.10.3.2 Radar Test System
The Radar Test System is comprised of an omnidirectional antenna and a radar test set.

4.1.3.10.3.2.1 Omni Antenna
The radar test set is associated with an omnidirectional antenna AS-177B/UPX.

4.1.3.10.3.2.2 Radar Test Set
AN/USM-719 Mode 5 is the IFF radar test set. This test set is used to calibrate and maintain IFF equipment such as interrogators, transponders, coders-decoders, display systems, and automatic data processors.

4.1.3.10.3.3 Interrogator System
The interrogator system AN/UPX-29(V) is used to query transponders on aircraft or ships. It includes an electronically steered array, an interrogator set, and a central processor and has the ability to provide 360 degree coverage in azimuth and up to 60 degrees of elevation.

The processor generates interrogation commands, processes returns, and has the ability to store a number of complete IFF target reports. IFF target reports are available by continuous scan or by interrogation via request from the host combat system. The system also supplies IFF video to the display consoles for operator use.

The interrogator transmits a coded signal and receives a coded signal in return. Based on antenna angle, time delay, and data encoded in the response, the interrogator is able to provide location and identification information for the platform. The IFF interrogator group supports all MK-XIIA IFF codes (SIF Mode 1, Mode 2, Mode 3/A, Mode C altimeter, Mode 4, Mode 5, and Mode S).

4.1.3.10.3.3.1 Interrogator Set
The Interrogator Set AN/UPX-24(V) operates with standard shipboard IFF components: up to four radar sets, Data Distribution System (DDS), display consoles, IFF antenna and a weapons system. The AN/UPX-24(V) consists of the following equipment:

4.1.3.10.3.3.1.1 IFF Interface Unit
The IFF Interface Unit (IIU) provides the analog-to-fiber Ethernet conversion for request of IFF challenges and IFF video signals in the system.

4.1.3.10.3.3.1.2 Control-Indicator
The Control-Indicator C-10064/UPX-24(V) unit provides a readout indication of the evaluation and codes of a selected target or targets.

4.1.3.10.3.3.1.3 Control-Monitor

The Control Monitor C-10065/UPX-24(V) unit controls and provides the initial conditions of the AN/UPX-24(V) system.

4.1.3.10.3.3.1.4 Processor Control

The Processor Controller CP-1273/UPX-24(V) receives IFF video and mode tags from the AN/UPX-45(C)Interrogator and performs target detection, target location, and code validation. The Processor Controller also receives IRIG-B: GPS-150 data from NAVSSI via a terminal box. Target reports are stored by the Processor Controller for display, and synthetic IFF video symbology is provided by the Processor Controller for display in synchronism simultaneously with as many as four independent radar sets. The Processor Controller then distributes the Long Range IFF trigger signal to the Data Distribution System (DDS). The Processor Controller provides dual units centralized processing and storage of IFF data. The main functional units of the Processor Controller are an IFF Data Processor, an Interface Control Unit, and a Display Processor.

4.1.3.10.3.3.1.4.1 IFF Simulator

The IFF Simulator interfaces with the Advanced Training Domain to receive ground truth data and provides equipment status and data recording status. The IFF simulator will simulate IFF responses, including Mode 4, Mode 5, Mode S, and emergency responses, provide those IFF responses at realistic ranges, and support the ability to initiate CEC IFF-only tracks and CEC IFF doctrine.

4.1.3.10.3.3.2 Interrogator Set AN/UPX-45(C)

The Interrogator Set AN/UPX-45(C) is capable of interrogating Mk XII IFF/Selective Identification Feature (SIF) type Radar Identification Sets (transponders), receiving the Radio Frequency (RF) replies from them, and processing the replies into proper video signals to be applied to the Decoders and Indicators. The interrogations are transmitted on a crystal-controlled frequency of 1030 MHz; the replies are received at 1090 MHz. The Interrogator Set generates interrogation pulse pairs for Modes 1, 2, 3/A, C, 4, 5, and S whenever one of these modes is challenged. An embedded Crypto Computer generates the coded interrogations and decodes the replies. IFF crypto materials are supplied separately by the operator. Two units are part of the system, but only one is used at any time. The other is available as an 'off-line' hot spare. The Interrogator Sets receive FWD and AFT GPS-150 Data from NAVSSI via a terminal box.

In normal operation, the Interrogator Set is remotely controlled digitally by the Processor Controller CP-1273/UPX-24(V). However, the Interrogator Set can be controlled locally by means of front panel consoles. In normal modes of operation of the IFF System (AN/UPX-24(V)), control and AN/UPX-45(C) IFF video returns are routed to the CP-1273/UPX-24(V) where the information is digitized and stored in a processor for access as target reports by the combat system software. This information is also reconstituted as IFF synthetic video to interface with the Common Display System (CDS) via Data Distribution System (DDS). Connector receptacles for all the interconnecting cables are mounted on the rear panel, with the exception of the antenna connector, which is located on the front panel.

4.1.3.10.3.3.3 Antenna Group

The Antenna Set Group OE-120( )/UPX is a shipboard antenna system that operates with IFF equipment. It uses RF energy supplied by the Interrogator Set AN/UPX-45(C) to provide an electrically steered RF beam that is positioned from digital or standard synchro input commands. These synchro digital commands are generated within the IFF AN/UPX-24(V) Antenna Processor Controller.

4.1.3.10.3.3.3.1 Antenna

The Antenna AS-3134( )/UPX performs both transmit and receive functions and is formed by a circular array of 64 cavity-backed dipole radiators. The Antenna transmits both directional and omnidirectional RF beams. Switching between these beams and steering the directional beam is accomplished by the electronically steered array (ESA). The directional beam can be steered 360 degrees in azimuth, or jumped from one bearing position to any other bearing almost instantaneously. The Control Unit and Programmer develop the beam forming and beam steering signals that control the RF beam formation and beam steering.

4.1.3.10.3.3.3.2 Antenna Control

The Control Unit C-10063/UPX provides deck tilt correction (roll/pitch compensation) and determines the angular position of the radiated RF beam from the antenna. The Control Unit accepts directed beam

position data in digital form from the Processor Controller and translates them into a digital beam steering command that is roll and pitch compensated when ship NAVSSI roll and pitch synchro data is supplied. The combat system only operates in True mode so the Antenna Group bearing reference selected on the front panel . Roll, pitch, and heading inputs from DMS are used by the Control Unit to develop roll and pitch compensation data; thus the digital beam steering command supplied to the Programmer will be corrected for deck tilt. Beam position data which represents the position to which the directed beam is steered is available from the Control Unit to external shipboard equipment.

4.1.3.10.3.3.3.3 Antenna Programmer

The Programmer CV-3372/UPX receives an RF input from the interrogator/receiver and distributes it among the 64 radiating elements that form the antenna. The digital beam steering command from the Control Unit determines how the RF energy is to be distributed among the 64 radiating elements, which consequently determines the direction of beam radiation. The antenna can radiate a beam in any of 1024 directions around the antenna. When the Interrogator Sidelobe Suppression (ISLS) trigger is received from the Interrogator/Receiver, the Programmer distributes the RF energy equally among the 64 radiating elements and forms an omnidirectional beam. Transponder replies received by the Antenna are coupled through the programmer to the interrogator receiver for decoding. Each unit of the Antenna Group except the Antenna has a Built-In-Test Equipment (BITE) feature that monitors the operational status of each unit. The Control Unit exchanges BITE data with the programmer and remote display units. Whenever a fault occurs within the Antenna Group, the Control Unit provides a display that identifies the faulty module or component.

4.1.3.10.3.3.4 Alarm Monitor

These alarm monitors generate audible alarms when an interrogated ship or aircraft sends an emergency alarm. The alarm monitors are connected to select Control Indicators (CIs) in CIC.

4.1.3.10.4 Element Interfaces

Table 4.1-10 Identification, Friend or Foe System Interfaces

Element	Interface Description	IDS
02 C&D	The C&D Computer Suite interfaces with the IFF AN/UPX-29 IFF Interrogator Set Processor-Controller CP-1273/UPX-24(V) via an ALIS Ethernet connection. These interfaces provide IFF data (codes) in response to Demand Interrogation requests by the C&D for specific target range and azimuth positions in support of engagements and various track ID IFF interrogation doctrines.	WS-35603
14 NAV/NAVSSI	The IFF terminal box receives a RS-422 GPS-150 message from both FWD and AFT RTS via ICOM. The message is then distributed within the IFF system.	NA (Nav Data)
14 NAV/RLGN	The Antenna Control Unit receives ships synchro data heading, pitch, and roll from RLGN Inertial Navigation Set via FODMS.	NA (Attitude Data)
28 CEC	(FOUO) CEC provides interrogation control and receives IFF Target Reports from the Processor Controller of IFF via ALIS. Classified as FOUO by CEC SCG [OPNAVINST S5513.3B-(119.10)]	WS-35603

Element	Interface Description	IDS
34 ATD	The IFF Simulator component of the AN/UPX-24(V) component of the IFF system interfaces with the Advanced Training Domain to receive training related IFF data.	WS-35604
39 ACI/SPQ-15	The AN/SPQ-15(V) interfaces with the AN/UPX-24(V) of the IFF system to receive IFF video and data, and to request specific video. There is one physical connection which provides 14 virtual channels.	FES 455011

4.1.3.10.5 Design Approach/Rationale/Constraints

No changes are identified for Aegis BL10. However, any changes determined to be needed during detailed design will be included in a future version of the SSDD.

4.1.3.11 Electronic Warfare System (11)

4.1.3.11.1 Purpose

The Electronic Warfare System (EWS) provides the capability to (1) detect and analyze the electromagnetic environment, (2) provide information to the combat system on threat identification and position (bearing), and (3) initiate and coordinate the launching of off-board countermeasure devices. The EWS is intended to enhance ship passive RF surveillance, identification, and self-defense against anti-ship missiles and launch platforms.

For the SLQ-32(V)6 configuration, EWS includes the Softkill Coordination Subsystem (SKCS), which enables effective utilization of softkill assets against threats and provides enhanced track classification data.

4.1.3.11.2 Requirements Satisfied

The EWS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.3.

4.1.3.11.3 Description

The EWS System consists of the SLQ-32(V)6/7 Electronic Warfare System and the MK 53 Decoy Launching System.

4.1.3.11.3.1 SLQ-32(V)6

The EWS System consists of the SLQ-32(V)6 Electronic Warfare System and the MK 53 Decoy Launching System.

The Electronic Warfare System is depicted in Figure 4.1-10.

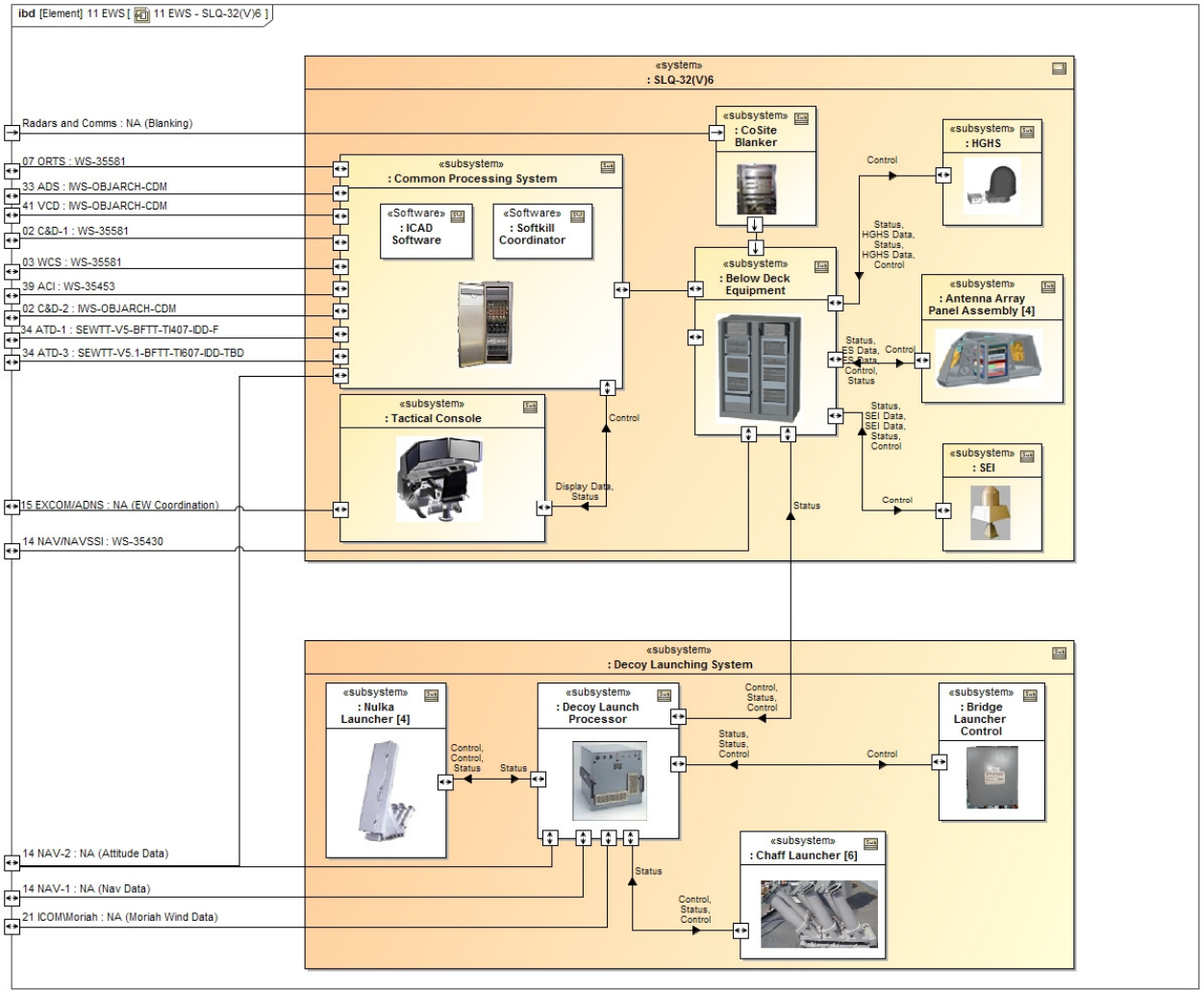

Figure 4.1-10 11 EWS (AN/SLQ-32(V)6)

4.1.3.11.3.1.1 SLQ-32(V)6

The AN/SLQ-32(V)6/7 System consists of four Electronic Support (ES) Antenna Array Panel Assemblies (AAPA), the Specific Emitter Identification (SEI) and High Gain High Sensitivity (HGHS) Antennas, the CoSite Blanker, a Core Computing System, Below Deck Equipment, the Decoy Launching System, and a Tactical Console.

The AN/SLQ-32(V)6/7 was developed under the Surface Electronic Warfare Improvement Program (SEWIP) Blk 2 upgrade. The AN/SLQ-32(V)6/7 adds the SKC to the existing SLQ-32(V)6, which provides coordinated employment of softkill weapons, using EW and Radar sensor inputs to provide recommended or automatic actions and manage softkill weapons, including NULKA, expendable decoys, and future onboard and offboard EA assets.

4.1.3.11.3.1.2 Antenna Array Panel Assembly

The SLQ-32(V)6 contains four array sets of the Topside Equipment Group (TEG) per ship. The SRCS variant is intended for DDG Ships. Each array set consists of the conventional band antenna elements, high power limiters, calibration and redundancy select switches, High Probability of Intercept (HPOI) FR Distribution (RFD) model, Millimeter Wave (MMW) antennas, MMW Down-Converter modules and activity detectors, calibration support electronics and space provisions for growth band antennas and associated electronics.

4.1.3.11.3.1.3 Below Deck Equipment

The SLQ-32(V)6/7 equipment contained in the below deck hardware consists of the HPOI Receiver Unit (HPU) made up of HPOI switches, tuners and receivers, the Directional Finding Unit (DFU) made up of the PDF switches, tuners and receivers, and the ES Processing Unit (PU) which contains the signal processing hardware and software. The equipment is mounted in two rugged Commercial Off the Shelf (COTS) EIA 19” equipment cabinets that have space for both the Specific Emitter Identification (SEI) and High Gain/High Sensitivity (HGHS), or space for capability expansion.

4.1.3.11.3.1.4 SEI

The SEI system extracts characteristics of received radar emissions providing a unique "fingerprint" of that specific radar to its emitting platform. The SEI provides a reliable, long-range, all-weather positive target identification capability against seaborne platforms and land-based systems that emit radar signals.

4.1.3.11.3.1.5 HGHS

The High Gain High Sensitivity (HGHS) system detects, localizes, and identifies the presence of high threat-level emitters not normally detectable by the SLQ-32 that may pose danger to ownship or other Force vessels.

4.1.3.11.3.1.6 Tactical Console

The Tactical Console establishes a family of common display systems implemented across the display platform. Tactical Console provides communication and a control interfaces between the operator and the computer. SLQ-32(V)6 upgrades add watch station enhancements. This special purpose console is manned by an EW operator and contains the controls and displays for the EWS. Included on the console is a Chaff Launcher Control Group to operate decoy launchers. Associated with this console is a communications panel for both IC and radio communications.

The Tactical Console hosts the EW Operator Human System Interface software and also provides the computing environment for the Surface Electronic Warfare Tactical Trainer (SEWTT) component.

4.1.3.11.3.1.7 CoSite Blanker

The SLA-10 will be upgraded to the next generation SLA-10D blanker which provides pre-trigger data from radar and communication equipment and provides it to the AN/SLQ-32(V)6 for filtering.

4.1.3.11.3.1.8 Common Processing System

The SLQ-32(V)6 is hosted on common processors provided by ACI.

4.1.3.11.3.1.8.1 ICAD Software

The ICAD software is designed to interface to the Combat System in accordance with the data model and messages defined in the PLA Common Data Model, which is reflected in the SEWIP Blk 2 IDD. The PLA compliant software includes:
• Composite Track Correlator (CTC) – The CTC performs in the role of a source manager to the System Track Manager (STM) in C&D. It publishes EW sensor level and EW Composite tracks to the ALIS for consumption by subscribing track servers. EW sensor level tracks are created and updated based upon emitter reports sent to the CTC from one of the EWS sensors via their applicable Sensor Controller CSCI. EW Composite tracks represent a single emission source and result from the association process that determines whether an EW sensor level track represents a new report of a specific emitter or that it is another source for a previously reported EW Composite Track. EW Composite tracks that are reported to STM form the basis for new Electronic Warfare System Tracks, which are then displayed on tactical consoles and are reported on tactical data links, if eligible.
• Electronic Warfare Composite Tracker (EWCT) – The EWCT maintains the Emitter History Log, matches emitters to emitters of interest, identifies EMCON and EMCAP violations, provides HMI support functions, and sends commands to the SEI subsystem. The Emitter History Log stores all emitter detection and tracking activity. Alerts are sent to the EW Operator when emitters match emitters of interest and when EMCON/EMCAP setting violations occur. HMI support functions include providing EW track data and detailed emitter data to the HMI Server for display to the EW Operator. EWCT generates prioritized SEI measurement requests to the SEI subsystem.
• Electronic Warfare Common Controller (EWCC) – The EWCC is the primary interface between the AN/SLQ-32(V)6 and the rest of the combat system. It manages and reports system operational modes and settings, manages execution and reports the status of CMS-ordered tasks, and reports system health and status. The EWCC is also responsible for managing the ES sensors on interfaced MH-60R helicopters and is the control point for using AN/SLQ-32(V)6 as an EW weapon. Note that the SKC may provide the primary control point for using AN/SLQ-32(V)6 as an EW when developed, which will be determined in detailed design.

4.1.3.11.3.1.8.2 Softkill Coordinator Subsystem

The Softkill Coordination Subsystem manages all of the softkill engagements. SKCS provides automatic and recommended softkill engagements based on doctrine, EW Console Operator action, or receipt of engagement orders from the combat management system, and then determines which softkill weapons to employ and directs the launch of those weapons. It also provides enhanced track classification data to the combat management system.

4.1.3.11.3.1.8.3 ES/Radar Track Correlator

The ES/Radar Track Correlator provides automatic ES and radar track association. The Correlator receives radar tracks via the Track Server, determines if there are any ES tracks that represent the same real-world object, and provides the association to the rest of the EWS system and the Combat System via the Track Server.

4.1.3.11.3.1.8.4 Surface Electronic Warfare Team Trainer

SEWTT is an EW training support software component designed to provide stimulation to onboard tactical EW systems, including Specific Emitter Identification (SEI) and High Gain High Sensitivity (HGHS), and give afloat operators the ability to train for tactical operations using their organic equipment. SEWTT provides the onboard training team the ability to exercise individual, team, combat team and force level operational scenarios.

SEWTT interfaces with the Advanced Training Domain to receive ground truth scenario data.

4.1.3.11.3.1.9 Mk 53 Decoy Launching System

The MK 53 Decoy Launching System (DLS) is a fast response decoy dispensing system utilized to counter Anti-Ship Missile (ASM) threats. Its purpose is to defend ownship by launching various expendable decoy payloads to misdirect incoming hostile ASMs. The MK 53 MOD 5 DLS consists of a Nulka Launcher, six Mark 137 Chaff Launchers, a Decoy Launch Processor, and a Bridge Launcher Control.

4.1.3.11.3.1.9.1 Nulka Launcher

There are four MK 137 Active Decoy Launchers installed on AEGIS, each capable of firing two Nulka decoys for a total of eight "ready Nulka." The MK 137 launchers are not re-loadable at sea.

4.1.3.11.3.1.9.2 Chaff Launcher

Six deck-mounted Mark 137 Chaff launchers, three port and three starboard, are used to launch decoys aloft at a specified distance from the ship to provide passive countermeasures for ownship against homing missiles. Each launcher is a 5.125 inch launcher incorporating an assembly of six fixed launch tubes mounted on a base assembly. The launch tubes are mounted in two sets: (1) three tubes at quadrant elevations of 45 degrees and (2) one tube at 45 degrees and two tubes at 60 degrees.

4.1.3.11.3.1.9.3 Decoy Launch Processor

The Mark 24 DLP consists of the hardware and software necessary for proper decoy selection and programming in response to inputs from the AN/SLQ-32 display console. The DLP accepts threat data, threat bearing, and firing commands from the AN/SLQ-32 display console via a direct RS-232-D interface. Ship environmental, motion and speed data are provided to the DLP via GEDMS (ICOM).

4.1.3.11.3.1.9.4 Bridge Launcher Control

The Bridge Launcher Controls are located in the pilot house to maximize observation of the fired chaff cartridge and the field of view for threat detection so that firing, based on visual contact, is readily accomplished. The two Mark 164 Mod 2 and two Mark 164 Mod 3 controllers each operate a Mark 137 launcher port or starboard. Each Bridge Launcher Control is designed to control the firing of its associated launchers only.

4.1.3.11.4 Element Interfaces

Table 4.1-11 Electronic Warfare System Interfaces

Element	Interface Description	IDS
01 SPY	The SLQ-32(V)6 interfaces with SPY emission schedules to prevent co-site interference. SPY-6 communicates co-site data to EWS via a one-way single-mode fiber optic link utilizing the Serial Front Panel Data Port (sFPDP) protocol.	AMDR External IRS
02 C&D-1	The SLQ-32(V)6 interfaces with C&D via ALIS to send EWS element status and softkill engagement status. EWS receives controls, C&D status, and C&D ordered softkill engagements. The SLQ-32(V)6 also reports inventory status.	WS-35581
02 C&D-2	The SLQ-32(V)6 provides EW Source Tracks including classification data, associations to the C&D Computer Suite. The C&D Computer Suite provides System Track data to SLQ-32(V)6.	IWS-OBJARCH-CDM
02 C&D-3	The SLQ-32(V)2/3 interfaces with C&D via NTDS to send EWS element status and EW sensor data, and to receive wind/gyro and GMT data. For ships equipped with AN/SLQ-32(V)2 or 3, C&D will provide MH-60R ESM data and status to EWS.	WS-35424
03 WCS	WCS sends survive assessment requests to EWS to support Kill Evaluation assessment. EWS provides survive assessment data to WCS via ALIS.	WS-35581
07 ORTS	EWS provides readiness data to ORTS via ALIS.	WS-35581
14 NAV-1	Ownship heading and roll are provided by NAV to the DLP via GEDMS (ICOM) to support decoy launch calculations.	NA (Nav Data)
14 NAV-2	EWS interfaces with WSN-7 for ownship, pitch, roll and heading data via ICOM. This data is provided to the EWS gyro select switch.	NA (Attitude Data)
14 NAV/NAVSSI	The SLQ-32(V)6 interfaces with the Navigation System, via ALIS, to receive ownship navigation data for operator and system use in launched decoy deployment.	WS-35430
15 EXCOM/ADNS	EXCOM provides TACELINT and Mission Planning data to EWS via a CANES interface via EXCOM.	NA (EW Coordination)
21 ICOM\Moriah	Wind speed and direction are provided to the DLP by the Moriah Wind System in ICOM via GEDMS (ICOM) to support decoy launch calculations.	NA (Moriah Wind Data)

Element	Interface Description	IDS
33 ADS	For ships with SLQ-32(V)6, the EWS interfaces with ADS via ALIS to report system status (including inventory).	WS-35581
34 ATD-1	For the SLQ-32(V)6 configuration, the SEWTT component of EWS provides stimulation of the SLQ-32(V)6 during training using ground truth synthetic data received via the Training LAN. This data includes emissions, kinematics and control signals required to provide integrated training. The SEWTT component will inject synthetic EW contacts into the EWS sensor resulting in sim EW tracks being generated in the Combat System.	SEWTT-V4-BFTT-TI1207-IDD
39 ACI	The ACI provided instantiation of the IWS objective architecture component framework application programmers interface. The interface is used by SLQ-32(V)6.	WS-35453
41 VCD	For ships with SLQ-32(V)6, the EWS interfaces with VCD via ALIS to synchronize and integrate EW Source Tracks. VCD provides EWS with MH-60R ESM segment control.	IWS-OBJARCH-CDM
Radars and Comms	The radars and communications systems within the ACS send blanking triggers to the EWS to prevent co-site sensor interference	NA (Blanking)

4.1.3.11.5 Design Approach/Rationale/Constraints

No changes have been identified for EWS for BL10 Phase 0. SEWIP Block III improvements are for phase 1.

4.1.3.12 Underwater Surveillance and Communications System (12)

4.1.3.12.1 Purpose

The shipboard Underwater Surveillance and Communications System (US&CS) is used to detect underwater targets actively and passively, analyze and classify acoustic energy received by ownship sensors, perform underwater communications with friendly submarine and surface ships, record and reproduce acoustic contacts, determine water temperature as a function of depth, measure depth to the ocean floor, record the ocean floor terrain profile, as well as provide Anti-Submarine Warfare (ASW) combat team training and operator proficiency, torpedo recognition, sonar performance prediction, and conduct mine reconnaissance. In addition US&CS contains the Undersea Warfare Control System, which provides contact management, display support, and fire control for the AN/SQQ-89A(V)15 (herein referred to in this section as AN/SQQ-89).

4.1.3.12.2 Requirements Satisfied

The US&CS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.4.

4.1.3.12.3 Description

The US&CS is partitioned into seven subsystems:

- Sonar Communications Set, Underwater Telephone, AN/WQC-2A
- AN/UQN-10 Fathometer
- Bathythermograph Set, AN/BQH-7A(V)2
- Sonar Detecting-Ranging Set, AN/SQS-53C(V)1
- Surface Ship Undersea Warfare Combat System, AN/SQQ-89A(V)15 ACB-15/TI-14 (EC-220) or ACB-15/TI-16 (EC-222)
- ASW Controller

The Underwater Surveillance and Communications System is depicted in Figure 4.1-11 and Figure 4.1-12.

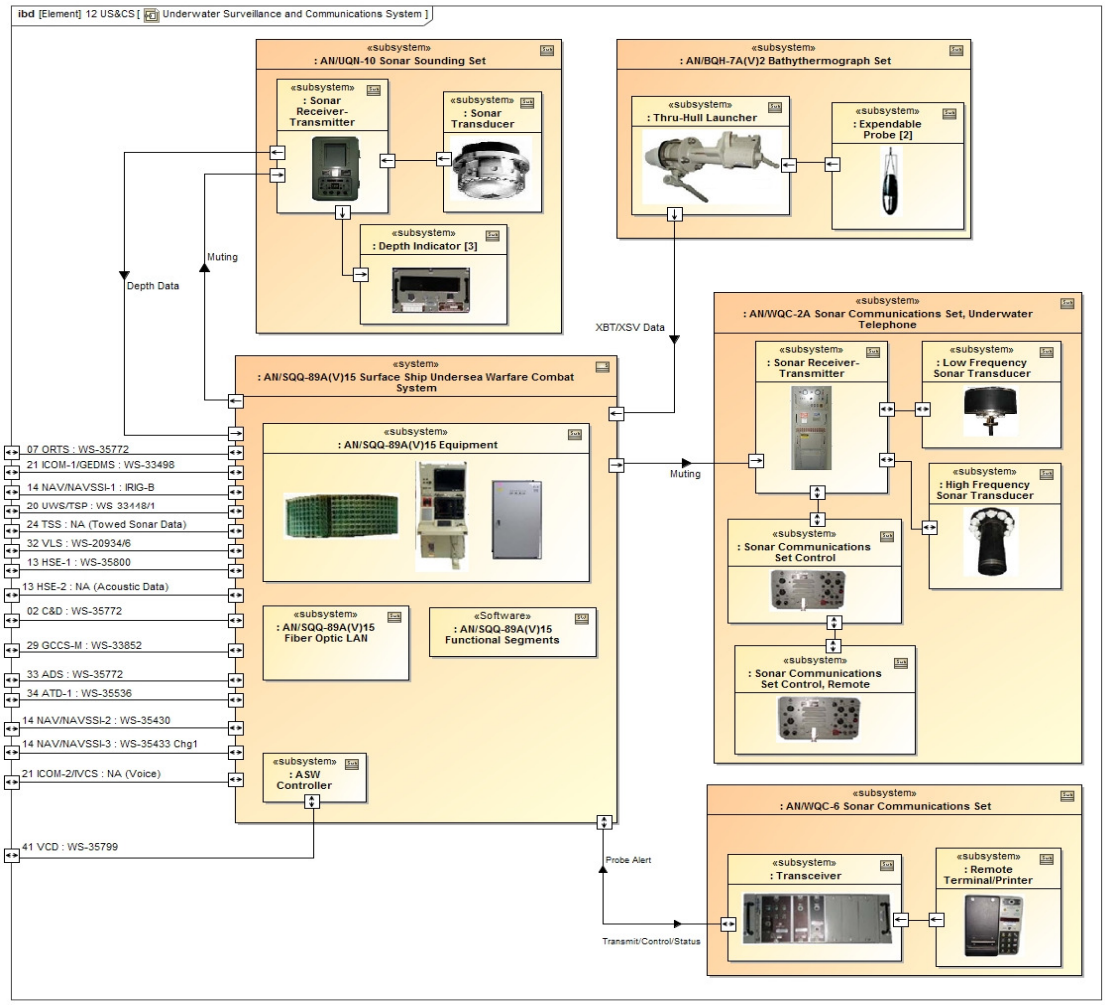

Figure 4.1-11 12 US&CS

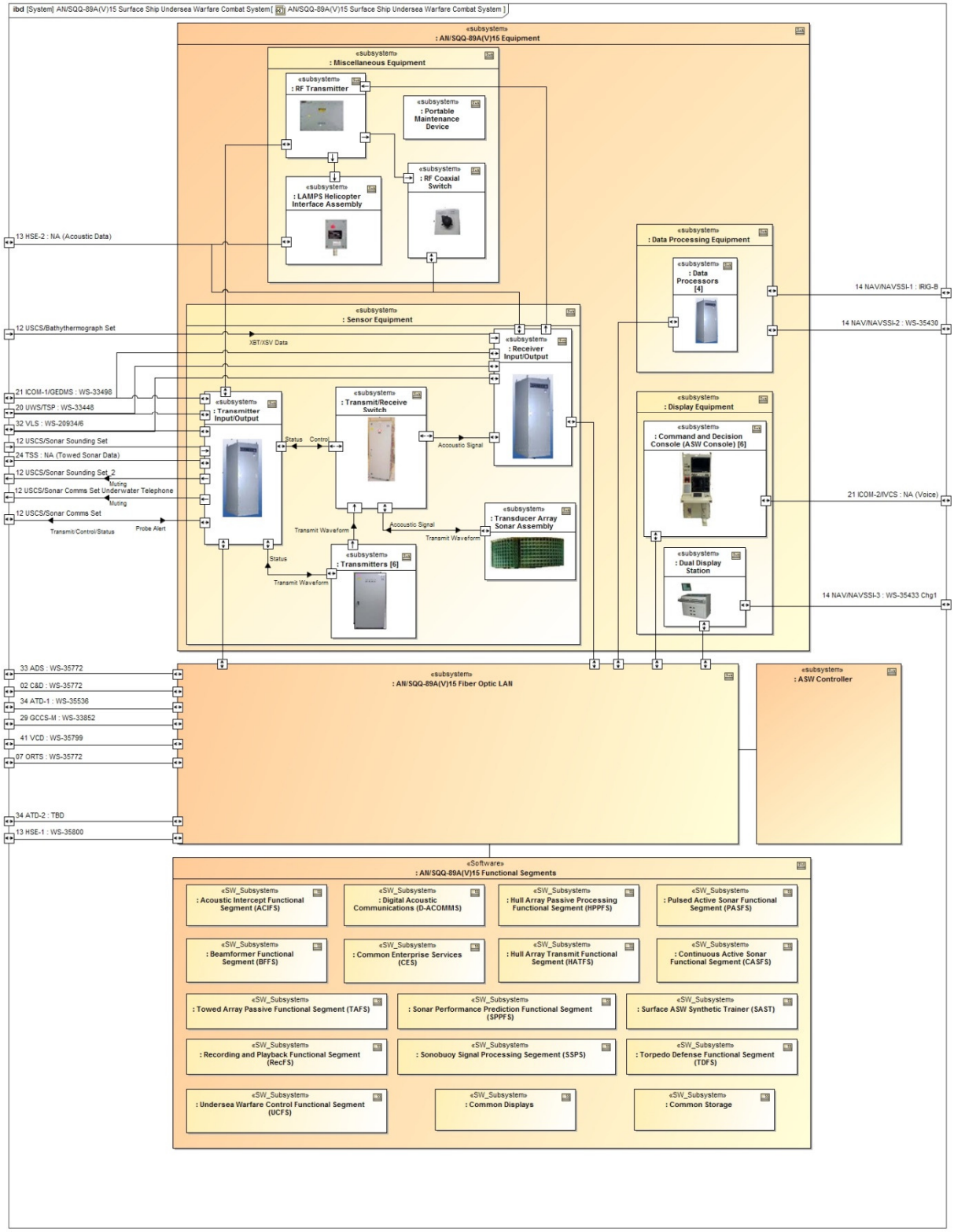

Figure 4.1-12 12 AN/SQQ-89(V)15 Surface Ship Undersea Warfare Combat System

4.1.3.12.3.1 AN/WQC-2A Sonar Communications Set, Underwater Telephone

The Sonar Communications Set (SCS), AN/WQC-2A, is a single-sideband (SSB) general purpose, voice and keyed continuous wave (CW) data SCS. It functions as an underwater communications system to link together surface ships, submarines, and coastal–based shore stations. The AN/WQC-2A consists of a Low Frequency Sonar Transducer (TR-232B/WQC-2), High Frequency Sonar Transducer (TR-233B/WQC-2), Sonar Receiver-Transmitter (RT-876A/WQC-2), Sonar Communications Set Control (C-7440A/WQC-2), and a Remote Sonar Communications Set Control (C-7441A/WQC-2). The AN/WQC-2A SCS has two way communications capability.

4.1.3.12.3.1.1 Low Frequency Sonar Transducer

The Low Frequency Sonar Transducer, TR-232B/WQC-2, is an omnidirectional transmit/receive transducer located in the ship's Sonar Dome. The TR-232B/WQC-2 is used for longer-range transmission of voice and keyed CW data through the water. The transducer has a frequency band between 1.45 and 3.1 KHz. When not transmitting, the TR-232B/WQC-2 receives acoustic energy within its frequency band for input to the Sonar Receiver-Transmitter (RT-876A/WQC-2).

4.1.3.12.3.1.2 Sonar Receiver-Transmitter

The Sonar Receiver-Transmitter, RT-876A/WQC-2, is a combined SSB voice and keyed CW data transmitter and receiver. The unit is designed to operate in two frequency bands. Full or reduced transmission power can be selected depending on the distance to the receiving ship (or listening station). When in receive mode, the omnidirectional transducers provide acoustic signal inputs. The AN/SQQ-89Transmitter I/O provides an input signal to the RT-876A/WQC-2 for muting the transducers.

4.1.3.12.3.1.3 Sonar Communications Set Control

The Sonar Communications Set Control, C-7440A/WQC-2, is a small, bulkhead-mounted unit located in the Sonar Control Room. The unit is the primary control station for operating the SCS and the unit's front panel provides the primary operator interface for operating the SCS.

4.1.3.12.3.1.4 Sonar Communications Set Control, Remote

The remote Sonar Communications Set Control, C-7441A/WQC-2, is a small, bulkhead-mounted unit located in the Pilot House. The unit provides a secondary operator interface with reduced SCS functionality. The unit's front panel provides two audio jacks, one for a headset and one for a microphone, and a volume control. The unit may be used to support voice transmission or voice/keyed CW reception. Full functional control of the SCS must be conducted at the primary control station located in the Sonar Control Room.

4.1.3.12.3.1.5 High Frequency Sonar Transducer

The High Frequency Sonar Transducer, TR-233B/WQC-2, is an omnidirectional transmit/receive transducer located in the ship's Sonar Dome. The TR-233B/WQC-2 is used for shorter-range transmission of voice and keyed CW data through the water. The transducer has a frequency band between 8.3 and 11.1 KHz. When not transmitting, the TR-233B/WQC-2 receives acoustic energy within its frequency band for input to the Sonar Receiver-Transmitter (RT-876A/WQC-2).

4.1.3.12.3.2 AN/UQN-10 Fathometer

The AN/UQN-10 Fathometer, is an acoustic depth sounding device used to measure the distance from the ship's keel to the ocean floor and provide a profile of the bottom terrain. It transmits acoustic (sound) pressure pulses into the ocean that reflect off the bottom and return to the ship. A sound pulse travels through the ocean at approximately 4800 ft/sec. The round-trip travel time of the sound pulse is measured and converted to distance. Water depth data is used as a navigation aid and in ASW environmental calculations. The AN/UQN-10 Fathometer is designed to measure depth of water ranging from 4 feet to 6000 fathoms. The AN/UQN-10 Fathometer consists of Sonar Transducer (TR-355/UQN-1), Navigation Echosounder [KEL 320N], three Network Remotes, a Network Hub,, and a terminal box used to interface the equipment.

4.1.3.12.3.2.1 Sonar Transducer

The sonar transducer, TR-355/UQN-1, converts electrical energy to acoustic pressure pulses for transmission through the water. After the transmitted pulse has completed its trip to the ocean bottom and back, the transducer converts the received acoustic echo energy into electrical energy.

4.1.3.12.3.2.2 Navigation Echosounder

The navigation echosounder, KEL 320N, generates the electrical transmit pulses to the transducer and processes the returned acoustic signal from the transducer. The time between when the pulse is sent and received is measured and converted to depth. The depth data is sent to Data Multiplexing System (DMS) for distribution to ACS equipment (NAV, WCS, and AN/SQQ- 89) and to Depth Indicators in CIC, the Pilot House, and the Chart Room. The AN/SQQ-89 Transmitter I/O provides an input signal to the sonar receiver-transmitter for muting the transducer.

4.1.3.12.3.2.3 Depth Indicator

The Network Remotes, provide remote display of the ocean depth on a digital numeric display. There are three network remote units installed: one in the CIC, one in the Pilot House, and one in the Chart Room.

4.1.3.12.3.3 AN/BQH-7A(V)2 Bathythermograph Set

The Bathythermograph (BT) Set, AN/BQH-7A(V)2, consists of a Thru-Hull Launcher (MX-8577/SSQ-61), BT Probe (OC-14/SSQ-56), Sound Velocimeter Probe and a terminal box used to interface the AN/BQH-7A(V)2 to the AN/SQQ-89 Receiver I/O. The BT Set provides two functions; it measures the water temperature and velocity of sound in water as functions of depth. The probes can be deployed under any sea-state condition or ship's motion.

4.1.3.12.3.3.1 Thru-Hull Launcher

The Thru-Hull Launcher, MX-8577/SSQ-61, consists of a breech, breech handle, breech adapter, cable, and launch tube. The launch tube, which penetrates the hull, includes a manually operated ball valve. The cable is connected to contacts that mate with the loaded probe canister and is connected via a terminal box to the AN/SQQ-89 Receiver I/O. BT data is used in SPPFS processing.

4.1.3.12.3.3.2 Expendable Probe

There are two types of probes: an OC-14/SSQ-56 Expendable Bathythermograph (XBT) probe Type T4 and an Expendable Sound Velocimeter (XSV) probe Type -01. The velocity of sound in water is determined by measuring the time for the pulse to travel to a brass reflector and back (a total length of 52 mm).

4.1.3.12.3.4 AN/SQQ-89A(V)15 Surface Ship Undersea Warfare Combat System

The Surface Ship Undersea Warfare Combat System, AN/SQQ-89A(V)15, is one of the major functional elements of the AEGIS Combat System (ACS), providing an integrated Undersea Warfare (USW) capability. The USW mission area comprises all tasks associated with securing and maintaining, for ownship and any supported surface asset, adequate protection from subsurface threats throughout an established operational environment. These tasks include Anti-Submarine Warfare (ASW), Mine Avoidance, and Torpedo Defense. The AN/SQQ-89 supports the Guided Missile Destroyer (DDG) and Guided Missile Cruiser (CG) platform requirement to conduct all phases of surface USW operations, either independently or as part of a coordinated task structure. The AN/SQQ-89 system includes the ability to plan, conduct and evaluate underwater searches; detect, classify, localize and track contacts; and engage or evade submarines, mine-like small objects and torpedo threats. An Integrated Digital Fire Control Interface (DFCI) capability is included within the Undersea Warfare Control Functional Segment (UCFS) allowing employment of digital Torpedoes such as the MK 54 Lightweight Hybrid Torpedo (LHT) (OTS and VLA) against ASW threat platforms.

4.1.3.12.3.4.1 AN/SQQ-89A(V)15 Functional Segments

The AN/SQQ-89 system functions are organized into the following functional segments:

· Acoustic Intercept Functional Segment (ACIFS)

· Beamformer Functional Segment (BFFS)
· Continuous Active Sonar Functional Segment (CASFS)
· Common Displays
· Common Enterprise Services (CES)
· Common Storage
· Digital Acoustic Communications (D-ACOMMS)
· Hull Array Passive Processing Functional Segment (HPPFS)
· Hull Array Transmit Functional Segment (HATFS)
· Pulsed Active Sonar Functional Segment (PASFS)
· Recording and Playback Functional Segment (RecFS)
· Sonar Performance Prediction Functional Segment (SPPFS)
· Sonobuoy Signal Processing Segment(SSPS)
· Surface ASW Synthetic Trainer (SAST)
· Torpedo Defense Functional Segment (TDFS)
· Towed Array Passive Functional Segment (TAFS)
· Undersea Warfare Control Functional Segment (UCFS)

The AN/SQQ-89 system architecture is based upon a distributed processing configuration, which permits a single processing function to be executed in one of several equipment enclosures.

4.1.3.12.3.4.1.1 Acoustic Intercept Functional Segment (ACIFS)

ACIFS processes data from the Calibrated Reference Hydrophone (CRH) and Towed Acoustic Intercept sensors for both Passive Broadband (PBB) and Passive Acoustic Emission (PAE) signals. PBB and PAE provide data to trackers, which track signals of interest and pass tracks to Contact Management (CM). CM provides track association and contact follower functionality. The bearing of a contact that is of interest is passed to Cued Beamforming (CBF). Up to four (4) beams per sensor may be steered simultaneously. The beam-steered data is then passed to Passive Narrowband (PNB) and Demodulated Noise (DEMON) processing. Additionally, active cueing and processing provides the additional functionality to locate and interrogate targets of interest.

4.1.3.12.3.4.1.2 Beamformer Functional Segment (BFFS)

BFFS provides processed acoustic data from both the towed array and the hull mounted array. The Towed Array Receiver/Beamformer Computer Program (TRBCP) receives digital time series data from acoustic and non-acoustic sensor elements of the MFTA. The towed array consists of three nested acoustic apertures: low frequency, medium frequency and high frequency. The towed array beamformer performs conventional beamforming for all three apertures concurrently and spectrally combines medium frequency and high frequency aperture beams. The TRBCP also processes and distributes Non-Acoustic Sensor (NAS) and Performance Monitoring/Fault Localization (PM/FL) data.

The Hull Receiver Beamformer Computer Program (HRBCP) performs the front-end Hull Passive Broadband and Narrowband receive adaptive beamforming processing for the Hull Mounted Array HMA. The HRBCP will generate the Passive Beam data to Torpedo Detection Functional Segment (TDFS) and Sonar Performance Prediction Functional Segment (SPPFS), adaptive beamformer data to Hull Passive Processing (HPP) and TDFS, and Active Processing Messages to Pulsed Active Sonar Functional Segment (PASFS).

4.1.3.12.3.4.1.3 Continuous Active Sonar Functional Segment (CASFS)

CASFS detects, classifies, and tracks contacts using continuous active sonar transmissions. CAS is an Active Sonar operating mode of the AN/SQQ-89. When CAS mode is selected the hull array transmitter will be utilized in a continuous manner, i.e., transmission at 100% duty cycle. Consequently, there is no other active or passive receive function available from the hull array while in CAS mode.

CAS reception is performed on the MFTA using the active receive apertures. The array acoustic and non-acoustic data is processed in the CAS processing functional segment and provided to the Common Storage and Common Active Displays for the operator selected coverage area. CAS processing provides automated detection, tracking, and classification alerts used for target display and fire control functions.

4.1.3.12.3.4.1.4 Common Enterprise Services (CES)

CES provides an infrastructure for all system functions. CES provides system initialization and is the PM/FL collection point. CES provides each functional component with common system utilities, and provides interface protocol computer program processors to isolate the functional segments from AN/SQQ-89 external interfaces.

CES also includes the Knowledge Management System (KMS)/Learning Management System (LMS), which provides embedded electronic logistics support applications, electronic technical manual support, and operating instructions.

4.1.3.12.3.4.1.5 Digital Acoustic Communications (D-ACOMMS)

D-ACOMMS provides unencrypted, two-way acoustic communications between surface ships and submarines at speed and depth. The D-ACOMMS capability provides receive, transmit and display processing to support digital underwater acoustic communications using the AN/SQQ-89 hull and towed array sensors.

The Receive Processing supports reception of incoming D-ACOMMS waveforms on the hull and towed arrays. It detects and tracks incoming waveforms using beam data provided by the BFFS. The Transmit Processing supports transmission of outbound messages on the hull array only.

4.1.3.12.3.4.1.6 Hull Passive Processing Functional Segment (HPPFS)

HPPFS provides the capability to manually and automatically detect and track hull PBB with Precision Trackers and Contact Followers (CFs).

HPPFS uses passive beamformed sensor data from BFFS. The following processing functions are accomplished within HPPFS: PBB, PNB, CLASS Low Frequency Analysis and Recording (LOFAR), and Search DEMON. HPPFS shares a common signal processor with TAFS and TDFS.

4.1.3.12.3.4.1.7 Hull Active Transmit Functional Segment (HATFS)

The Hull Array Transmit capability provides setup, scheduling, and execution of transmissions to support medium frequency PASFS, CASFS, Surface ASW Synthetic Trainer (SAST), SPPFS, and D-ACOMMS. The HATFS includes three software components known as Common Display Transmit GUI, the Scheduler, and the Transmit Controller Computer Program (XMCP). The Scheduler creates transmit and receive active parameters for distribution to the XMCP and BFFS respectively. Active parameters are also shared with SPPFS and SAST.

4.1.3.12.3.4.1.8 Pulsed Active Sonar Functional Segment (PASFS)

PASFS provides monostatic and bistatic mid-frequency active capabilities for USW search, detection, classification, tracking and localization. PAS is an Active Sonar operating mode of the AN/SQQ-89. PASFS processes beamformed towed array and hull array active sensor data from BFFS. PASFS comprises the functions of Active Signal Processing, Audio Processing, and Segment Control.

The primary inputs to PASFS are the BFFS active band beam data, along with supporting non-acoustic information including ping cycle descriptions, environmental parameters, ownship navigation, and towed array kinematic state. The primary outputs from PASFS are processed acoustic data.

4.1.3.12.3.4.1.9 Recording and Playback Functional Segment (RecFS)

RecFS is used to record raw acoustic sensor level data, system level messages, and select ancillary platform or system information data. The recorder buffers the high bandwidth data and then transfers this data to removable magnetic tape media. In a playback state, the tapes are dumped to memory and then the data is output onto the network. There are two distinct recorders, the Sensor Recorder and the System Recorder.

The Sensor Recorder is the acoustic sensor data recorder which records the AN/SQQ-89 raw sensor data and select ownship information. The System Recorder records processed data messages from the AN/SQQ-89 network such as PM/FL, track/contact, alerts, operator actions, etc. for post collection analysis.

4.1.3.12.3.4.1.10 Sonar Performance Prediction Functional Segment (SPPFS)

SPPFS supports USW planning and optimal sensor utilization. SPPFS performs the following: measurement, definition and evaluation of the physical and tactical environments; estimation of ownship sensor performance for PASFS, HPPFS, SSPS, and Towed Array Passive Functional Segment (TAFS); recommendations for sonar search settings and modes; prediction of ownship counter detection vulnerability; forecast performance for sonobuoys and friendly force sonars; and dissemination of information to AN/SQQ-89 operator consoles. SPPFS provides the ability to merge historical with live environmental and acoustic performance for the best source for accurate, real-time environmental picture.

4.1.3.12.3.4.1.11 Sonobuoy Signal Processing Segment (SSPS)

SSPS operates in conjunction with the ASW helicopter and the Aegis Weapons System to process passive, active and environmental acoustic data from helicopter-deployed and/or ship-deployed sonobuoys to: search, detect, classify, localize and track in support of the USW mission requirements. Additionally SSPS is used to tune deployed sonobuoys.

4.1.3.12.3.4.1.12 Surface Ship Anti-Submarine Warfare Synthetic Trainer (SAST)

SAST is a simulation/stimulation system built to provide high-fidelity, realistic, acoustic in-port or at-sea training to develop individual and team USW watch stander knowledge and skills. SAST provides synthetic training in support of operator, team, unit and strike group/force level USW and certification. SAST supports both additive and substitutive training modes. It implements an all-world environment simulation (AWESIM) interface with 53C Hull active and passive, and MFTA passive.

External training interfaces provide the capability to share data across the distributed training environment, allowing the ship to participate in Fleet Synthetic Training (FST) events. Connectivity to the Navy Continuous Training Environment (NCTE) is supported through the use of external High Level Architecture (HLA) messaging with the Advanced Training Domain (ATD).

4.1.3.12.3.4.1.13 Torpedo Defense Functional Segment (TDFS)

TDFS provides ships with the capability to automatically detect torpedoes using the ship's acoustic sensor suite. TDFS provides the necessary signal processing and controls to detect, classify, localize and avoid threat torpedoes in a timely manner and/or to employ torpedo countermeasures.

TDFS shares a common signal processor with TAFS and HPPFS.

4.1.3.12.3.4.1.14 Towed Array Passive Functional Segment (TAFS)

TAFS performs signal processing for towed array passive contacts and tracks, and processes beamformed towed array sensor data from BFFS. TAFS comprises the functions of Passive Narrowband Signal Processing, Passive Broadband Signal Processing, Audio Processing, and Segment Control. TAFSs share a common signal processor with TDFS and HPPFS.

4.1.3.12.3.4.1.15 Undersea Warfare Control Functional Segment (UCFS)

The UCFS coordinates and integrates the total ship's USW capability, including the capability for contact reporting and ASW threat engagement. The UCFS provides confirmed threat contact descriptions and engagement status to the AWS.

The UCFS segment provides contact status management, and ASW engagement planning and control. UCFS has interfaces to SPPFS, as well as to the ship's over-the-side and vertical-launch ASW weapons systems and the AWS. These interfaces enable UCFS capabilities for support of mission planning and control, contact management (including tagging, status, and association), weapon fire control, and target engagement. UCFS transfers confirmed target tracks to AWS. Targets to be engaged and the weapons

for engagement are determined by AWS and designated in engagement orders to UCFS. UCFS controls the engagement process and reports engagement status from planning through weapon launch, including fire control solution development, generation of weapon employment recommendations and weapon orders, and launch control.

4.1.3.12.3.4.2 AN/SQQ-89A(V)15 Equipment

The AN/SQQ-89 system contains commercial off the shelf (COTS) units that provide all signal processing, data processing, interface processing and networking allowed within the system design constraints. These units use common components with a common enclosure design, which hosts a common software environment. The power distribution system filters, conditions the input power, monitors input voltage, monitors temperature in the enclosure, and supplies various logic and control voltages.

4.1.3.12.3.4.2.1 Sensor Equipment

The AN/SQQ-89 15 sensor equipment includes a transmitter I/O unit, a receiver I/O unit, a transmit/receive switch, six transmitter units, and the transducer array sonar assembly.

4.1.3.12.3.4.2.1.1 Transducer Array Sonar Assembly

The Transducer Array Sonar Assembly, TR-343/SQS (Unit 717), is mounted in the Sonar Dome at the bottom bow of the ship. It consists of an array of 576 electro/acoustic elements arranged in 72 vertical staves with eight elements per stave. Each transducer element is housed in a steel tube with the head end sealed within a watertight boot to protect the element. Electrical signals are converted to acoustic energy during transmission and acoustic energy is converted into electrical signals during reception.

4.1.3.12.3.4.2.1.2 Receiver Input/Output

The Receiver I/O, Unit 858, contains one of the two main network switches for the redundant star network topology and supports a PMD port on the front panel. The Receiver I/O unit also contains the receiver interfaces for the hull array, sonobuoys, as well as other non-network interfaces. Functionality of the Receiver I/O unit includes:

- LAN Function processing hardware (primary server) for transmitting data to/from other processors within the AN/SQQ-89 System, and to ALIS
- ASFS Hull Receiver Beamformer (HRB) processing hardware
- Light Airborne Multipurpose System Interface Processing (LIP) Function processing hardware, which includes:
  - Digital interface to ALIS for 8 sonobuoy acoustic channels.
- Interface Control Processing (ICP) Function processing hardware, which includes:
  - AEGIS Time-of-Day Processor (ATP) IRIG-B interface (FWD Sync)
  - Analog interface to the Radio Frequency (RF) transmitter - Unit 606 and to a test jack
  - AN/BQH-7A Bathythermograph Set interface
  - FWD NAV data interface via Data Multiplex System (DMS)
  - Discrete power & temperature status and Battleshort control & status interface to Data Processor Units 841 and 842
  - Fire Control (FC) Function processing hardware and interface to the TSP and to the VLS LCU 1 and LCU 2.

4.1.3.12.3.4.2.1.3 Transmitter Input/Output

The Transmitter I/O, Unit 859, contains one of the two main network switches for the redundant star network topology and supports a PMD port on the front panel. It contains the hull transmitter interfaces and other non-network interfaces. Functionality of the Transmitter I/O Unit includes:

- LAN Function processing hardware (alternate server) for transmitting data to/from other processors within the AN/SQQ-89 system, and to the ALIS
- ASFS Transmit Waveform Function processing hardware
- ASFS Transmit Controller Function processing hardware which includes:
  - Overall control of the ASFS transmit waveform generation and beamforming process
  - Discrete digital I/O interface to the Transmitter units – Units 705-710

- o Discrete digital I/O interface to the Transmit/Receive (T/R) Switch – Unit 711
- o Transmit waveform, control and status interface to the AN/WQC-6 Sonar Communications Set
- o Relay output interfaces (Mute Signal) to the AN/WQC-2A Sonar Communications Set, and the AN/UQN-4A Sonar Sounding Set.

· ICP Function processing hardware which includes:
- o A SAST interface to ATD (via ALIS).
- o Discrete digital I/O and serial interfaces to the RF transmitter – Unit 606
- o Discrete digital I/O power status interfaces to Transmitter PDU – Unit 703 and Data Processor PDUs – Unit 761 and Unit 762
- o AFT NAV data interface via the Data Multiplex System (DMS) (DDG)
- o ATP (AFT Sync)

· Discrete power & temperature status and Battleshort control & status interface to Data
· Processor Units 845thru 848
· FC Function processing hardware and interface to the TSP and to the VLS LCU2.

4.1.3.12.3.4.2.1.4 Transducer Array Sonar Assembly

The Transducer Array Sonar Assembly, TR-343/SQS (Unit 717), is mounted in the Sonar Dome at the bottom bow of the ship. It consists of an array of 576 electro/acoustic elements arranged in 72 vertical staves with eight elements per stave. Each transducer element is housed in a steel tube with the head end sealed within a watertight boot to protect the element. Electrical signals are converted to acoustic energy during transmission and acoustic energy is converted into electrical signals during reception.

4.1.3.12.3.4.2.1.5 Transmitters

The six transmitter units (Units 705-710) contain in total 576 individual solid-state linear power amplifier modules corresponding to the 576 transducer elements. The individual transmitter power amplifiers are replaceable and completely interchangeable within the six transmitter units. The transmitters amplify the transmit waveform signals received from the transmit beamformer processor located in the Transmitter I/O (Unit 859).

4.1.3.12.3.4.2.1.6 Transmit/Receive Switch

The Transmit/Receive (T/R) Switch (Unit 711) switches the 576 transducer elements between the Transmitters (Units 705-710) and the receive processor located in the Receiver I/O (Unit 858). The T/R Switch provides 40 dB of amplification to each of the 576 receive signals. Unit 711 and Unit 859 interface directly to exchange T/R Switch Control/Status information.

4.1.3.12.3.4.2.2 Data Processing Equipment

The AN/SQQ-89 data processing equipment consists of four data processors.

4.1.3.12.3.4.2.2.1 Data Processors

The design of each Data Processing Unit (Units 845-848) is the same. The Data Processor Units are AN/UYQ-70 Mission Critical Enclosures (MCE) and contain Symmetric Multi- Processors (SMP) that runs Computer Software Configuration Items (CSCI). The Common SMP design supports reconfiguration on failure (auto and manual) at the cabinet level, around an SMP failure. The internal design is generic to facilitate easy migration to new SMP technology as it becomes available and as processing capability needs expand. Each Data Processor interfaces via the AN/SQQ-89 1000Base-LR LAN to both the Receiver I/O (Unit 858) and the Transmitter I/O (Unit 859). In addition, each Data Processor has a PMD port on the back panel. Only one PMD port is active in any one computing area (compartment), with the unused PMD ports capped, although the unused ports are active. The Data Processor enclosures are water cooled and have a dual power input system.

4.1.3.12.3.4.2.3 Display Equipment

The AN/SQQ-89 display equipment consists of a Multi-Funtion Plot and six ASW consoles.

4.1.3.12.3.4.2.3.1 Multi-Function Plot

The Multi-Function Plot) (Unit 837) is a unit shared between the AN/SQQ-89 system and the NAVSSI navigation equipment. The Multi-function Plot (MFP) consists of two subsystems: a ceiling mounted Auxiliary Flat Panel Display (AFPD) and a deck mounted MFP console. The AFPD houses a Small Screen Display (SSD) that provides graphics displays supporting operator tasks requiring detailed information. The MFP console houses a Large Screen Display (LSD) and associated processors, peripherals, Human Machine Interface (HMI) devices, and interface circuitry for both displays. The MFP supports AN/SQQ-89 US&CS missions by displaying contact management, data fusion, and situational awareness information in accordance with the Interface Requirements Specification for the AN/SQQ-89A(V)15 Surface Ship USW Combat System. The MFP is used for area and bottom contour charts, tactical overlays, target motion analysis tools, ASW and other warfare area tactical decision aids. When the MFP is supporting AN/SQQ-89 functions, the DDS is incapable of conducting any other operations not associated with the AN/SQQ-89 system. In support of NAVSSI, the MFP's computer program displays both on ship and off ship submarine, surface and air sensor measurements. It has tactical decision aids and tools to show search and attack patterns, battlespace intelligence, search information, sensor coverage and National Imagery and Mapping Agency (NIMA) Charts.

4.1.3.12.3.4.2.3.2 Command and Decision Console (ASW Console)

The ASW consoles (Units 830-835) provide the primary Man Machine Interface (MMI) for the AN/SQQ-89A(V) system. Each console is equipped with color display screens, flat touch-panel displays, a keyboard, a trackball, an audio control, and either a Console Multi-Channel Terminal (CMT) or a Virtual Console Multi-Channel Terminal (VCMT) Intercommunications Station (part of the ON-740/UYQ-70(V)2 SVS). There are no AN/SQQ-89 operational computer programs executed within the consoles. All command input and display processing is performed in the Data Processor units. The display capability implemented allows any functional segment interface to be allocated to any of the consoles. Five of the six consoles, Units 830-833, and 835 are located in the Sonar Control Room (SCR). The sixth console, Unit 834, is located in the Combat Information Center (CIC), adjacent to the Dual Display Station (Unit 540).

4.1.3.12.3.4.2.4 Miscellaneous Equipment

The AN/SQQ-89 consists of additional equipment grouped as miscellaneous equipment.

4.1.3.12.3.4.2.4.1 RF Transmitter

The RF Transmitter (Unit 606) receives up to 8-channels of simulated sonobuoy signals (analog) from the SAST. These signals are converted to RF and amplified to represent up to eight of 99 pre-assigned sonobuoy frequencies. The amplified signals are routed to either the SAST Antenna (Unit 607) (via the RF Coaxial Switch) for RF transmission to a MH-60R Helicopter or the LAMPS Helicopter Interface Assembly (Unit 608) for direct RF transmission via an umbilical cable connection to the Helicopter.

4.1.3.12.3.4.2.4.2 RF Coaxial Switch

The RF Coaxial Switch is installed in the path between the RF Antenna (Unit 607) and the OR-69/ARR-90 Radio Receiver Group. This switch permits simulated sonobuoy acoustic signals from the RF Transmitter (Unit 606) to be up-linked to the helicopter for training purposes or enable reception of line-of-sight Sonobuoy RF signals by the OR- 69/ARR-90 Radio Receiver Group.

4.1.3.12.3.4.2.4.3 LAMPS Helicopter Interface Assembly

The LAMPS Helicopter Interface Assembly (Unit 608) is a small, bulkhead-mounted unit used to interface the RF Transmitter (Unit 606) to the Helicopter. The RF Transmitter outputs 8-channels of simulated sonobuoy RF signals. The LAMPS Helicopter Interface Assembly attenuates the signals for transmission directly to the Helicopter through an umbilical cable connection.

4.1.3.12.3.4.2.4.4 Portable Maintenance Device

The AN/SQQ-89 PMD is primarily used for the local control and maintenance of units lacking other display devices immediately available. The PMD is a UNIX or Windows NT based COTS portable computer which has its own screen used to display outputs for such functions as the SRM, PM, and Fault Management (FM). The Integrated Electronics Technical Manual (IETM) is local to the PMD allowing for

convenient training of new users. PMD ports are located in the following equipment: Unit 871 (LAMPS Equipment Rack), Unit 845-848, Unit 858, Unit 859.

4.1.3.12.3.4.3 AN/SQQ-89A(V)15 Fiber Optic LAN

The AN/SQQ-89 LAN is a single IP-based LAN, implemented with fully non-blocking LAN switches. The AN/SQQ-89A(V)15 architecture will be centered on a LAN. The architecture supports multiple LAN implementations (e.g., ATM, Gigabit Ethernet or hybrids of the two) to allow the latest possible selection based on network needs, commercial availability, support, cost, and form/fit.

4.1.3.12.3.4.4 System Control Panel

The System Control Panel (Unit 818) provides the operator with the ability to manually control on/off power commands to the AN/SQQ-89 A(V)15 Equipment.

4.1.3.12.3.5 ASW Controller

The ASW Controller is a non-Product Line Archtecture software component that complies with the PLA ASW Controller System Requirements Specification. It resides on the AN/SQQ-89 LAN. The ASW Controller is responsible for converting tasking from various coordinators, controllers, or operators into sonobuoy-specific controls. It maintains health and status information on the helo and shipboardsonobuoy inventory.

4.1.3.12.4 Element Interfaces

Table 4.1-12 Underwater Surveillance and Communications System Interfaces

Element	Interface Description	IDS
02 C&D-1	The AN/SQQ-89 system interfaces with ACI ALIS LAN via a 1000Base-LR LAN interface. The interface between the UCFS and the C&D Computer Suite function is the principal external AN/SQQ-89A(V) interface for exchanging tactical data. The C&D Computer Suite sends engagement orders, MH-60R ASW sensor track data, and doctrine to the UCFS. UCFS sends torpedo alerts, and engagement status to the C&D Computer Suite.	WS-35772
07 ORTS	The AN/SQQ-89 system interfaces with ACI ALIS LAN via a 1000Base-LR LAN interface. The AN/SQQ-89 system sends all status messages to ORTS that are sent to C&D.	WS-35772
13 HSE-1	The AN/SQQ-89 system receives 8 channels of sonobuoy acoustic signals (digital) from the helicopter via HSE	PMA299-07000
13 HSE-2	Simulated sonobouy signals from the SQQ-89 are transmitted to the airborne helicopter through the RF Antenna. The Shipboard Sonobuoy Receiver Set sends four channels of analog sonobuoy acoustic signals to the SQQ-89.	NA (Acoustic Data)
14 NAV/NAVSSI-1	US&CS receives IRIG-B timing via IRIG Timing Network.	IRIG-B STD 200-98

Element	Interface Description	IDS
14 NAV/NAVSSI-2	The SQQ-89 receives wind data via ALIS (Cruisers only).	WS-35430
14 NAV/NAVSSI-3	The SQQ-89 Dual Display System (DDS) receives navigation data via ALIS (as well as charts).	WS-35433 Chg1
20 UWS/TSP	The AN/SQQ-89 system has two 100Base-FX point-to-point interfaces with the UWS MK 33 TSP: one from the Receiver I/O (Unit 858) and the other from the Transmitter I/O (Unit 859). These interfaces provide the AN/SQQ-89 system the capability to initiate a torpedo launch and to monitor torpedo status prior to launch.	WS-33448/1
21 ICOM-1/GEDMS	NAV messages OD-4 and OD-5 and wind and depth data is received by Unit 858 via an NTDS-E LLS interface. The Sonar Receiver-Transmitter sends depth data for distribution to NAV via RS-422 serial interface.	WS-33498
21 ICOM-2/IVCS	The five US&CS consoles, Unit 830-834, interface to the ship's Interior Voice Communications System (IVCS) via the C&D Secure Voice System (SVS) Central Switching Unit, ON-740/UYQ-70(V)2.	NA (Voice)
24 TSS	The AN/SQQ-89 Unit 859 Transmitter I/O processor has a fiber optic interface with the MFTA Winch assembly. Unit 859 also has both has a fiber optic control and status interface and receives analog MFTA sensor data from the Towed Array Power Supply (TAPS).	NA (Towed Sonar Data)
29 GCCS-M / MTC2	The AN/SQQ-89 system interfaces with Global Command and Control System – Maritime (GCCSM), via the AN/SQQ-89 1000Base-LR LAN interface to the ALIS LAN. The MTC2 interface supports AN/SQQ-89SPPFS performance predictions. MTC2 supplies force-level environmental information via OTH Gold messages to the AN/SQQ-89 system.	WS-33852

Element	Interface Description	IDS
32 VLS	There are three bi-directional NTDS-E interfaces between the AN/SQQ-89 system and the VLS. One of the interfaces is between the Transmitter I/O (Unit 859) and VLS LCU No. 2. The other two are between the Receiver I/O (Unit 858) and VLS LCU No. 1 and No. 2. These interfaces provide the AN/SQQ-89system the capability to initiate a Vertically Launched ASROC (VLA) missile launch and to monitor the status of the VLA prior to launch. For a description of the VLA missile, please refer to Underwater Weapon System (UWS) section 4.1.3.20.	WS-20934/6
33 ADS-1	The AN/SQQ-89 system interfaces with ADS via the AN/SQQ-89 1000Base-LR LAN interface to ALIS LAN. The AN/SQQ-89 system sends sonar performance prediction overlays to ADS.	WS-35772
34 ATD-1	The AN/SQQ-89A(V)15 Surface Ship Anti-submarine Warfare Synthetic Trainer (SAST) interfaces with the Advanced Training Domain via the Training LAN on ALIS. SAST accepts simulated ASW target and environmental data from the Advanced Training Domain components and uses that to inject simulated acoustic data into the sonar signal processors.	WS-35536
41 VCD	The VCD Computer Suite system interfaces with AN/SQQ-89 via ALIS. The VC Computer Suite sends sonobuoy task orders/settings and acoustic segment status to US&CS to synchronize acoustic segment database and integrate acoustic data.	WS-35799

4.1.3.12.5 Design Approach/Rationale/Constraints

Changes are identified for Aegis BL10 due to J3.4 integration.

AN/SQQ-89 will process J3.4 messages from C&D for subsurface tracking.

4.1.3.13 Helicopter Shipboard Equipment (13)

4.1.3.13.1 Purpose

The Helicopter Shipboard Equipment (HSE) provides the capability for the combat system to digitally interface with Strike Group helicopters. Through the HSE, combat system elements are able to control Electronic Warfare (EW), Under Sea Warfare (USW), Radar, and Identification Friend or Foe (IFF) assets on the helicopter to extend shipboard capabilities. The HSE also includes equipment to control and communicate with deployed sonobuoys.

4.1.3.13.2 Requirements Satisfied

The HSE Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.5.

4.1.3.13.3 Description

The HSE element contains three major subsystems: The Shipboard Sonobuoy Receiver Set, AN/SQQ-89 Surface Ship Undersea Warfare Combat System (part of), and the AN/SRQ-4 Radio Terminal Set (Ku-Band).

The Helicopter Shipboard Equipment is depicted in Figure 4.1-13.

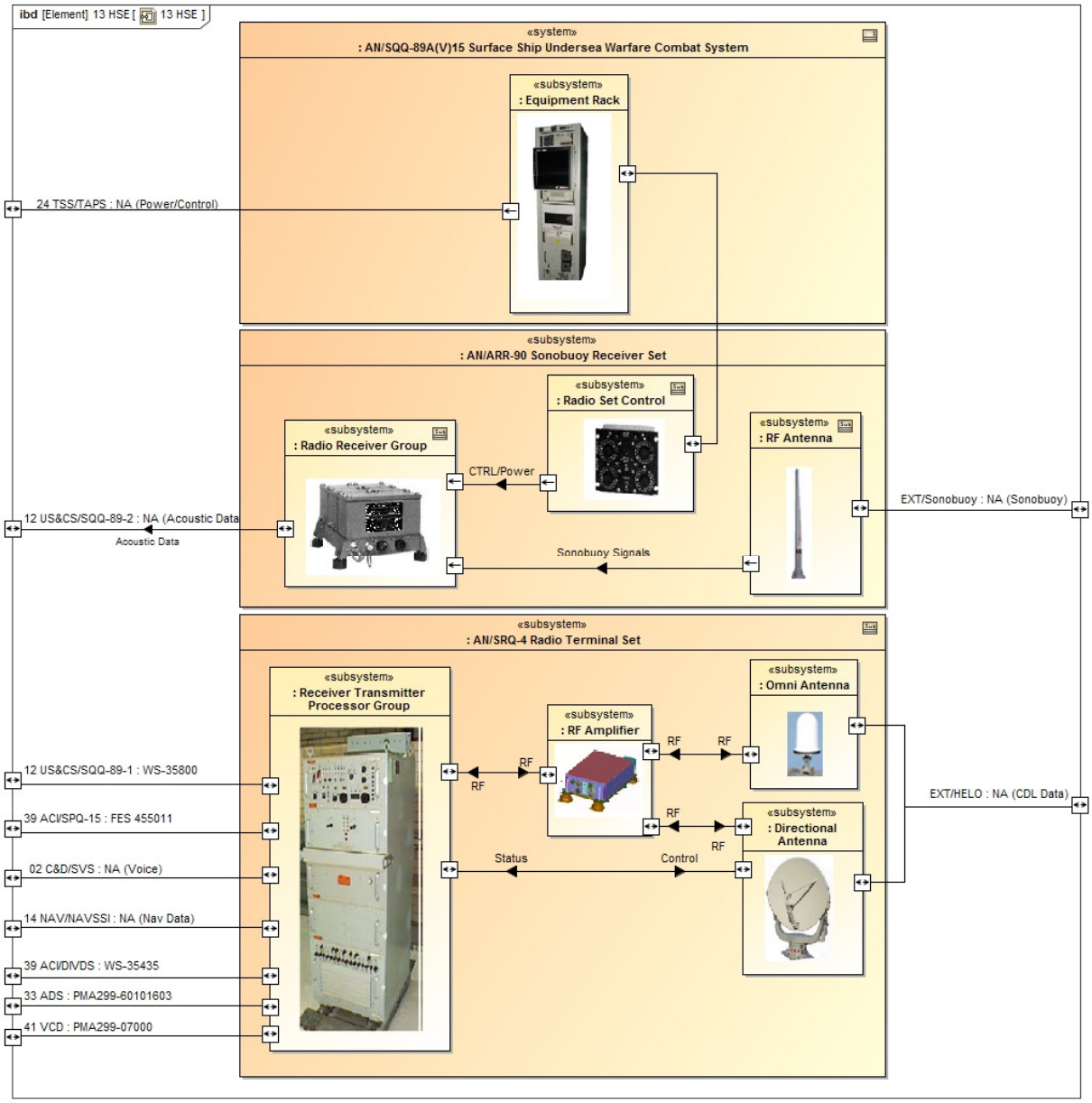

Figure 4.1-13 13 HSE

4.1.3.13.3.1 Shipboard Sonobuoy Receiver Set

The AN/ARR-90 Sonobuoy Receiving Set receives wideband acoustic data through a Radio Frequency (RF) Antenna from deployed line-of-sight sonobuoys and forwards the data to the AN/SQQ-89A(V) Receiver I/O (Unit 858). The Shipboard Sonobuoy Receiver Set supports reception of up to four channels of line-of-sight sonobuoy signals simultaneously.

4.1.3.13.3.1.1 Radio Receiver Group

The OR-69/ARR-90 Radio Receiver Group (Unit 1) receives, de-modulates, and amplifies sonobuoy signals. It provides four independent, demodulated, audio outputs representing any one of 99 RF input channels. The OR-69/ARR-90 Radio Receiver Group is located in the Sonar Control Room.

4.1.3.13.3.1.2 RF Antenna

The Vertical Dipole Antenna provides shipboard reception of sonobuoy signals by sensing all transmissions within the Shipboard Sonobuoy Receiving Set frequency range. The raw RF signals received by the antenna are routed through the AN/SQQ-89A(V) RF Coaxial Switch to the Shipboard Sonobuoy Receiver Set. The RF Antenna also transmits simulated sonobuoy signals, received from the AN/SQQ-89A(V) RF Transmitter (Unit 606) and routed thru the AN/SQQ-89A(V) RF Coaxial Switch, to an airborne helicopter or nearby ASW platform with an ARR-75 or Sonobuoy Receiver for training purposes.

4.1.3.13.3.2 AN/SQQ-89A(V)15 Surface Ship Undersea Warfare Combat System

The AN/SQQ-89A(V)15 Surface Ship Undersea Warfare Combat System (referred to herein as AN/SQQ-89A(V)) is described under Underwater Surveillance and Communications System (US&CS). The AN/SQQ-89A(V) equipment performs Shipboard Sonobuoy Processing and radio set control functionality for the Shipboard Sonobuoy Receiver Set. The RF Antenna (Unit 607) is shared between the AN/SQQ-89A(V) system and the Shipboard Sonobuoy Receiver Set.

4.1.3.13.3.3 AN/SRQ-4 Radio Terminal Set

The AN/SRQ-4 (Ku-Band) Radio Terminal Set is the shipboard portion of a two-way digital data link to the MH-60R helicopter. The Ku-Band SRQ-4 is an upgrade to the C-Band SRQ-4 that provided communications with the LAMPS MK III SH-60B helicopter.

The Ku-Band SRQ-4 provides full-duplex, digital transmission and reception of data between the MH-60R and surface ships by means of point-to-point communications. For AEGIS ACB-20, the ACS and the MH-60R will communicate via PMA299-07000 messages, which, when combined with the increased bandwidth of the Ku-Band, allows for simultaneous reception of sonobuoy audio, FLIR video, and other helo data.

The ACS serves as the primary ASW interface to the helo for both AEGIS and the AN/SQQ-89A(V). ACS up-links command and control, tactical, navigational, and voice data to the helicopter. Vehicular track reports, electronic surveillance/support measure (ESM) reports, radar/identification video (live or pre-recorded VCR), forward looking infrared (FLIR) video, navigation, system status, voice audio, Identification Friend or Foe (IFF) identification, Inverse Synthetic Aperture Radar (ISAR) video, Airborne Low Frequency Sonar (ALFS), and acoustic data from deployed sonobuoys are down-linked to the shipboard equipment. The AN/SRQ-4 Radio Terminal Set consists of an Omni Antenna, Directional Antenna, RF Amplifier, Receiver-Transmitter Processor Group, Antenna Control-Monitor, and a Control/Video Device.

4.1.3.13.3.3.1 Receiver Transmitter Processor Group

The Receiver-Transmitter Processor Group provides simultaneous transmission and reception of the encrypted, full-duplex voice data and PMA299-07000 message. A data processor provides conversion of duplex RF signals to/from the helicopter. The processor group routes FLIR and ISAR video to DiVDS, analog PPI Radar Video to the AN/SPQ-15 DDS SDC, digital sonobuoy Audio to the ANSQQ-89A(V)15 in US&CS, Voice data to the SVC in C&D, and all other data to the MH-60R Controller via a 100 Base-FX ALIS interface. A TSEC/KG-135A Communications Security Equipment is mounted within the Receiver-Transmitter Processor Group to provide the encryption/decryption to provide crypto security for the RF interface to the MH-60R.

4.1.3.13.3.3.2 Antenna Control Monitor

The Antenna Control-Monitor provides remote control and monitoring of the AN/SRQ-4 Radio Terminal Set. The Antenna Control-Monitor is located in the Combat Information Center (CIC) and is used by the ASW/ASUW Tactical Air Coordinator (ASTAC) Console operator. When the AN/SRQ-4 Radio Terminal Set is operated in remote mode, the directional-antenna azimuth angle and Receiver-Transmitter Processor Group operating mode are controlled by the Antenna Control-Monitor.

4.1.3.13.3.3.3 Directional Antenna

The AS-4595 Directional Antenna is a high-gain, parabolic dish, directional antenna housed within the CW-1184/SRQ-4 Radome (Unit 5). It is used for the simultaneous transmission and reception PMA299-07000 messages and voice data between the shipboard equipment and the MH-60R helicopter. The antenna scans 360 degrees in azimuth and from -30 degrees to +90 degrees in elevation. The use of a narrow-beam antenna, combined with RF signal encryption, impedes hostile reception of the helicopter tactical data.

4.1.3.13.3.3.4 Omni Antenna

The AS-4596/SRQ-4 Omni Antenna is used for data link communication when the MH-60R is operating at near range or conducting ship fly-over operations, providing the same functionality as the Directional Antenna when the MH-60R is in close range.

4.1.3.13.3.3.5 RF Amplifier

The RF Amplifier receives the RF transmit signal from the Receiver Transmitter Group, amplifies the signal to broadcast signal strength and switches the amplified signal between Omni and Directional Antennas. The RF Amplifier also directs RF receive energy to the Receiver Transmitter Processor Group. The RF Amplifier receives control commands from the Receiver-Transmitter Processor Group and is mounted within the SRQ-4 Radome.

4.1.3.13.4 Element Interfaces

Table 4.1-13 Helicopter Shipboard Equipment Interfaces

Element	Interface Description	IDS
02 C&D/SVS	Radio communications between C&D and the helicopter are facilitated by the C&D Secure Voice System via the ICOM element. Operators utilize the C&D Secure Voice System to conduct all radio communications exterior to the ship.	NA (Voice)
12 US&CS/SQQ-89-1	The AN/SRQ-4 sends 8 channels of sonobuoy acoustic signals (digital) to the SQQ-89.	WS-38500
12 US&CS/SQQ-89-2	Simulated sonobuoy signals from the SQQ-89 are transmitted to the airborne helicopter through the RF Antenna. The AN/ARR-90 sends four channels of sonobuoy acoustic signals to the SQQ-89.	WS-25502
14 NAV/NAVSSI	Augmented Navigation message OD-19C is received from NAVSSI as a Multi-Cast message via a dual redundant LAN connection to the ALIS LAN.	NA (Nav Data)
24 TSS/TAPS	The Shipboard Equipment Rack (Unit 871 Element 24) has a power and control interface with TAPS. Equipment Rack (Unit 871) functionally supports AN/SQQ-89A(V) but is allocated as a HSE (Element 13) piece of equipment. TAPS is interfacing with AN/SQQ-89 but the equipment rack is allocated to HSE.	NA (Power/Control)
34 ATD	AN/SQQ-89A(V)15 MH60R SIM interfaces with the Advanced Training Domain via the Training LAN on ALIS.	WS-35536

Element	Interface Description	IDS
39 ACI/DIVDS	The SRQ-4 sends three analog camera video feeds from the MH-60R to DiVDS: Forward Looking Infrared (FLIR), VCR video, and Inverse Synthetic Aperture Radar (ISAR) Video. This video is displayed on consoles throughout the combat information center and the bridge.	WS-35435
39 ACI/SPQ-15	The AN/SRQ-4 sends analog helicopter radar video and radar video sync signals to the SPQ-15 video Data Distribution System (DDS). This video is displayed on consoles throughout the combat information center.	FES 455011
41 VCD	Digital communications between VCD and the MH-60R helicopter are facilitated by the Helo Shipboard Equipment element. The VCD sends and receives all digital communications exterior to the ship via the Common Data Link (CDL).	PMA299-07000
EXT/HELO	Tactical data is exchanged with the MH-60R via the Common Data Link (CDL). CDL operates within the Ku-band at data rates up to 274 Mbs. The data exchanged is documented in the Shipboard Aviation Upgrade (SAU) IDS, PMA 299-07000 Rev 1 Change 4.	PMA299-07000
EXT/Sonobuoy	The SQQ-89 issues controls for and modifies settings of sonobuoys deployed from ownship and/or from supporting units and helicopters via RF interface.	WS-35799

4.1.3.13.5 Design Approach/Rationale/Constraints

No changes have been identified for Aegis BL10.

4.1.3.14 NAV System (14)

4.1.3.14.1 Purpose

The Navigation System (NAV) provides ownship position and navigation data, ship attitude and inertial velocity, calculated ocean current, Tactical Air Navigation capability, ship tracking, wind data, and precise time to the combat system.

Note that changes for AEGIS BL10 have not been made to the NAV element for this SSDD release. Changes are identified to reflect Inertial Navigation System - Replacement (INS-R) replacement of the WSN-7, and potential changes for GPS-based Positioning, Navigation, and Timing Service (GPNTS) replacement of NAVSSI. INS-R changes are not expected to impact system integration or performance.

4.1.3.14.2 Requirements Satisfied

The NAV Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.6.

4.1.3.14.3 Description

The Navigation System (NAV) provides:

· Ownship position as latitude and longitude, component velocity vectors (north and east), Coordinated Universal Time (UTC), Satellite Navigation (SATNAV) almanac data, ownship speed over ground can also be provided from the Navigation Sensor System Interface (NAVSSI), AN/SSN- 6N(V)4/GPS-based Positioning, Navigation, and Timing Service (GPNTS).
· Ownship speed through the water as detected by the Digital Hybrid Speed Log (DHYSL), AN/WSN-9.
· Ship's attitude, inertial velocity north and east, ship's dead reckoned position, and calculated ocean current from the Inertial Navigation System (INS), AN/WSN-7(V)1.
· Remote displays of the ship's attitude data, anemometer data, shaft data and rudder angle.
· Collection of environmental wind data through the Moriah Wind System.
· A range and bearing signal as an aide to aircraft navigation from the AN/URN-25 (hereinafter called Tactical Air Navigation (TACAN)).
· Automated tracking and identification of large ships and commercial vessels via the Automatic Identification System (AIS).
· Distribution of Navigation data (both synchro and digital types) to users via the Data Multiplex System (DMS), AN/USQ-82(V). For a description of the DMS refer to the ICOM section of the CDD.

The NAV System is depicted in Figure 4.1-14.

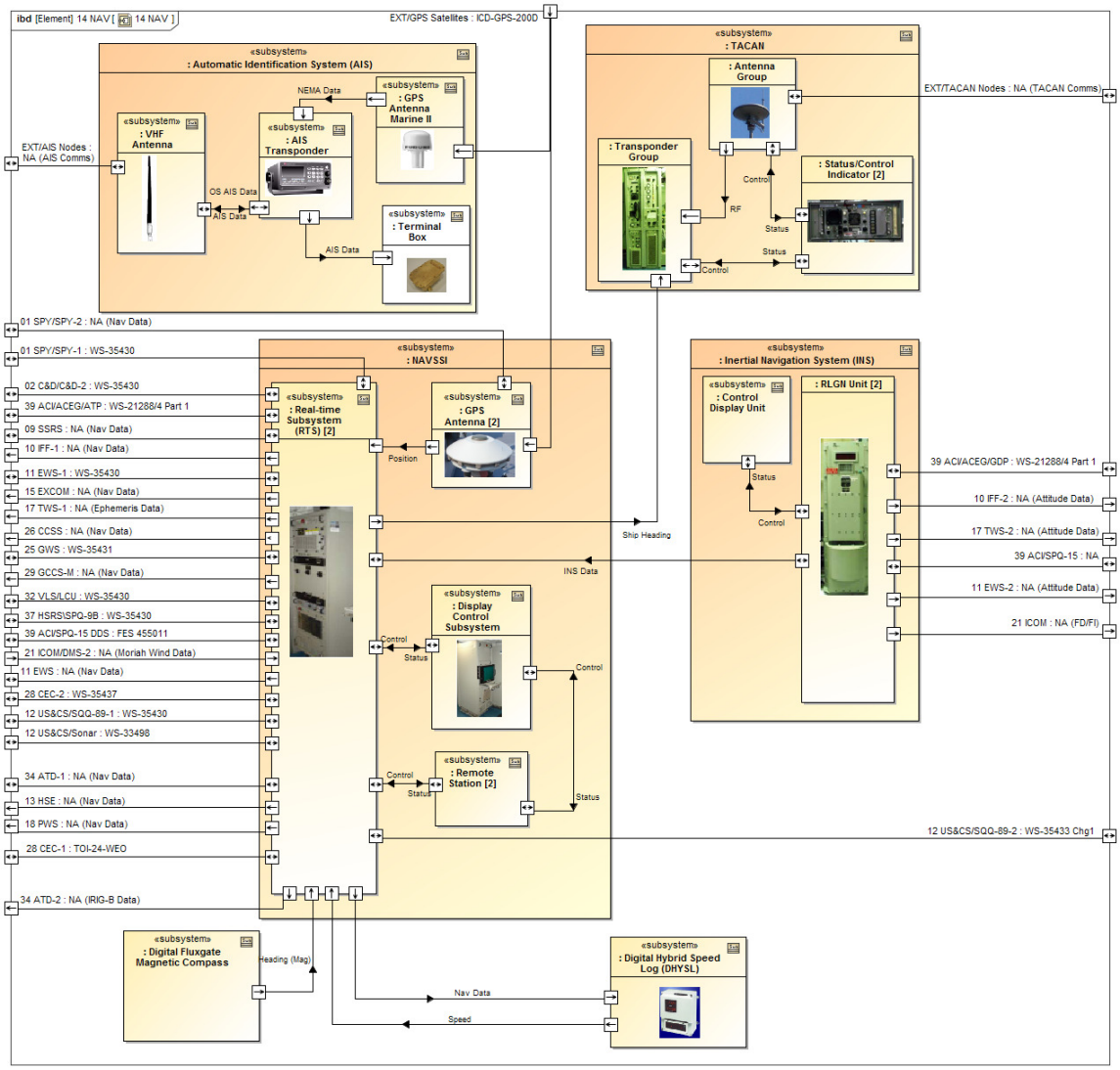

Figure 4.1-14 14 NAV

4.1.3.14.3.1 NAVSSI

NAVSSI integrates inputs from different shipboard navigation sensors and distributes the integrated navigation solution to shipboard weapon and combat support systems. NAVSSI continuously monitors the health and status of the data inputs from each source to ensure data integrity. The NAVSSI configuration consists of the following equipment:

· Real Time Subsystem (RTS)
· NAVSSI Remote Station (NRS)
· Global Position System (GPS) Antennas

The primary function of the NAVSSI AN/SSN-6N(V)4 is to collect, process, integrate, and distribute common position, velocity, time and almanac data to onboard combat systems. This is done in real time, with the GPS serving as the primary source of navigation data. NAVSSI produces a blended solution to reduce variation about true position relative to inertial in order to provide consistent and accurate data to the navigation data user equipment and combat systems.

The system gives users a Human-Machine Interface (HMI) to monitor current navigation data and their sources.

4.1.3.14.3.1.1 Real-time Subsystem (RTS)

NAVSSI is configured with two redundant RTS units. Each RTS receives navigation data from different sensors and systems, analyzes the performance of the sensors, and provides a real-time output of an integrated navigation solution to multiple users. The RTS collects, processes, and distributes the position, navigation, and timing data in a variety of formats.

The RTSs maintain memory copies of each other's data via the Fiber Optic Reflective Memory System. The Reflective Memory appears as one common memory area shared by both RTSs, which allows sensor data to be shared and the RTSs to be synchronized.

Each RTS unit interfaces with the DCS and the two NRS via the NAVSSI net (LAN). The RTS receives control data from the DCS and both the NRSs and provides navigation and sensor data as well as status information to the DCS and NRSs.

Fathometer and anemometer data is sent to NAVSSI via a bi-directional RS-422 interface from DMS. In the event of a failure, NAVSSI alerts the system user via a visual alert to be displayed on the DCS.

The RTS is comprised of a ruggedized 19 inch equipment rack hosting the RTS Computer Software Configuration Item (CSCI). The rack consists of the Fiber Optic Antenna Link (FOAL) Receiver Module Tray, an Ethernet Switch, an Uninterruptible Power Supply and Power Distribution Unit. The RTS also includes a 20-Slot VME chassis that houses a Motorola PowerPC CPU with PMC Expansion Bridge, a GPS VME Receiver Card (GVRC) R-2589A/URN, a Precision Time Unit, a Serial Communication Processor, a Reflective Memory, and various Input/Output modules such as NTDS-A/B/E and a synchro/digital converter. The function of each component is described below.

- FOAL Receiver Module Tray—The FOAL receiver module provides an optical data path between the GPS antenna and the GVRC module. The FOAL receives input from the two GPS antennas and provides one of those inputs to the GVRC module. The FOAL tray allows for manual switching of the two antenna sources.
- Ethernet Switch—This is an OSI layer 3 Fast Ethernet switch providing all network activity required by the RTS.
- Uninterruptible Power Supply (UPS)—The UPS receives the ship's power and provides it to the Power Distribution Unit. The UPS provides back-up power for the RTS, if the ship power fails. The UPS contains a set of rechargeable batteries that are kept fully charged and are used during ship AC power loss to the RTS.
- Power Distribution Unit (PDU)—The PDU provides the distribution and monitoring of AC and DC power to the RTS rack.

- VME Chassis Module Description—The VME chassis includes the following internal modules.
- PowerPC CPU—The PowerPC provides the processing infrastructure for the RTS application software. The CPU controls all the boards in the RTS. It directs the I/O boards to send and receive data, checks and processes data received, and communicates navigation solutions to the DCS.
- RAMIX Expansion Board—This is an intelligent PCI Mezzanine Card (PMC) expansion card attached to the CPU, giving the CPU flexibility for several network interfaces.
- Reflective Memory—The reflective memory provides for the creation of a virtual common memory between the two RTS units. This board transmits all data it is provided to the other RTS via a high-speed interface.
- GVRC R-2589A/URN—The GVRC is a precise positioning service receiver that uses signal broadcasts from the NAVSTAR GPS satellites in order to calculate the ship's three dimensional position, velocity and time. The GVRC calculates position, velocity, and time at a rate of one solution per second. Included in the VME chassis is a battery back-up board for the GVRC in case of power loss to the rack.
- Precision Time Unit (PTU)—The PTU module provides accurate timing and frequency output signals, synchronized to the GPS reference source (via the GVRC 1 PPS and HaveQuick interfaces). The PTU provides synchronized IRIG-B, 1 PPS, HaveQuick, BCD timing signals, and 5 and 10 MHz frequency reference signals. The module contains an ultra-stable oscillator, microprocessor controller and bus interface drivers. The PTU utilizes Coordinated Universal Time (UTC), not Greenwich Mean Time (GMT). GMT differs from UTC by up to 900 msec. Sometimes the term GMT is used synonymously for UTC in the navigation community. The GVRC passes the UTC to the RTS 20 slot VME. The data is incorporated into the message traffic sent to the RLGN. The RLGN incorporates the UTC into the digital navigation message and sends the data to DMS. DMS distributes the digital navigation message to AN/SQQ-89 and C&D. HaveQuick time (per ICD-GPS-060) is sourced directly from the GVRC card. The data is used to aid the HaveQuick transceiver in performing synchronous frequency hopping transmission and reception. Inter-Range Instrumentation Group time code format B (IRIG-B) is a time coded word that has a one second frame period and is transmitted as either a DC level-shift modulation envelope or as a modulated 1000 Hz. carrier. This time code contains 74-bits consisting of 30-bits of Binary Coded Decimal (BCD) time-of-year information in days, hours, minutes, and seconds; 17-bits of straight binary (SB) seconds-of-day; and 27-bits for control functions. One Pulse-Per-Second (1 PPS) (per ICD-GPS-060) is the Time Roll Over Pulse and uses the leading positive edge of a square wave synchronized to UTC second roll over. BCD Time Code (per ICD-GPS 060) is a 40 bit serial 8421 BCD Code defining UTC time of day, day of year and Time Figure-Of-Merit (TFOM) and is also referred to as the Time Mark Code (TMCode).
- Serial Communications Processor—The Serial Communications Processor is a high speed micro-processor based board with sixteen independent, synchronous/asynchronous communication ports. The board has 12 ports that are RS-485 and 4 ports that are RS-232. The board simultaneously supports RS-232, RS-422, and RS-485 interfaces in four line increments.
- NTDS-A/B and NTDS-E Boards—The NTDS MIL-STD 1397 boards provide support for NAVSSI communication with military computers and peripherals with legacy Input/Output interfaces.
- Synchro/Digital Converter Board—This board is an 8-channel synchro to digital converter used for interfacing with equipment having legacy synchro interfaces (such as the EM Log for the ownship speed).

Two NAVSSI Signal Data Reproducers (SDR) were added to NAVSSI to solve the depleting RS-422 port problem. One SDR is associated with the FWD RTS and the other with the AFT RTS. Each enclosure consists of two individual RS-422 8 port splitters. One of the internal splitters is responsible for splitting the GPS-150 navigation message and the other NMEA-183 navigation message from the RTS. In addition, each enclosure has an attached UPS that provides power to the enclosure.

4.1.3.14.3.1.2 GPS Antenna

NAVSSI contains two forward and aft AS-3819D/SRN GPS antennas.

4.1.3.14.3.1.3 Remote Station

Two NRSs provide operators with parallel control, monitoring and display of NAVSSI system data, as supplied by the DCS. One NRS is located in the Combat Information Center (CIC) and the other NRS is located in the Pilot House. Each NRS can control operation of each RTS, control the selection of navigation sensors and users, display navigation data from each sensor connected to NAVSSI, and display status from each RTS.

Each NRS consists of a workstation, LCD monitor (flat panel display), keyboard and trackball. Both NRSs are connected to the DCS via the fiber optic NAVSSI LAN.

4.1.3.14.3.2 Inertial Navigation System (INS)

The Inertial Navigation System (INS) is composed of redundant Ring Laser Gyro Navigation Units CN-1695/WSN-7 and a Control Display Unit (CDU) IP-1747/WSN-7. The function of the RLGN is to provide ship's attitude data (roll, pitch, ownship heading) and ship's velocities (north and east) in an analog dual-speed synchro format. In addition, the RLGN provides ship's attitude, inertial velocity vectors (north and east), ship's dead reckoned position and calculated ocean current in a digital format. The RLGN outputs a single System Fault Alarm in the event of a system failure.

4.1.3.14.3.2.1 RLGN Unit

There are two Ring Laser Gyro Navigation Units (RLGNs) aboard ship for redundancy. One inertial navigation cabinet is located in the forward gyro room and the other in the aft gyro room. Each AN/WSN-7 is a self-contained unit which employs an Inertial Measurement Unit (IMU) utilizing three single-axis ring-laser gyros and three accelerometers as the inertial reference to determine ship's position, velocity, heading, roll, and pitch. The RLGN continuously accepts ship's speed and GPS position data and operates automatically after power is applied and acceptance of the first position reset. Battery back-up power assures that the equipment will function during loss of ship's primary AC power source. Battery backup is designed to operate for approximately 30 minutes. To conserve battery power, all non-vital synchro outputs are discontinued including roll, pitch and heading, while vital heading and vital velocities (Vt, Vn, and Ve) are maintained. Built-In-Test Equipment (BITE) circuits monitor equipment operation, identifies faults, and enable visual identification of the faulting assembly or subassembly. Each AN/WSN-7(V) cabinet has a control panel with a 40 character, 6 line display and a 28 button, variable action type keypad. The function of each key depends on which mode is selected. In general, all calibration, maintenance and operational control of a RLGN cabinet can be performed via this control panel. The RLGN requires no operator action after it is initialized and has entered the desired mode of operation with the exception of monitoring data and interpreting system fault indication. All operation, including mode control, sensor selection, data entry, and parameter display as well as initiation of calibration, and self-test is performed using the Display and Keypad Assembly located on the front of the cabinet and in the Control Display Unit.

Each unit provides ship's heading, roll, pitch, velocity north, and velocity east data automatically and continuously in analog dual-speed synchro format to the ship's Navigation Distribution Panels for distribution to the combat system via the ICOM DMS and also provides Digital Navigation Data (OD1 message) to the AEGIS Weapon System Gyro Data Processors.

Each RLGN also has two interfaces with NAVSSI. The first is an NTDS-A interface, which allows GPS fix data to be sent to the INS and Navigation Aid Data to be sent to the RTS. The second is an NTDS-E interface, which is used for the "Superchannel" data exchange. This interface allows each RLGN to provide health and status as well as exchange of navigation and attitude data.

4.1.3.14.3.2.2 Control Display Unit

The Control Display Unit (CDU) provides all of the monitoring functions required by the RLGN. The CDU, a laptop computer with a three-card ISA I/O expansion rack, is designed to automatically collect and record data (velocities and velocity components; roll, pitch and heading data and rates; accelerations; etc.) from both inertials and display the data in a windows format such that the operator has only to analyze the trends. The performance of each RLGN can be shown simultaneously, side-by-side on the CDU display. Diagnostic applications within the CDU translate fault codes into text and are archived for

retrieval. Access to a color printer is required to provide hard copies of the displays.

A second function of the CDU is a remote-control function. It can perform all of the functions of each RLGN cabinet's control panel. The CDU can control both inertials and mimic the display of either inertial. This function is required in the event of a failure to an inertial's keyboard or display.

The CDU and its associated color printer are located in a standalone TAC IV Rack. The CDU interfaces directly with the RLGNs via an RS-422 for data and control as well as an NTDS-E for the superchannel interface.

4.1.3.14.3.3 Automatic Identification System (AIS)

AIS is a commercial-off-the-shelf (COTS), transponder-based maritime collision avoidance system. Network participants can be vessels, shore nodes, and aircraft. System transponders work on shared Very High Frequency (VHF) channels. Standardized protocol messages are used to exchange dynamic voyage and static hull information including safety advisories, vessel name, position, speed over ground, course over ground, call sign, number of passengers embarked, hazardous cargo and Maritime Mobile Service Identity (MMSI) number and vessel type, length and breadth.

Current AIS Version 3 systems are not integrated with the combat system, but fleet guidance requires real time entry of merchant ship data into MTC2 . This information is a major input into fleet commander's Common Operational Picture (COP) and is a primary data source in the national Global War on Terrorism (GWOT).

For USN ships, submarines, and aircraft, AIS is usually operated in a 'silenced' mode (receive only) to identify, plot, and track nonmilitary commercial vessels without counter-detection. Of note, AIS receivers are also installed on or planned for MH-60R, P-3C, P-8, and EP-3 aircraft.

4.1.3.14.3.3.1 VHF Antenna

The VHF omni-directional antenna provides the pathway of communication between other AIS equipped platforms to establish a "virtual" network.

4.1.3.14.3.3.2 GPS Antenna Marine II

This antenna is crucial to operation of the AIS transponder because the internal transmission synchronization relies on the accuracy of the time signal obtained from the antenna. The antenna provides NMEA standard messages containing position, speed, and other important messages required for the AIS to work properly.

4.1.3.14.3.3.3 AIS Transponder

The AIS transponder operates in two modes; transmit/receive and receive only. The ship's crew can choose the operational mode. In receive only mode, the AIS transponder receives one-way serial data transmitted from another ship. The data the AIS transponder receives includes the other ship's Marine Mobile Service Identity, Navigation Status, Speed Over Ground, Position Accuracy, Lat/Long, True heading, Course Over Ground, Time Stamp, IMO Vessel Number, Call Sign, Name of Ship, Type of Ship/Cargo, Dimensions of Ship, Reference Point for Position Reports, Type of Position Fixing Device, Draft of Ship and Destination. In the transmit/receive mode, the transponder not only receives broadcasts from other ships but also transmits the same type of AIS data about itself to every ship within VHF coverage range.

4.1.3.14.3.3.4 Terminal Box

The AIS transponder forwards that received data to the terminal box for distribution. Users may connect to the terminal box to obtain the received AIS data.

4.1.3.14.3.4 TACAN

The TACAN beacon is used to augment the Class 1 air control function and is a land-based or ship RF transponder group used by aircraft to determine range and bearing relative to the ship.

4.1.3.14.3.4.1 Status/Control Indicator

This unit displays the status of the transponder and any failure alarms. It also allows limited control of the transponder from a remote location.

4.1.3.14.3.4.2 Antenna Group

This antenna group receives aircraft TACAN signals and transmits the RF pulses generated by the TACAN Transponder Group. It also supplies timing signals to the transponder to control the transmission of RF bearing reference pulses. Ownship heading is supplied to the antenna group to directionally orient the transmitted antenna pattern.

4.1.3.14.3.4.3 Transponder Group

This unit receives interrogation pulses from aircraft TACAN sets and transmits pulses used by the aircraft to determine range and bearing to ownship. Periodically, the transponder group transmits a station identification signal in Morse code. A single TACAN beacon is capable of handling 100 aircraft.

4.1.3.14.3.5 Digital Hybrid Speed Log (DHYSL)

The WSN-9 DHYSL is a speed measuring sensor that uses the magnetic current generated by the water molecules passing by a rodmeter sensor to measure the ship's forward motion. DHYSL consists of a Rodmeter, Remote Control Unit, and two Indicator-Transmitters. Ownship speed from the DHYSL is transmitted to NAVSSI via the DMS in ICOM.

4.1.3.14.3.6 Digital Fluxgate Magnetic Compass

The Fluxgate Compass system is an electronic compass system that uses digital processing techniques to determine the heading of a vessel referenced to magnetic North. Data is displayed to the operator in numerical format on a liquid crystal display.

The Fluxgate Compass consists of a sensor assembly (Processor Unit), a control and interface assembly (Junction Box) and two display assemblies (Remote Displays), plus associated power and signal cabling.

The Fluxgate Compass employs a fluxgate magnetometer sensor, which is located in the Processor Unit, to determine orientation of the vessel with respect to the earth's local magnetic north. Digital heading data is sent via the sensor to the Junction Box for the presentation on the Remote Display. The Junction Box mounts the operating controls used to power up the compass and selects various operating modes. All connections to the operating power and to external navigation devices are made at the Junction Box.

The Fluxgate Compass displays the vessel's heading with respect to magnetic north, and uses auto-compensation techniques to correct for local magnetic disturbances.

4.1.3.14.4 Element Interfaces

Table 4.1-14 NAV System Interfaces

Element	Interface Description	IDS
01 SPY/SPY-1	SPY will receive OD22 data from NAVSSI RTS following IDS WS-35430 for ownship location.	WS-35430
01 SPY/SPY-2	SPY will receive GPS RF Data from NAVSSI.	NA (Nav Data)
02 C&D-2/C&D	C&D receives OD19B navigation data generated by the NAVSSI RTS via an 1000BLX interface from ALIS IAW with the common NAVSSI IDS WS-35430.	WS-35430

Element	Interface Description	IDS
09 SSRS	The DMS receives the relative antenna bearing from the AN/SPS-73 Radar. The DMS then provides a true antenna bearing signal back to the AN/SPS-73 Radar by combining ownership heading with the relative antenna bearing of the AN/SPS-73 within the DMS. Ownship's heading (1X) is sent from Navigation via the DMS to the Signal Data Converter of the AN/SPS-73 Radar. The AN/SPS-73 Signal Processor will receive LLS digital navigation data from either the forward or aft RLGN via the DMS. In addition the AN/SPS-73 receives Lat, Long, time, date and course/ground speed directly from the FWD RTS via a RS-422 interface.	NA (Nav Data)
10 IFF-1	The IFF terminal box receives a RS-422 GPS-150 message from both FWD and AFT RTS via ICOM. The message is then distributed within the IFF system.	NA (Nav Data)
10 IFF-2	The Antenna Control Unit receives ships synchro data heading, pitch, and roll from RLGN Inertial Navigation Set via DMS.	NA (Attitude Data)
11 EWS	Ownship heading and roll are provided by NAV to the DLP via GEDMS (ICOM) to support decoy launch calculations.	NA (Nav Data)
11 EWS-1	Countermeasures Set AN/SLQ-32 interfaces with the Navigation System, via DMS in ICOM to receive ownship's heading, speed, wind speed, and direction.	WS-35430
11 EWS-2	EWS interfaces with WSN-7 for ownship, pitch, roll and heading data via ICOM. This data is provided to the EWS gyro select switch.	NA (Attitude Data)
12 US&CS/Sonar	The US&CS Sonar Receiver-Transmitter depth data is sent to NAV via ICOM.	WS-33498
12 US&CS/SQQ-89-1	The SQQ-89 receives wind data via ALIS (Cruisers only).	WS-35430
12 US&CS/SQQ-89-2	The SQQ-89 Dual Display System (DDS) receives navigation data via ALIS (as well as charts).	WS-35433 Chg1
13 HSE	Augmented Navigation message OD-19C is sent to HSE as a Multi-Cast message via a dual redundant LAN connection to the ALIS LAN.	NA (Nav Data)

Element	Interface Description	IDS
15 EXCOM	The EXCOM Satellite Communications System receives ownship heading (syncho data) and HaveQuick time-of-day from NAVSSI for use by the UHF satellite antennas. HaveQuick time is also provided to CDLMS for UHF operations.	NA (Nav Data)
17 TWS-1	The TTWCS TEC-A and TEC-B receive GPS Satellite almanac data either from the FWD or AFT RTS via MIL-188 type point-to-point interfaces.	NA (Ephemeris Data)
17 TWS-2	The Tactical Tomahawk Weapon Control System (TTWCS) interfaces with both FWD and AFT RLGN Inertial Navigation Sets via a Digital Linear Movement Switch. The RLGN provides digital latitude, longitude, roll, pitch, and ship's heading to both TTWCS TEC-A and TEC-B via NTDS-A interfaces.	NA (Attitude Data)
18 PWS	Own Ship Heading (OSH) is supplied from the Navigation System, via DMS, to each of the two Local Control Stations in PWS.	NA (Nav Data)
21 ICOM	System Fault—RLGN (FWD and AFT) system faults are transmitted via DMS of ICOM to the IC/SM alarm panel.	NA (FD/FI)
21 ICOM/DMS-2	NAVSSI receives wind data from the Moriah Wind System via ICOM.	NA (Moriah Wind Data)
25 GWS	Digital Inertial Navigational Data from both RLGNs is transmitted to the GWS Data Processing Set via a multicast message from NAVSSI over ALIS.	WS-35431
26 CCSS	The Ships Signal Exploitation Equipment Cabinet receives redundant one pulse per second, OD19, 10Mhz, HAVEQUICK and OBC3 interfaces from the FWD and AFT Real Time Sub-system (RTS).	NA (Nav Data)
28 CEC-1	(FOUO) The Black side of the Data Terminal Processor of CEC receives OD19 messages from the FWD and AFT RTS via DMS (part of 21 ICOM).	T01-24-WEO
28 CEC-2	(FOUO) The Red side of CEC (CEP) receives redundant 100BaseFX OD12 and OD19 messages from the FWD and AFT RTS via ALIS. Classified as FOUO by CEC SCG [OPNAVINST S5513.3B-(119.10)]	WS-35437
29 GCCS-M / MTC2	The Global Command and Control System – Maritime (MTC2) receives position, velocity and time data from NAVSSI via a RS-232 type point-to-point interface.	NA (Nav Data)

Element	Interface Description	IDS
32 VLS/LCU	NAVSSI RTS No.1 and 2 transmit GPS RF data directly from the FOAL receiver module to the Launch Control Units (LCU). The data is used by the LCU to transmit GPS Hot Start data to the SM-3, SM-6 Block IA, and SM-6 Dual II missile.	WS-35430
34 ATD-1	The NAVSIM component of the Advanced Training Domain provides the RTS with simulation data that is used to create the OD12 navigation training message. The NAVSIM component of the Training Domain interfaces with ICOM to distribute simulated navigation data during training exercises. To maintain ships reference, ICOM passes digital navigation messages containing pitch, ownship heading, roll, and lat/long to the NAVSIM component. During training exercises, this navigation data is distributed to other AWS and ACS systems via NAVSSI.	NA (Nav Data)
34 ATD-2	NAVSSI RTS provides the ATD with IRIG-B time data to synchronize the training systems with other ACS systems during a training scenario.	NA (IRIG-B Data)
37 HSRS/SPQ-9B	Digital Inertial Navigational Data from both RLGNs is transmitted to the SPQ-9B Radar Data Processor via a multicast message from NAVSSI over ALIS. Applicable to SPQ-9B equipped ships only.	WS-35430
39 ACI/ACEG/ATP	The OL-653(V)6/SSN-6(V) RTS provides the ATP of the ACEG cabinet with IRIG-B time data. The ATP serves as the centralized distribution system of the IRIG-B time code. The ATP also sends NAVSSI the Leap Second Notification Request (ID18) and NAVSSI responds with the Leap Second Notification Message via an interface to ALIS. The intent of the OD18 is to inform the ATP that there will be a Leap Second added or deleted to the UTC at the next occurrence of the UTC.	WS-21288/4 Part 1
39 ACI/ACEG/GDP	The Gyro Data Processor (GDP) of each ACEG cabinet (see element 39 ACI) receives an OD1 Navigational Data Periodic Message directly from one of the WSN-7(V) RLGNs via an NTDS-D interface. The OD1 message contains time, position data (LAT/LONG), attitude data (heading, roll, pitch) and velocity data. The GDP converts and reformats the OD1 data into the GDR message and transmits that data to AEGIS Weapon System element processors.	WS-21288/4 Part 1

Element	Interface Description	IDS
39 ACI/SPQ-15	To support the display of radar video, the SPQ-15 DDS receives ownship heading and speed synchro data from the RLGNs via ICOM.	WS-35436
39 ACI/SPQ-15 DDS	The Electrical Equipment Racks receive RS-422: NMEA-183 messages from both the FWD and AFT RTSs via their respective NAVSSI splitters. The NMEA-183 messages are used to convert relative bearing to true bearing, which is then distributed by the racks to the consoles. The other purpose of the NMEA-183 message is to supply the SPA-25H radar display with navigation data, specifically OS heading, OS speed, and position data.	FES 455011
EXT/AIS Nodes	Automatic Identification System (AIS) receives data from AIS equipped units.	NA (AIS Comms)
EXT/GPS Satellites	GPS satellite data is received through GPS equipment	ICD-GPS-200D
EXT/TACAN Nodes	TACAN communicates with aircraft transponders via TACAN equipment.	NA (TACAN Comms)

4.1.3.14.5 Design Approach/Rationale/Constraints

Changes are identified for Aegis BL10 due to SPY-6 integration.

SPY-6 needs GPS RF feeds for navigation data to the SPY-6 INSs.

4.1.3.15 EXCOM System (15)

4.1.3.15.1 Purpose

The Exterior Communications System (EXCOM) provides the capability for Continuous Wave (CW) telegraphy, secure and non-secure voice through digital secure voice (SATCOM), secure and non-secure emulated teletypewriter (TTY), and secure data communications encompassing the frequency ranges of VLF (10 Hz-30 kHz) through LF (30 kHz-300 kHz) receive only, and MF (300 kHz-3 MHz) through EHF (30 GHz-300 GHz) transmit and receive. These capabilities enable the EXCOM System to not only provide tactical communication, but also to provide for the administrative support requirements of the ship.

4.1.3.15.2 Requirements Satisfied

The EXCOM Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.7.

4.1.3.15.3 Description

The EXCOM element is comprised of the following major subsystems:

- Automated Digital Network System (ADNS),
- UHF, SHF, and EHF Satellite Communications Systems,
- Link 16 Joint Tactical Information Distribution System (JTIDS) or Multi-Function Information Distribution System (MIDS) terminal,
- Link 11 and Link 16 Tactical Digital Link (TDL) message processing and forwarding provided by a Common Data Link Management System (CDLMS),
- Naval Modular Automated Communications System (NAVMACS),
- Infrared (IR) System.

High-level system details and tactical capabilities provided are described in the following paragraphs.

The EXCOM System is depicted in Figure 4.1-15.

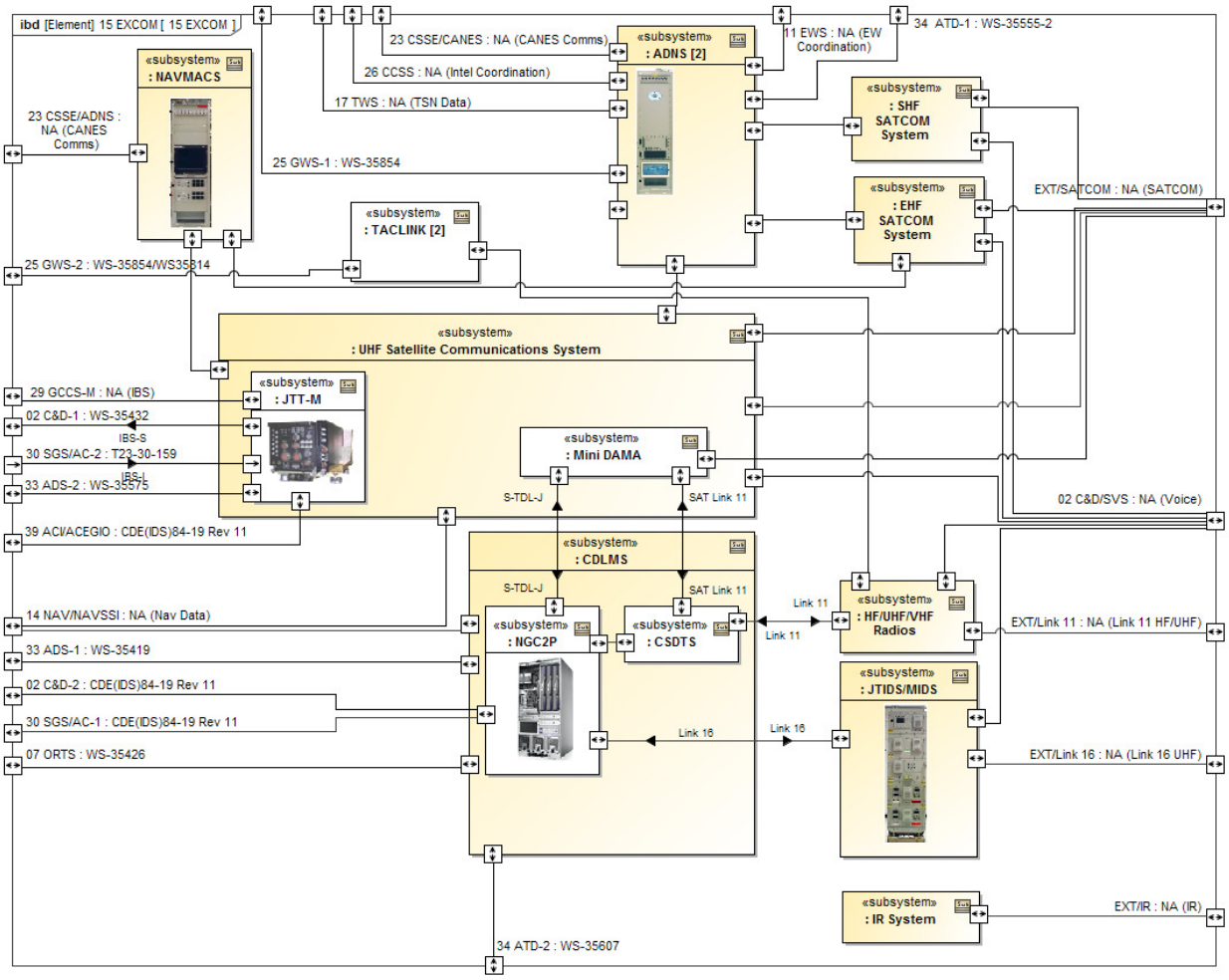

Figure 4.1-15 15 EXCOM

4.1.3.15.3.1 IR System

The IR System utilizes the AN/SAT-2B IR transmitting set which consists of two IR transmitters T-438B/SAT-2 Beacons mounted on the mast, a transmitter controller, C-1356/SAT-2, and two manual telegraph keys, KY-129/SAT-2A. The function of the IR System equipment is to transmit signals in the IR spectrum between 0.75 and 1.2 microns. This equipment provides a secure means for line-of-sight signaling under darkened ship conditions.

4.1.3.15.3.2 NAVMACS

The Naval Modular Automated Communication System (NAVMACS) provides capability to perform the automatic broadcast address screening and management functions required in the processing of incoming narrative messages, and the storage, formatting, link control, input/ output, and accountability of these messages. NAVMACS provides sorting of messages and message content and the logical forwarding of hooked messages through the secure network as email formatted messages to designated users.

The NAVMACS subsystem includes message storage and retrieval capability as well as certain functions associated with message composition, editing, formatting, or assignment of printers. Interconnecting box and selector switches are also provided for printer and data terminal sets. The basic units of NAVMACS are:

- Printer LaserJet 4—These printers provide hardcopy for NAVMACS. They have printing rates of 12 pages per minute with a resolution of 600 dots per inch. Normal operation is at a 9600-baud rate.
- Data Circuits—Data circuits are connected to the NAVMACS via the switchboards for various functions relating to decrypted SATCOM data.
- Computer Tactical Display—The Computer Tactical Displays exemplify the use of commercial computers to fulfill many of the requirements for shipboard and shore-based computing. The Computer Tactical Displays offer improved speed and functionality to the system. X-Windows terminals are connected to the TAC-3 units via an ethernet, and are sourced by an uninterruptible power supply UPSI-800.

4.1.3.15.3.3 ADNS

The ADNS system is the Tactical Internet Protocol (IP) Routing and Switching system for all Wide Area Network (WAN) IP services which connect afloat units to the various global shore sites. It provides ship and shore IP connectivity and promotes the efficient use of available satellite and line of sight communications bandwidth. ADNS is engaged in converging all voice, video, and data communications between ship and shore to an IP medium taking full advantage of all radio frequency (RF) means aboard ship to transmit data efficiently. Specifically, it automates the routing and switching of tactical and strategic C4I data via Transmission Control Protocol/Internet Protocol (TCP/IP) networks linking deployed battle group units with each other and with the Defense Information Systems Network (DISN) ashore.

4.1.3.15.3.4 JTIDS/MIDS

AN/URC-141 Multi-functional Information Distribution System (MIDS) on Ships (MOS) terminal is included to provide Link 16 communications. The terminal supports rapid, secure, jam-resistant (frequency-hopping) communications, navigation, and identification capabilities appropriate for military use up to and including secret information. Link 16 is a time division multiple access (TDMA) communication system operating at L-band frequencies. It operates over line-of-sight ranges up to 500 nautical miles with automatic relay extension beyond. The primary function of the terminal is to distribute Link 16 tactical information in digital form. The terminal automatically broadcasts outgoing messages at predesignated, and repeated, intervals. When a terminal is not transmitting, it receives messages sent by other terminals that transmit, in turn, in a prearranged order; i.e. TDMA.

The MOS Terminal is the newer replacement for JTIDS and offers all of the same functions and capability. The Core MOS system consists of three main LRUs: the MIDS terminal, the Remote Power Supply (RPS), and the High Power Amplifier Group (HPAG).

4.1.3.15.3.5 Command and Control Processor (C2P)

The AN/UYQ-120(V) C2P Tech Refresh provides command and control capabilities of various tactical data communications systems. It receives, stores, and transmits data from shipboard sensors and the Combat System.

CDLMS extends the functionality of the Command and Control Processor by consolidating several functions previously performed by separate systems or subsystems, and providing improved Human Machine Interface (HMI) and Link maintenance. C2P Tech Refresh also incorporates the Link Monitoring System (LMS) along with supporting the initial phase of development of the Common Shipboard Data Terminal Set (CSDTS).

C2P Tech Refresh provides real-time control and management, real-time performance monitoring, and maintenance of the TDL in a single system. CDLMS will facilitate participation and monitoring of operations on Link 11 and Link 16 in support of C&D. The HMI for CDLMS is implemented through the AEGIS Display System (ADS) MK 6 Display Local Area Network (LAN) at the Tactical Information Coordinator (TIC) operator's CPS/CDS console.

Console operators can initiate a Remote-X session with the C2P Tech Refresh. C2P Tech Refresh can support two sessions from two different consoles simultaneously. That means, two operators can monitor link performance simultaneously if desired.

4.1.3.15.3.5.1 CSDTS

The CSDTS Link 11 data terminal replaces legacy Link 11 terminal hardware while incorporating Multi-Frequency Link 11 (MFL), Satellite Link 11, and supporting the initial Dual Net Link 11. The CDLMS integrates the CSDTS in a set of Versa Modular European (VME) cards to provide consolidated displays and controls to monitor multi-TDL networks simultaneously. The CDLMS/ NGC2P program has fielded the USQ-86 (V), consisting primarily of an UYQ-70 Embedded Processor System (EPS) housing four VME chassis.

4.1.3.15.3.5.2 NGC2P

The Next Generation Command and Control Processor (NGC2P) allows the Combat System to internally process tactically oriented messages in a normalized format without regard to the actual link being used. It provides real-time initialization, control, management, performance monitoring, and maintenance of the links. The NGC2P provides message formatting and link protocols conforming to the Military Standards (MIL-STDs) governing the applicable link(s) and control of the data links. Initialization and control of the data links, as well as monitoring and troubleshooting of link equipment, are provided by the NGC2P, with the HMI for NGC2P being implemented through X-windows displays on ADS consoles. The NGC2P also supports Multicast TDL J (MTJ) and Unicast TDL J (UTJ) that it operates through the Multiple Link Interface Unit (MLIU).

The NGC2P provides monitoring and troubleshooting of link equipment. The Combat System sends and receives messages via a redundant Navy Tactical Data System Type E (NTDS-E) Low Level Serial (LLS) interface to the NGC2P in accordance with the protocols defined in the Model 5 C2P-CDS Interface Design Specification (IDS). The NGC2P translates the normalized N-Series messages generated by the Combat System into appropriate Link-specific messages and automatically directs them to the correct link equipment interface. Conversely, messages received over the various links are translated by the NGC2P into N-Series messages for transfer to the combat system. The NGC2P can also forward data between Link 11 and Link 16, in both directions, if initialized to do so. NGC2P data forwarding is independent of Ownship link operations, and can be performed by the NGC2P on a standalone basis, even when the Combat System interface is not enabled.

The NGC2P has seven distinct modes of operation, controllable via the X-window displays on ADS:

- None—no data link is in use; TDL link data is neither sent nor received.
- Link 11 Only—Link 16 is not used, but will remain in network synchronization if the terminal has previously been initialized and fine sync achieved.
- Link 16 Only—Link 11 is not used, but the DTS may still be active and serve as Network Control Station.

- Concurrent Operations—Both links operate in parallel, with Link 16 as the preferred link and Link 11 as the backup link, and as the link to those participants without Link 16 capability.
- Data Forwarder (Also called Forwarding JTIDS Unit TDL-A, or FJUA)—Ownship uses both TDL links to originate its own link data, while the NGC2P automatically forwards received remote link data between the TDL links in both directions.
- Link 11/Alternate Data Forwarder—Link 11 is used as the Ownship data link, but the NGC2P monitors Link 16 in the background in preparation for becoming the Data Forwarder when ordered to assume that role by the network manager.
- Link 16/Alternate Data Forwarder—Link 16 is used as the Ownship data link, but the NGC2P monitors Link 11 in the background in preparation for becoming the Data Forwarder when ordered to assume that role by the network manager.

The NGC2P provides a Satellite TDL-J (S-TDL-J) capability that supports the exchange of Link 16 messages by augmenting Link 16/TDL-J communications with concurrent operation of TDL-J/Link 16 Beyond Line-of-Sight (BLOS) operation. This capability provides seamless transition between Link 16 Line-of-Sight (LOS) and S-TDL-J data as JTIDS LOS connectivity is gained or lost.

4.1.3.15.3.6 EHF SATCOM System

The EHF SATCOM System operates in the frequency range of 30 GHz to 300 GHz. Navy Multiband Terminal (NMT) provides transmission and receive data rates between up to 8 megabits per second. The system provides mission critical data for Mission Data Updates (MDUs) that support Tomahawk Land Attack Missile (TLAM) engagements. EHF SATCOM also supports the exchange of Tactical Data Links. BMD uses MTJ and UTJ messages exchanged through EHF SATCOM for mission support and Launch on TDL (LoT). The entire SATCOM system comprises satellites, control stations, and aircraft, ship, and ground terminals to provide worldwide, secure, anti-jam, survivable communications for the National Command Authority, CINCs, and operational commanders.

4.1.3.15.3.7 SHF SATCOM System

The SHF SATCOM System operates in the 3 GHz – 30 GHz frequency range. NMT provides communication links, via satellite, between designated mobile units and shore sites worldwide. SHF SATCOM also supports the exchange of Tactical Data Links. BMD uses UTJ messages exchanged through SHF SATCOM for mission support and Launch on TDL (LoT). The system is part of a composite of information exchange systems that use the satellites as relays for communications and control as well as quality monitoring subsystems that provide data to manage satellite resources. The shipboard SATCOM configurations vary in size and complexity and dependent upon the message traffic level, types of communications and operational missions of the ship. The SHF SATCOM system provides highly reliable, high capacity, long range ship to shore communications with a high degree of immunity to jamming and direction finding.

4.1.3.15.3.8 UHF Satellite Communications System

The UHF SATCOM System operates in the range of 300 MHz to 3 GHz. The UHF Satellite Communication (SATCOM) System provides the ship with ship-to-ship or ship-to-shore communications and consists of: (a) Dual Channel Demand Assigned Multiple Access (Mini-DAMA), Control Monitor Group AN/USC-42(V)1; (b) UHF Satellite Follow-On Antenna Group OE-()/WSC; and (c) Satellite Signal Receiving Set AN/SSR-1A. The UHF SATCOM system provides reliable, secure, UHF communications that are unaffected by ionospheric and atmospheric disturbances. The system with its peripheral equipment is capable of handling high-speed data, voice and teletypewriter circuits.

4.1.3.15.3.8.1 JTT-M

The Joint Tactical Terminal - Maritime (JTT-M) Provides eight receive and one transmit channels that are interoperable with current Integrated Broadcast Service (IBS) networks - Simplex (IBS-S and Interactive (IBS-I). JTT provides ten RS-232 and 422 programmable serial ports and provides a MIL-STD-1553B interface. JTT also provides a Fast Ethernet Interface (IEEE 802.3). All communications security (COMSEC) supports the DS-101/102 Electronic Key Management System (EKMS) interface. JTT also is compatible with existing Commander's Tactical Terminal 3 (CTT3) and Multi-Mission Advanced Tactical Terminal (MATT) host interfaces.

The Antenna feeds the broadband UHF amplifier AM-7317A/SSR-1 which feeds the MX-11673/USC. The MX-11673/USC, receives amplified RF on four different channels, from four separate AM- 7317A/SSR-1 amplifiers. Each individual RF input to the MX-11763 is split to provide two outputs per RF input. After being split, these outputs are then routed to the SSR-1, Fleet Broadcast system, and the R-2609(V)2/USC-62 of the JTT system.

The USC-62 is controlled by a dedicated host computer, part of the AN/USQ-151 system. The JTT system, USC-62, provides outputs for the Tomahawk Weapon Control System, Maritime Tactical Command and Control (MTC2), C&D and the JTT processor. JTT interfaces with Link 11 which provides local to ship or local Theater track data. JTT receives the one Pulse-Per-Second (1 PPS) signal from the Precision Time and Time Interval (PTTI) interface.

4.1.3.15.3.9 HF/UHF/VHF Radios

The AN/USQ-155(V) Black Switching Matrix is a non-secure switch that provides audio switching between transmitters, receivers, transceivers, and voice cryptographic equipment, amplifiers, speakers, or headset jack boxes.

The switching matrix employs non-blocking space division matrixes for the routing of transmit and receive signals. The Communications Remote Control Unit (CRCU) allows remote programming of the AN/USQ-155(V), on 54 lines and 33 trunks.

4.1.3.15.3.10 Tactical Data Link Simulator

The Tactical Data Link (TDL) Simulator supports single ship training with simulated IUs, and simulated air and space tracks. The TDL Sim will provide synthetic data via to CDLMS and the Combat System via the Joint Range Extension Application Protocol interface.

4.1.3.15.3.11 TACLINKS

EXCOM has two TACLINKs for communicating with AFATDS/TLDHS/PFED to support Naval Guns Fire Support missions. The TACLINKs communicate over HF/UHF/VHF radios and with the Gun Weapon System.

4.1.3.15.4 Element Interfaces

Table 4.1-15 EXCOM System Interfaces

Element	Interface Description	IDS
02 C&D-1	C&D receives IBS-S data for SPY Cueing over two RS-422 interfaces from the AN/USQ-62(V)1 JTT-M system.	WS-35432
02 C&D-2	C&D interfaces with the C2P via NTDS for Link 11 and Link 16 tactical data. The C2P computer translates the Link 11 and Link 16 data into a Link 16 based normalized format (N-series) before being sent to C&D. This interface provides ownship local and remote datalink track and engagement status information exchange for coordination among battlegroup participants via Link 11 and/or Link 16.	CDE(IDS)84-19 Rev 11/Chg3
02 C&D/SVS	The Secure Voice System in Command and Decision interfaces with the EXCOM systems to provide secure voice communications for the operators.	NA (Voice)
07 ORTS-1	Provides health and status of C2P Tech Refresh for mission readiness and assessment.	WS-35426

Element	Interface Description	IDS
11 EWS	Provides TACELINT and Mission Planning data via CANES interface to EWS.	NA (EW Coordination)
14 NAV/NAVSSI	Ownship heading (syncho data) from either RLGN unit is received via ICOM for use by the UHF satellite antennas. CDLMS also uses NAV data for HAVEQUICK time synchronization.	NA (Nav Data)
17 TWS	ADNS interface with the Tomahawk Comms Interface Processor (TCIP) in the Tomahawk Weapon System (TWS) element. This interface goes through CANES and AEGIS Combat System LAN (ALIS). TWS can communicate via IP or EHF to exchange strike planning, tasking, execution and asset data (e.g. inventory).	NA (TSN Data)
23 CSSE/ADNS	The ADNS provides a multimedia data delivery service of Tactical/ Administrative/Intelligence information to/from all data user resources (Navy, Allied and Joint) via Slice Radio and ITP. ADNS comprises three functional elements: Integrated Network Management (INM), Routing and Switching (R&S), and Channel Access Protocols (CAPs). In the initial build multiple security levels from unclassified to Top Secret SCI will be enforced by cryptographic separation using the COTS Network Encryption System (NES). In successive ADNS builds the NES will be replaced by the Embedded INFOSEC Product (EIP). Users may also interface directly to ADNS via Multiple Level Secure (MLS) LANs or embedded MLS products.	NA (CANES Comms)
23 CSSE/CANES	This interface provides access to NAVMACS data from connections on CANES. NAVMACS provides for the processing of tactical messages and distribution through CANES.	NA (CANES Comms)
25 GWS-1	EXCOM exchanges mission planning data with offboard AFATDS/TLDHS/PFED systems for GWS to support shore bombardment. Systems provide target and observer updates, ammo inventory and fire unit's status, HF Radio (voice) and/or UHF SATCOM.	WS-35854
25 GWS-2	EXCOM exchanges mission planning data with offboard AFATDS system (thru CANES) for GWS to support shore bombardment. Systems provide target and observer updates, ammo inventory and fire unit's status, HF Radio (voice) and/or UHF SATCOM.	WS-35854/WS-35814

Element	Interface Description	IDS
26 CCSS	Sensitive Compartmented Information (SCI) is provided to the Cryptologic Combat Support System (CCSS) element users via Slice Radio and Integrated Terminal Program (ITP) for satellite services. The interface is provided via a teletype (TTY) connection.	NA (Intel Coordination)
29 MTC2 -2	MTC2 interfaces with the JTT-M for Intelligence Broadcast Service (IBS) data.	NA (IBS)
30 SGS/AC-1	This interface provides ownship local and remote datalink track and engagement status information exchange for coordination among battlegroup participants via Link 11 and/or Link 16.	CDE(IDS)84-19 Rev 11/Chg3
30 SGS/AC-2	The SGS/AC sends track data (one way) to EXCOM/TIPOFF, via an Ethernet connection, for transmittal over the Integrated Broadcast System (IBS).	T23-30-159
33 ADS-1	C2P Tech Refresh interfaces with the ADS via ALIS to display C2P/CDLMS/CSDTS HMI screens via X-Windows at the data link operator console. ADS sends X-windows control information to C2P Tech Refresh, and C2P Tech Refresh sends X-windows display graphics to ADS.	WS-35419
33 ADS-2	ADS interfaces with JTT-M via ALIS and CANES to provide the Alternate DBM and TAO workstation displays and controls via a Remote Desktop Protocol connection. JTT-M provides connection data and display frame buffers to ADS; ADS provides keyboard and mouse events to JTT-M.	WS-35575
34 ATD-1	The EXCOM TDL LAN provides the interface between the in port ships and the wide area network (WAN) gateway. The WAN gateway controls the flow of data between the shore sites and in port ships.	WS-35555
34 ATD-2	The Tactical Data Link (TDL) Simulator within EXCOM interfaces with the Advanced Training Domain via the Training LAN. The TDL Sim generates simulated Air and Space tracks and IU's based on the received ground truth training entities from ATD.	WS-35607
39 ACI	ACEGIO provides ownship local and remote datalink track and engagement status information	CDE(IDS)84-19 Rev 11/Chg3
EXT/IR	IR signals are transmitted by the IR system to provide a secure means for line-of-sight signaling under darkened ship conditions.	NA (IR)

Element	Interface Description	IDS
EXT/Link 11	UHF and HF Link 11 signals provide for the exchange of tactical information among airborne, land-based, and shipboard tactical data systems using a standard message format - M-series messages. When operating in the HF band, Link 11 provides gapless omni-directional coverage of up to 300 nautical miles (nm) from the transmitting site. When operating in the UHF band, the link provides omni-directional gapless coverage to approximately 25 nm ship-to-ship, or 150 nm ship-to-air. Link 11 is also referred to as Tactical Digital Information Link (TDL) A.	NA (Link 11 HF/UHF)
EXT/Link 16	Link 16 UHF provides a secure, jam-resistant, high-speed digital data link with participating command and control (C2) and non-C2 platforms and aircraft. It uses the transmission characteristics and protocols, conventions, and fixed-length or variable length message formats defined by MIL-STD 6016. Link 16 is also referred to as Tactical Digital Information Link (TDL) J.	NA (Link 16 UHF)
EXT/SATCOM	UHF (300 MHz - 3 GHz), SHF (3 GHz - 30 GHz), and EHF (30 GHz -300 GHz) SATCOM signals are generated by the combat system to provide long range communications with Task Force/Group platforms, operational commanders and other higher authorities supported by the combat system. Combat System SATCOM data includes standards based Integrated Broadcast Service Simplex (IBS-S) and Interactive (IBS-I); Satellite TDL J, SAT Link 11, and mission unique IP-based communications (e.g. Tomahawk Strike Net (TSN), MTJ, UTJ, etc).	NA (SATCOM)

4.1.3.15.5 Design Approach/Rationale/Constraints

EXCOM is changing for BL10 for a software upgrade to support the J3.4 design.

4.1.3.16 Not Used (16)

This number was previously used for the Harpoon Weapon System (HWS).

4.1.3.17 Tomahawk Weapon System (17)

4.1.3.17.1 Purpose

The Tomahawk Weapon System (TWS) is a long-range cruise missile weapon system that is designed to launch Tomahawk Land Attack Missiles (TLAMs) from surface ships to destroy, disable or damage enemy land targets. It provides capabilities for the joint force, maritime, and power projection missions of the United States Department of Defense. The TWS increases Navy power projection capabilities through improved joint integration and direct support to ground force commanders. It must operate in both a naval sea strike role and as an integral part of Joint Forces during the full spectrum of warfare including crisis response, regional conflict and major combat operations. These missions require that the TWS be sufficiently flexible and responsive to engage in a variety of rapidly developing and changing tactical scenarios. The TWS provides unmanned, precision, all-weather, deep strike capability. The TWS Baseline IV system includes all the capabilities of the earlier Baseline III and IV Phase 1 plus adds significant capabilities that increase system flexibility including reduced system response time, improved lethality against a wider target set, and improved reliability of Tomahawk Strike Network (TSN) communications. The TWS is composed of three unique subsystems known as segments, which contribute to the Tomahawk weapons employment. They include the All-Up-Round (AUR), the Theater Mission Planning Center (TMPC) and the Tactical Tomahawk Weapons Control System (TTWCS).

4.1.3.17.2 Requirements Satisfied

The TWS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.9.

4.1.3.17.3 Description

TWS is comprised of three major components: the Tactical Tomahawk All-Up-Round (AUR), Tactical Tomahawk Weapon Control System (TTWCS), and the Theater Mission Planning Center (TMPC). The components together provide the capabilities required to meet the expanded role of the TWS in overall power projection from sea in both contingency and campaign operations. The TMPC provides for planning and executing Tomahawk strike operations, managing resources, and managing Tomahawk missions and supporting information. The TTWCS provides the means to receive and process TLAM strike tasking, and to prepare and launch TLAMs via the VLS, which provides both environmentally protected storage and launch capabilities for the TLAM.

The Tomahawk Weapon System is depicted in Figure 4.1-16.

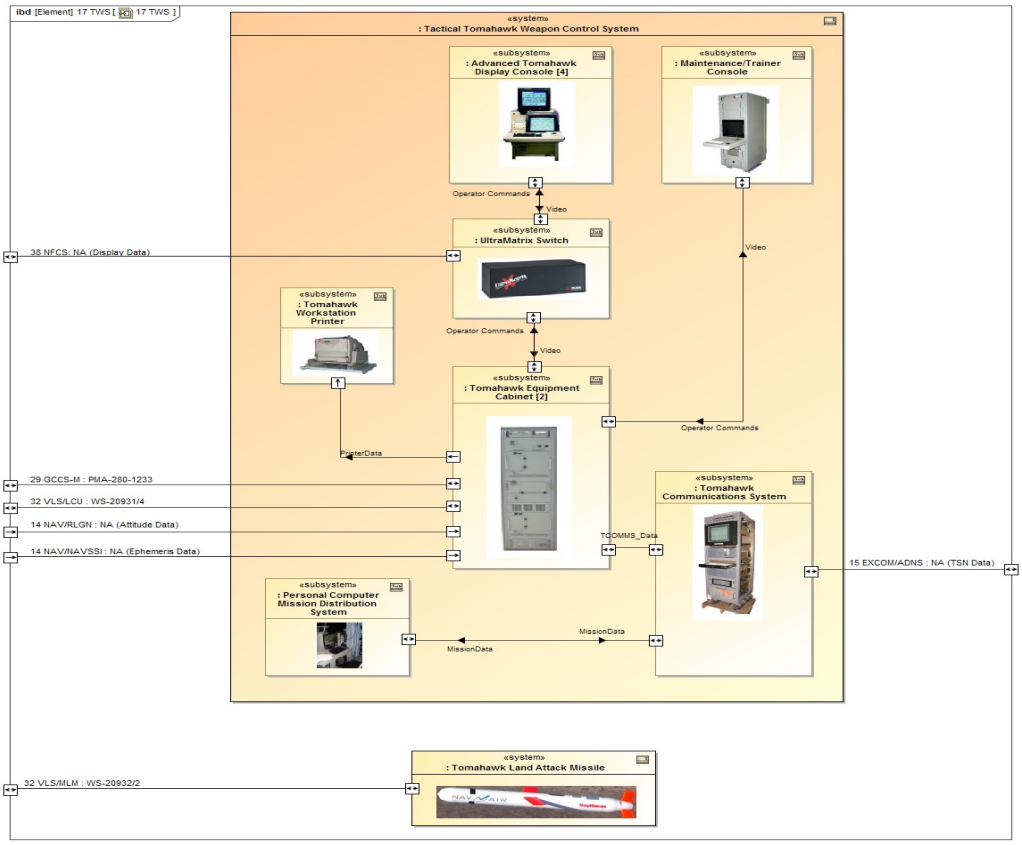

Figure 4.1-16 17 TWS

4.1.3.17.3.1 Tactical Tomahawk Weapon Control System

The TTWCS is a weapon control system that provides Tomahawk operators with enhanced Command and Control (C2) capabilities to plan, initialize, prepare, and launch missions for Block III TLAM-Conventional (TLAM-C) and TLAM-Block IV, Tactical Tomahawk (TLAM-E) missiles. TTWCS can also initialize, prepare, and launch Block III TLAM-Dispenser (TLAM-D) missiles, whose missions are preplanned only. The FRU can plan missions using the Launch Platform Mission Planning (LPMP) capability. These missions, which may contain a loiter maneuver, must be single outcome, GPS-only, terminal dive missions planned to go from the first preplanned waypoint to targets whose aimpoint coordinates are supplied by a source external to TTWCS. TTWCS has the capability to communicate with Block IV missiles via the Tomahawk Strike Network (TSN) to provide inflight mission updates, monitor Health and Status (H&S) reports, and Battle Damage Indication (BDI).

TTWCS major components are located in two areas: the Combat Information Center (CIC) and the Tomahawk Equipment Room (TER). In the ship's CIC, there are four Advanced Tactical Display Centers (ATDCs), and one Tomahawk Workstation Printer (TWP) that operate at the Secret level. In the TER, there are two Tomahawk Equipment Cabinets (TEC-A and TEC-B), and one Maintenance Trainer Console (MTC). The TER is an unmanned area and is classified at the Top Secret level.

4.1.3.17.3.2 Tomahawk Land Attack Missile

The TLAM is an all-weather, long range, subsonic cruise missile used for land attack warfare. Tomahawk cruise missiles are designed to fly at extremely low altitudes at high subsonic speeds, and are piloted over an evasive route by several mission tailored guidance systems. There are three variants within the Tomahawk cruise missile family, designated RGM-109C, RGM-109D and the upgraded Tactical Tomahawk missile RGM-109E.

TLAM RGM-109C — This conventional Land-Attack Tomahawk missile is 21 inches in diameter and 246 inches long. The missile airframe is a semimonocoque structure and contains wings that swing out from recesses in the missile body after launch. The missile travels at subsonic speeds and is designed to deliver a conventional warhead. The RGM-109C Missile is launched by means of a solid propellant booster which separates from the main vehicle body upon burnout. The cruciform tail fins, folded about the after body, extend during the boost stage and provide aerodynamic control. Engine start-up occurs after completion of the boost stage. The RGM-109C Missile flies a terrain-following profile with inertial guidance aided by the Terrain Contour Matching (TERCOM) System which updates the guidance system. The radar altimeter of the TERCOM System enables the missile to fly close to sea or land surfaces. This missile uses the Digital Scene Matching Area Correlator (DSMAC) for final target approach.

TLAM RGM-109D — The RGM-109D Missile is a variant of the RGM-109C Missile armed with a Combined Effects Bomblet (CEB) submunitions warhead which can be dispensed in partial packages to attack several targets in one mission.

Tactical Tomahawk RGM-109E — The RGM-109E Missile is more responsive and flexible than current variants. The AUR is equipped with a significantly more capable mission computer, two-way satellite data link via TSN and an anti-jam GPS receiver. The Tactical Tomahawk is able to receive a new or modified mission plan and be redirected to a secondary pre-planned target after launch. The missile transmits information on its in-flight status and confirms arrival in the target area (BDI).

4.1.3.17.4 Element Interfaces

Table 4.1-16 Tomahawk Weapon System Interfaces

Element	Interface Description	IDS
14 NAV/NAVSSI	The TTWCS TEC-A and TEC-B receive GPS Satellite almanac data either from the FWD or AFT RTS via MIL-STD-188 type point-to-point interfaces.	NA (Ephemeris Data)

Element	Interface Description	IDS
14 NAV/RLGN	The TTWCS interfaces with either the Forward or Aft RLGN Inertial Navigation Set via a Digital Linear Movement Switch. The RLGN provides digital latitude, longitude, roll, pitch, and ship's heading to both TTWCS TEC-A and TEC-B via NTDS-A interfaces for missile initialization.	NA (Attitude Data)
15 EXCOM/ADNS	Both legacy EXCOM (EHF LDR, STU-III) and Internet Protocol (IP) Network (NIPRNET, SIPRNET, JWICS) via Automated Digital Network System (ADNS) interface with TTWCS via TCOMMS unit. MDU can be received from SIPRNET via ADNS or from TCOMMS unit via a 10 Base2 Ethernet. TCOMMS unit provides communications interfaces for the TC2S and Tomahawk Strike Network (TSN) (UHF Satellite communication).	NA (TSN Data)
29 MTC2	TTWCS interfaces to MTC2 via the shipboard LAN. MTC2 supports TTWCS by providing the Common Operational Picture (COP) tracks to TTWCS and allowing a two-way overlay exchange.	PMA-280-1233
32 VLS/LCU	The two Tomahawk Equipment Cabinets interface with each Launch Control Unit of VLS via an NTDS-E interface to provide launch commands and information, and receive status.	WS-20931/4
32 VLS/MLM	The VLS Missile Launcher Module's Launch Sequencer interfaces with the TLAM contained in the Launcher to provide initialization and launch commands, and receive missile status.	WS-20932/2

4.1.3.17.5 Design Approach/Rationale/Constraints

No changes are identified for Aegis BL10.

4.1.3.18 Phalanx Weapon System (18)

4.1.3.18.1 Purpose
The Phalanx Weapon System (PWS) provides a close-in self-defense capability for air and surface threats, using self-contained sensors and a high rate of fire gun. This capability adds to the layered defense against Anti-ship Cruise Missile (ASCM) threats and provides a close-in gun capability for asymmetric surface and air threat deterrent and neutralization.

4.1.3.18.2 Requirements Satisfied
The PWS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.10.

4.1.3.18.3 Description
The PWS is also known as Phalanx Mk 15 Block IB Baseline 2. PWS consists primarily of Dual Weapon Group Mk 16 installed aft. Each weapon group consists of a 20mm Gatling type machine gun, mount, housing, fire control system, control panels, and other equipment required to search, acquire, track, and destroy air targets at close range. The PWS can operate independently from the Combat System but normally receives target designation data from the Weapon Control System (WCS). All communications across the WCS/FCS IOPs and PWS interface is controlled and maintained by WCS. Radar derived target and projectile data, and ship motion parameters are processed by the PWS fire control system computer for gun pointing solution. In search mode, the PWS radar is scanned in a raster pattern through a wide gimbal range (+ or –60 degrees of azimuth and +30 to –10 degrees elevation). When a target is acquired and the radar shifts to the acquisition/fire mode, the scan is approximately 3 degrees from the last target location. If the target escapes the acquisition scan, the PWS will cease fire and revert to the search mode until the target is reacquired. Only one Weapon Group Mark 16 is fired at a given target, however, both mounts can be fired at the same time against different targets.

The PWS can operate automatically, including firing; it can also be controlled from local or remote control panels. When operating autonomously, the PWS search/track radar automatically performs search and detection in the airspace assigned. After detection, the tracking radar scans about the detected point until it acquires the target. PWS automatically and continuously directs the stream of projectiles onto the target throughout the firing period. The PWS directs the projectiles by tracking both the projectiles and the target and correcting the projectile stream to conform with target location. PWS performs kill evaluation based on changes in target direction or velocity and automatically returns to a search mode after a target kill. PWS normally operates in a Remote Designate Mode in which it accepts target designation from an external sensor such as SPY via WCS. The tracking radar then searches about the designation point until it acquires the target. System operation thereafter is the same as when in independent mode.

The Mk 15 is a CIWS Block 1B Baseline 2 configuration that provides Surface Mode and enhanced Anti-Air Warfare (AAW) capabilities. These enhancements provide day/night surface mode detection capability against small, high-speed, very maneuverable surface targets and low, slow-speed and hovering air threats. It also provides the ability to remotely control the CIWS for use against surface or low air speed targets. The Block 1B is equipped with a manual video camera that is used to search for targets through the use of a control stick (thumb-type control).

The Phalanx Weapon System is depicted in Figure 4.1-17.

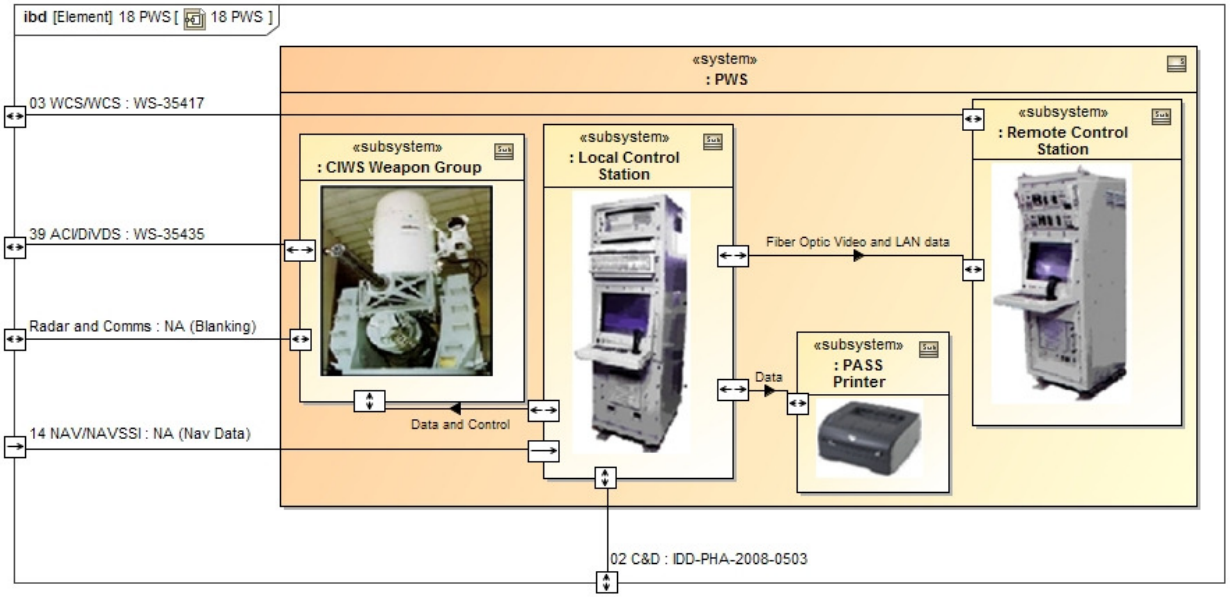

Figure 4.1-17 18 PWS

4.1.3.18.3.1 PWS

4.1.3.18.3.1.1 CIWS Weapon Group

The Weapon Group Mk 16 is divided into two separate units: (1) The Radar Module Assembly (RAM) Mk 7 and (2) the Electronics Enclosure Assembly (ELX) (Mk 20). The RAM is composed of the barbette assembly, elevation and train drive groups, the gun subsystem, Radar Servo Structure (RSS) and a lightweight search/track radar mounted in a radome on top of the rapid-fire 20 mm Gatling type machine gun with a trainable, elevatable gun cradle as the common support structure. The radar is a K-band pulse-Doppler type with separate search and track antennas and is a self-contained module.

The ELX is attached to the base (barbette). The assembly consists of a coherent pulse Doppler radar having separate search and track antennas and stabilization unit, a shared transmitter, a receiver and a signal processor, and a High Order Language Computer (HOLC). Most of the system’s electronics are contained on replaceable circuit cards which are housed in the ELX.

Mk 16 introduces the Electro-Optical (EO) Video Stabilized Automatic Tracking System, which is located on the right side of the Radar RSS when facing the ELX and is fitted with a Forward Looking Infrared (FLIR). This integrated FLIR provides Phalanx with a unique multi-spectral detect and track capability for littoral warfare threats and dramatically improves the existing anti-air warfare capability.

The gun is a six-barrel Gatling gun which fires the 20mm Mk 149 sub-caliber round. The 20mm round contains a heavy metal penetrator covered by a discarding plastic sabot and a discarding aluminum pusher. The Optimized Gun Barrels (OGB) are 79” long (19” longer than previous barrels), thicker, and heavier with a new Mid-Barrel Support Structure. The increased length of the barrels results in reduced dispersion, but the barrel sweep radius has increased.

4.1.3.18.3.1.2 PASS Printer

The Parameter Analysis and Storage System (PASS) Printer is connected with a Fast Ethernet Switch and is a Commercial-off-the-Shelf (COTS) 5-port, full duplex Fast Ethernet desktop switch for enterprise systems. The Ethernet switch is used to connect the two Local Control Stations (LCS) to the PASS printer. In the future, the Ethernet switch will interface the Remote Monitor Assessment System (REMAS) to the PASS Printer.

4.1.3.18.3.1.3 Remote Control Station

The Remote Control Station (RCS) Mk 2 houses the operator's control panels that interface with the local control stations for CIWS status indication and operational control. The RCS has the capability to individually control one or two Weapon Groups. The RCS is located in Combat Information Center (CIC) next to the Missile System Supervisor (MSS) Operator's console.

The RCS Mk 2 replaces the Mk 340 Remote Control Panel (RCP). The RCS contains the same control panels as the Mk 340 RCP and is used for AEGIS ships with digital remote designate capability.

4.1.3.18.3.1.4 Local Control Station

The Local Control Station (LCS) Mk 1 provides for local operator control and maintenance, and houses all support equipment except the printer, which is located nearby. LCS support equipment consists of the following units:

- PASS processor
- Power Supply
- Phalanx Integrated Maintenance System
- Surface Self Defense System Enable Switch
- External Network Computer (ENC)

LCS houses the PASS as well as the Phalanx Support Processor (PSP) and Video Tracker (VT). The LCS is the engagement controller for Phalanx Surface Mode (PSuM) and replaces the PASS stand used in earlier CIWS configurations. The engagement controller and PASS share a color video monitor for display of information. The LCS allows the operator to manually control the EO Video Stabilized Tracking

System. A video mixer integrates the FLIR image with graphics required to generate target acquisition, aim designation, and target bearing data on the color monitor while tracking the target.

A keypad is used to select and enter the range, bearing and offset aim for gun firing. The “Firing Obstruction Interlock” is not used on AEGIS ships. Therefore, a special jumper plug is installed in location J7 on the LCS.

4.1.3.18.4 Element Interfaces

Table 4.1-17 Phalanx Weapon System Interfaces

Element	Interface Description	IDS
02 C&D	The C&D Computer Suite, via ALIS, interfaces with the Phalanx Mk 15 Block IB Baseline 2 to receive CIWS radar tracks and sensor status/coverage. C&D sends sensor control and EMCON orders.	IDD-PHA.2008-0503
03 WCS	The AWS (AEGIS Weapon System) Computing Infrastructure (ACI) group includes the Ship MCE cabinets. The MCE cabinets house the processors, such as the Weapons Control System (WCS) I/O computer. The WCS computer supplies engagement designations, hold fire orders, designated bearing and elevation, in deck coordinates, plus target range, range rate, and amplitude for each mount to the Remote Control Station via either of the digital channels (normal or alternate). PWS provides engagement and mount status to WCS. The Digital Integrated Video Distribution System interfaces with the Mk 2 Phalanx Remote Control Station (RCS) to receive image data from the Mk 16 Weapon Group.	WS-35417
14 NAV/NAVSSI	Own Ship Heading (OSH) is supplied from the Navigation System, via DMS, to each of the two Local Control Stations in PWS.	NA (Nav Data)
39 ACI/DiVDS	DiVDS interfaces with CIWS to receive analog camera video from each CIWS Mount via the PWS Remote Control Station.	WS-35435
Radar and Comms	The radars and communications systems within the ACS send blanking triggers to the EWS to prevent co-site sensor interference	NA (Blanking)

4.1.3.18.5 Design Approach/Rationale/Constraints

Changes are identified for Aegis BL10 for CIWS Sensor Integration.

CIWS Sensor Integration is allowing the PWS sensor to be integrated with C&D for track data.

4.1.3.19 Underwater Countermeasures System (19)

4.1.3.19.1 Purpose

The Underwater Countermeasures System (UCS) provides the ship with torpedo defense. An acoustic transmitting unit (i.e. Towed Body) projects an amplified version of the ownship sonar signature in an attempt to attract and deceive hostile torpedoes. The Towed Body can be operated at any speed the towing ship can achieve, but must be deployed and retrieved at slow speeds. Ship's personnel are required to handle the Towed Body from storage to over-the-side deployment and retrieval. The system is equipped with two Towed Bodies; however, only one can be deployed and energized at any given time. A power operated, Double-Drum Winch is utilized to physically deploy, retrieve and control the Towed Body. The Towed Body can either be controlled locally at the Transmitter Control Set, or remotely by the Torpedo Countermeasures Transmitter located next to the Acoustic Supervisor in the Sonar Control Room.

4.1.3.19.2 Requirements Satisfied

The UCS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.11.

4.1.3.19.3 Description

The UCS consists of one main functional group -- the AN/SLQ-25A Torpedo Countermeasure Transmitting Set.

The Underwater Countermeasures System is depicted in Figure 4.1-18.

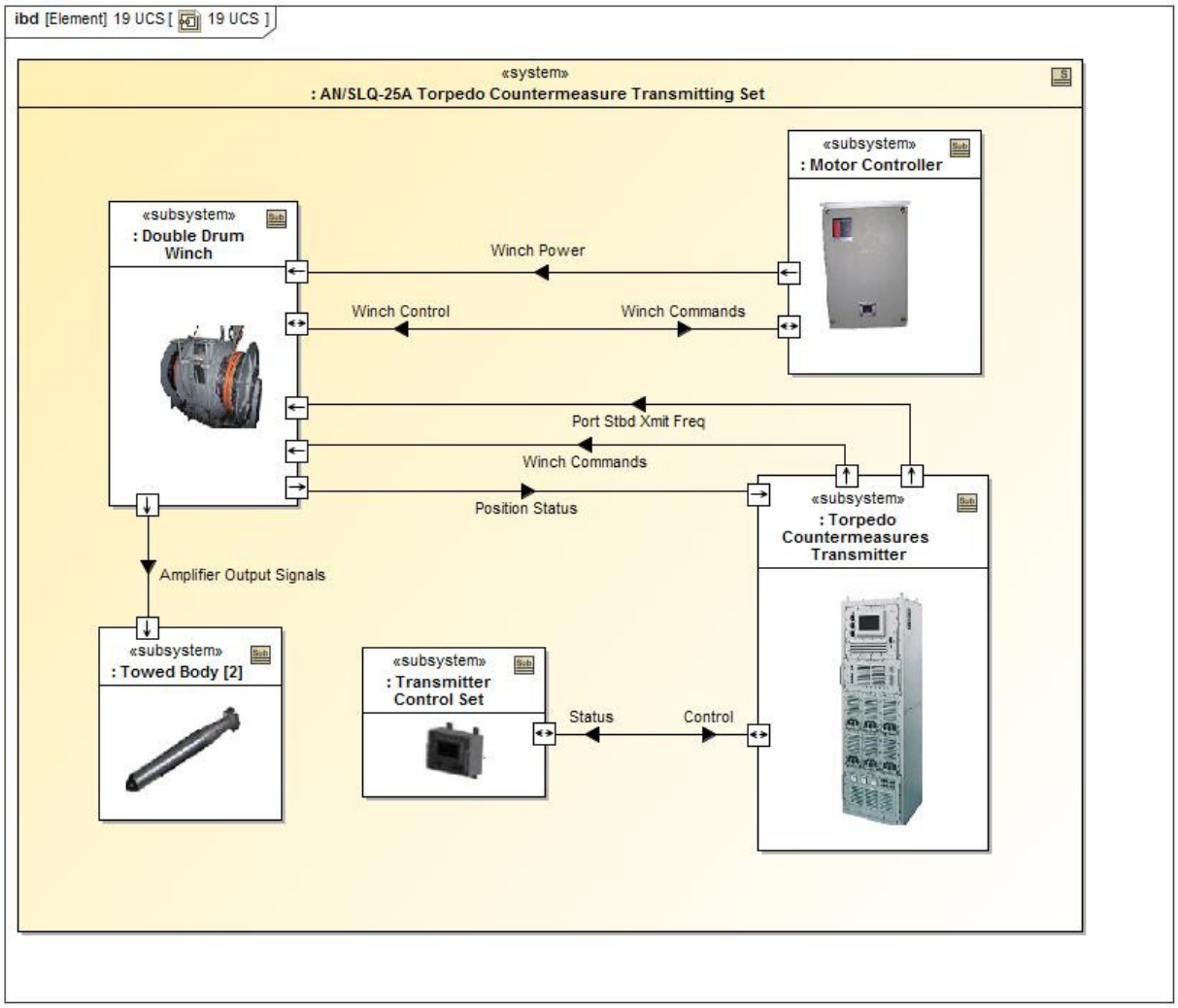

Figure 4.1-18 19 UCS

4.1.3.19.3.1 AN/SLQ-25A Torpedo Countermeasure Transmitting Set

The AN/SLQ-25 and its variants are towed torpedo decoys used on US and allied warships. The AN/SLQ-25 is commonly referred to as Nixie. It consists of a towed decoy device and a shipboard signal generator. The decoy emits signals to draw a torpedo away from its intended target. The Nixie attempts to defeat a torpedo's passive sonar by emitting simulated ship noise, such as propeller and engine noise, which is more attractive than the ship to the torpedo's sensors.

4.1.3.19.3.1.1 Transmitter Control Set

The Transmitter Control Set permits activation and deactivation of the system, selection of operating mode, and control of the notch (band-rejection) filtering and cycle timing functions. In addition, the Transmitter Control Set provides system performance monitoring and fault isolation testing.

4.1.3.19.3.1.2 Double Drum Winch

The Power Operated Double-Drum Winch (RL-272) receives the port and starboard signal outputs from the Transmitter Countermeasures Transmitter at conduit boxes on the outer drums of the winch assembly. Application of the amplifier outputs to the Towed Body is inhibited by gear driven limit switches until a predetermined length of cable, normally 150 feet, is payed out. The towed body signals are routed through slip ring assemblies to the port and starboard Littoral Fiber Optic Tow Cables (LFOTC). The cable

drums each hold 1600 feet of LFOTC and are driven independently by a single 10-hp motor. The drums are sheathed with fiberglass grooved sleeves to assist cable winding.

4.1.3.19.3.1.3 Motor Controller

The Motor Controller is a detachable unit mounted to the Double-Drum Winch. Electrical operation of the motor controller is accomplished at a master switch panel in the Control Transmitter Set.

4.1.3.19.3.1.4 Towed Body

The Towed Body receives electronic signals generated by the Transmitter Console via the Double-Drum Winch and a LFOTC. The Towed Body converts the electronic signals into acoustic signals for projection into the water. The Towed Body consists of four main components: a nose fairing, transducer, compensator, and tail cone. The Towed Body is stored in a rack near the Double-Drum Winch.

4.1.3.19.3.1.5 Torpedo Countermeasures Transmitter

The Torpedo Countermeasures Transmitter consists of a signal generator, three amplifiers, and a control panel, and is housed in an electronic equipment cabinet. The Transmitter provides and amplifies electronic signals sent to the Towed Body for projection into the water. All of the functions performed by the Transmitter Control Set can also be performed by the Torpedo Countermeasures Transmitter.

4.1.3.19.4 Element Interfaces

No element interfaces exist.

4.1.3.19.5 Design Approach/Rationale/Constraints

No changes are identified for Aegis BL10. However, any changes determined to be needed during detailed design will be included in a future version of the SSDD.

4.1.3.20 Underwater Weapon System (20)

4.1.3.20.1 Purpose

The Underwater Weapon System (UWS) is used to engage subsurface targets. The UWS consists of three functional groups: Torpedo Setting Panel (TSP), Over-the-Side Torpedo System (OTSTS), and Vertically Launched ASROC (VLA) Missiles, all controlled by the AN/SQQ-89 A(V) 15 Underwater Weapon Control Functional Segment (UCFS).

4.1.3.20.2 Requirements Satisfied

The UWS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.12.

4.1.3.20.3 Description

The UWS is decomposed into three subsystems: 1) TSP, 2) OTSTS, and 3) VLA Missiles and the AN/SQQ-89A(V) 15 UCFS.

The Underwater Weapon System is depicted in Figure 4.1-19.

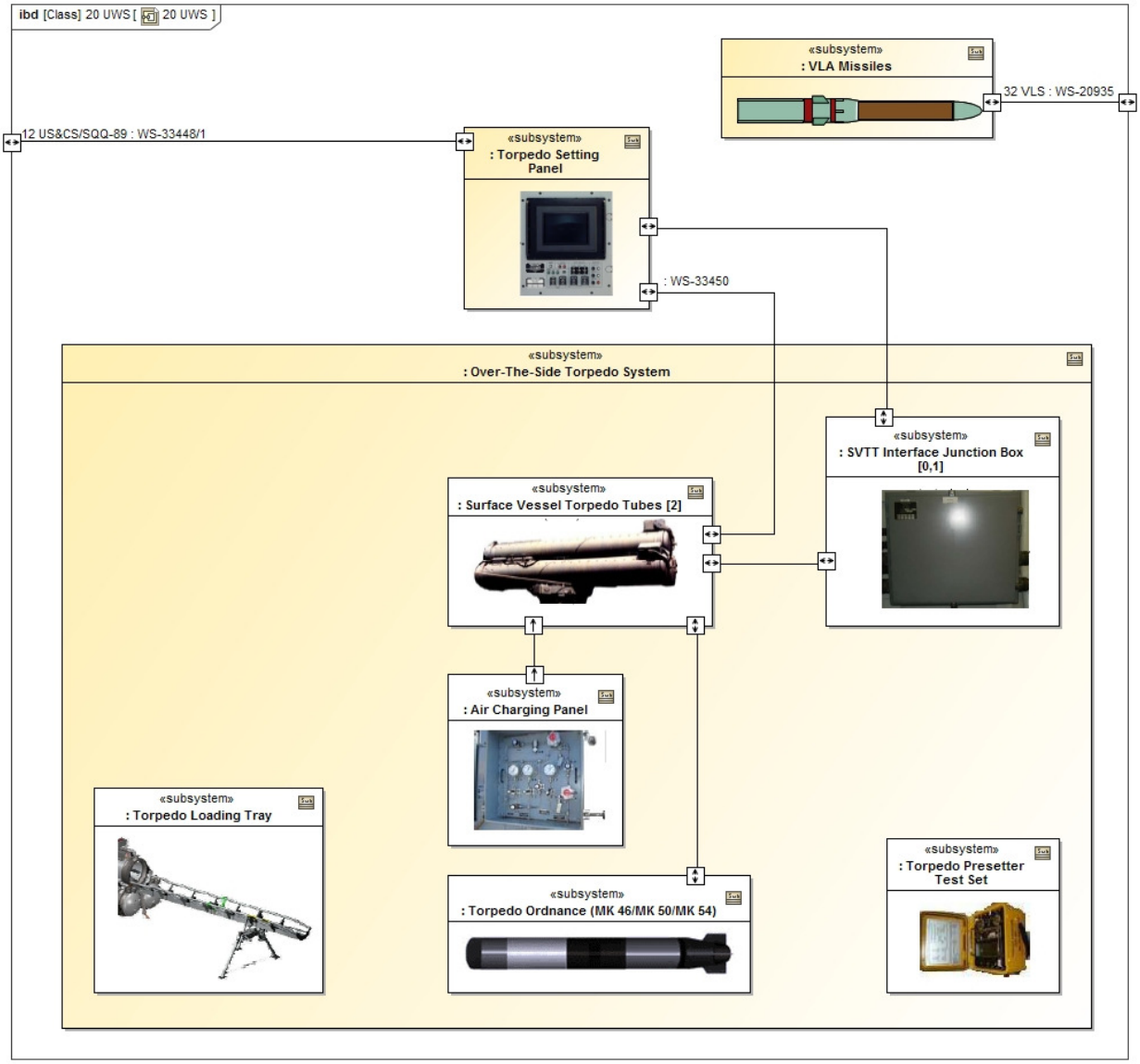

Figure 4.1-19 20 UWS

4.1.3.20.3.1 Over-The-Side Torpedo System

The OTSTS provides the ship with MK 46 and MK 54 torpedo launch capabilities. The OTSTS is comprised of a set of Surface Vessel Torpedo Tubes (SVTT) on the port and starboard sides of the ship, Torpedo Loading Tray, SVTT Interface Junction Box or Bulkhead Mounted Control Box, Test Set, Air Charging Panel, and torpedo ordnance.

4.1.3.20.3.1.1 Surface Vessel Torpedo Tubes

The OTSTS is equipped with two sets of SVTT. Each SVTT can stow and launch up to three torpedoes. The SVTT is a triple-tube mount located on the 02 Level near the aft Vertical Launch System (VLS), one set Port and one set Starboard.

4.1.3.20.3.1.2 SVTT Interface Junction Box

The MK 70 SVTT Interface Box provides the interface between the TSP and the OTSTS port and starboard Torpedo Tubes.

4.1.3.20.3.1.3 Torpedo Presetter Test Set
The MK 432 Mod 6 Torpedo Presetter Test Set provides torpedo interface simulation capability during times of testing and/or training. Typically, Ship's Force determines where they would like to store this equipment.

4.1.3.20.3.1.4 Torpedo Ordnance (MK 46/MK 50/MK 54)
The MK 46 Torpedo is an electrically-controlled torpedo with active, passive, or active/passive acoustic homing. It is programmed for a preset search pattern to optimize target intercept.

The MK 54 Torpedo combines elements of the MK 46, MK 50, and the MK 48 ADCAP Torpedoes along with a new, advanced digital Commercial Off the Shelf (COTS) Guidance and Control System. The MK 54 Torpedo provides improved shallow-water performance against littoral and traditional Ship, Submersible, Nuclear (SSN) targets, compared to the MK 46 Torpedo, with reduced life cycle support costs.

4.1.3.20.3.1.5 Air Charging Panel
The MK 429 Air Charging Panel (ACP) utilizes the ship's dry air to provide high-pressure charging of the breech mechanisms associated with both Torpedo Tubes.

4.1.3.20.3.1.6 Torpedo Loading Tray
The Mk 9 Torpedo Loading Tray is utilized to load torpedoes into the SVTT, and is stored in the Torpedo Strikedown Equipment Storeroom when not in use.

4.1.3.20.3.2 VLA Missiles
The RUM-139 Vertical Launched Anti-Submarine Rocket (ASROC) missile consists of a Torpedo (MK46(V) or MkK54), airframe, and rocket motor. VLA missiles employ MK 15 canisters as storage and launch containers.

Launch commands for the VLA are provided by the US&CS AN/SQQ-89A(V)15 Undersea Warfare Control Functional Segment (UCFS) which is sent to the VLS Launch Control Units. Localization information, in conjunction with environmental data at the launch ship is used by the UFCS to compute a water entry point for the VLA.

The missile is launched vertically in the air from the VLS. The VLA has Thrust Vector Control (TVC) to guide the missile from a vertical orientation through a pitch over maneuver into a trajectory intended to deliver the torpedo to a sea surface point. After a period of flight, the rocket motor separates from the airframe and a parachute deploys allowing the torpedo to descend to the water. Once in the water, the torpedo descends to its preset depth and begins seeking the target.

4.1.3.20.3.3 Torpedo Setting Panel
The AN/SQQ-89A(V)15 Surface Anti-Submarine Warfare Combat System is described under Underwater Surveillance and Communications System (US&CS). The TSP is considered to be part of the AN/SQQ-89A(V)15 system, but allocated to Underwater Weapons System (UWS).

The MK 331 Mod 4 TSP passes torpedo selection, preset values, and fire order commands received from the AN/SQQ-89A(V)15 Receiver I/O and Transmitter I/O to the OTSTS. The TSP provides all the circuitry, controls and indicators necessary to manually select, set, and launch torpedoes. During periods of testing and/or training, the interface with the OTSTS may be simulated by the MK 432 Mod 6 Test Set (part of OTSTS equipment). The Mod 4 version of the TSP supports Integrated Digital Fire Control Interface (DFCI) with advanced capabilities to fire digital MK 54 Torpedoes.

4.1.3.20.3.4 Bulkhead Mounted Control Boxes
Cruisers are equipped with two MK 60 Mod 0 Bulkhead Mounted Control Boxes, (port and starboard) that provide the interface between the Mark 331 TSP and the OTSTS port and starboard Mark 32 Torpedo Tubes.

4.1.3.20.3.5 AN/SQQ-89A(V)15 UCFS (external)

The UCFS is part of the functionality included in the Surface Ship Undersea Warfare Combat System, AN/SQQ-89A(V), as part of the Underwater Surveillance and Communications System (US&CS) ACS element providing an integrated Undersea Warfare (USW) 3 capability. Reference to all AN/SQQ-89 A(V)15 Function Segments are specified in the US&CS element system design description.

UCFS integrates ASW threat engagement with the total ship's USW capability, including capability for USW mission control, sensor management, and contact handling. The UCFS receives contact and track data the sensor processing functional segments of the AN/SQQ-89 that collect data from onboard USW sensors, and combine this with other acoustic and non-acoustic sources such as assigned LAMPS helicopters, other ship hull sonar and towed sonar systems to develop estimates of contact location, course, speed and identification.

This data is utilized to evaluate USW threats, assign weapons, perform fire control, conduct engagements, perform contact management, evaluate weapon effectiveness, and generate tactical decision aids. Targets to be engaged and the weapons for engagement are determined by C&D and designated in engagement orders to UCFS. UCFS controls the engagement process from planning through weapon launch, including fire control solution development, generation of weapon employment recommendations and orders, and launch controls. UCFS transfers confirmed target tracks to C&D.

The UCFS has the following data exchanges with the other functional segments. Contact and tactical data is exchanged with ASFS and SCFS. Environmental and performance prediction data are received from the SPPFS. Contact and tactical data are sent to the TRAFS, and contact alert data is received from TRAFS. Initialization and navigation data is received from the CSSFS and database data is sent to the CSS. The UCFS also receives AWS C&D orders and alerts via CSSFS and sends contact data summaries via CSSFS to the AWS via the AEGIS LAN Interconnect System (ALIS). Operators interact with the UCFS via shared display and control facilities (C&D Consoles Units 830- 835). The UCFS supports three Navy Tactical Data System Type E (NTDS-E) interfaces to the Vertical Launching System (VLS), two interfaces between the Receiver I/O (Unit 858) and the VLS LCU No. 1 and LCU No. 2, and one interface between the Transmitter I/O (Unit 859) and the VLS LCU No. 2. The UCFS controls the Over-the-Side Torpedo System via two 100BASE-FX point-to-point interfaces to the MK 331 TSP: one from Unit 858 and one from Unit 859.

UCFS supports the Integrated Digital Fire Control Interface (DFCI) with advanced capabilities to fire digital MK 54 Torpedoes from OTSTS and VLA. Integrated DFCI implements improved torpedo safety processing including Tactical Situation (TACSIT) safety graphics. Integrated DFCI introduces:
· A Dogbox display, an area where Surface Units (vessels) may interfere with or be endangered by torpedoes (a general region - applicable to MK 46, and 54 torpedoes)
· A Zone of Acceptable Detection (ZOD) display, an area where a (MK 54) digitally set torpedo will confine it's attack (more accurate area Dogbox above)

4.1.3.20.4 Element Interfaces

Table 4.1-18 Underwater Weapon System Interfaces

Element	Interface Description	IDS

Element	Interface Description	IDS
02 C&D	The AN/SQQ-89 system interfaces with ACI ALIS LAN via a 1000Base-LR LAN interface. The interface between the UCFS and the C&D Computer Suite function is the principal external AN/SQQ-89A(V) interface for exchanging tactical data. The C&D Computer Suite sends engagement orders, and doctrine to the UCFS. UCFS sends torpedo alerts, and engagement status to the C&D Computer Suite.	WS-35772
12 US&CS/SQQ-89	The AN/SQQ-89A(V)15 system has two 100 Base-FX point-to-point interfaces with the MK 331 Mod 4 TSP: a primary interface from the Receiver I/O and a secondary interface from the Transmitter I/O. These interfaces provide to the AN/SQQ-89A(V)15 the capability to initiate a torpedo launch and to monitor torpedo status prior to launch.	WS-33448/1
32 VLS	The VLS Launch Sequencer interfaces with the VLA to provide initialization and launch commands, and receive missile status.	WS-20935

4.1.3.20.5 Design Approach/Rationale/Constraints

No changes are identified for Aegis BL10. However, any changes determined to be needed during detailed design will be included in a future version of the SSDD.

4.1.3.21 Interior Communications System (21)

4.1.3.21.1 Purpose
The ship Interior Communications (ICOM) System provides the equipment required to perform the voice communication, alarm, indication, and data transfer functions required to support ship and Combat System element operation.

4.1.3.21.2 Requirements Satisfied
The ICOM Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.13.

4.1.3.21.3 Description
The ICOM element is composed of a Data Multiplex System (DMS), implemented by the Gigabit Ethernet Data Multiplex System (GEDMS), the Digital Integrated Announcing System (DIAS), the Shipwide Interior Wireless Communications System (SWICS), and the Moriah Wind System.

The Interior Communications System is depicted in Figure 4.1-20.

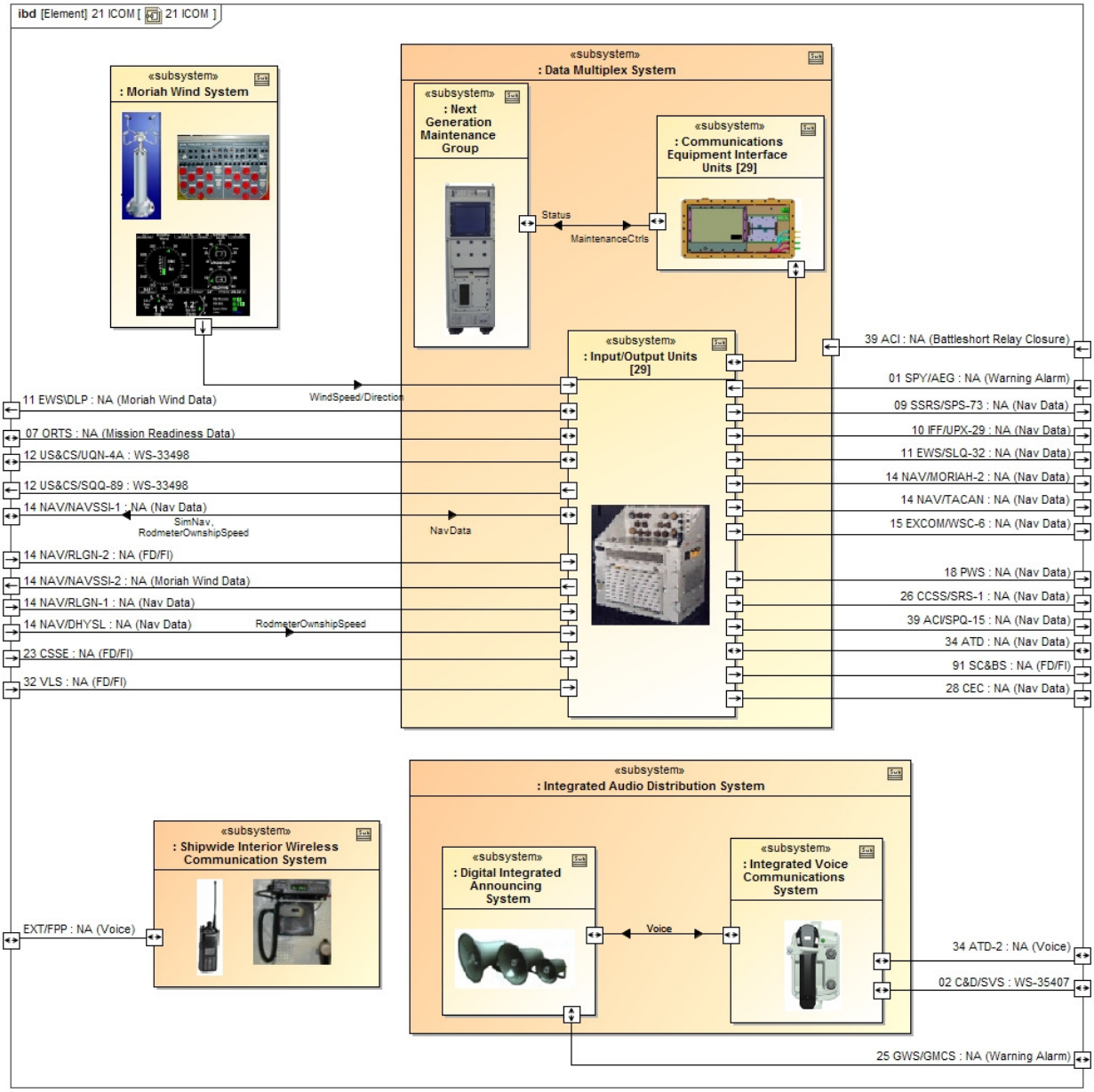

Figure 4.1-20 21 ICOM

4.1.3.21.3.1 Data Multiplex System

The Data Multiplex System (DMS) is a modular information transfer system for distributing combat system signals. It is implemented by the AN/USQ-82(V) Gigabit Ethernet Data Multiplex System (GEDMS). DMS conveys electronic data for many shipboard subsystems such as Navigation, IFF, Machinery Control, Damage Control, Steering and IC Alarm, and Indicating Systems. DMS has the ability to be readily adaptable to equipment or interface modifications in the subsystems that it services. The system accommodates NTDS Slow, NTDS Fast, LLS, NRZ Serial, 60 & 400 Hz Synchro, and various discrete signal formats. DMS output data can be provided in any of these signal formats, independent of the input data format.

GEDMS consists of 29, 15-Slot Signal Data Converter/Input Output Unit CV-4414/USQ-82(V) (SDCs), which contain up to 15 Input-Output Modules (IOMs), 20 Communications Equipment Interface Units J-

6745/USQ-82(V) which makes up the Gigabit LAN, a Next Generation Maintenance Group (NGMG), and Communication Equipment Interface Units (CEIU), J6746/USQ-82(V).

4.1.3.21.3.1.1 Input/Output Units

DMS contains 29 Input/Output Units (IOUs) that provide the interface for external systems to the DMS. The IOUs allow the interfacing of the multiple navigation source input signals to the DMS for distribution throughout the ship to the different equipment and systems, which are also connected to the IOUs. The IOUs are placed in different room locations to allow shorter distance interfacing by the different equipment. The IOUs contain System Modules and different Input/Output Modules necessary for the required interfaces to DMS.

System Modules provide system level functionality in each IOU and consist of one DMS Controller (DMSC) and two Gigabit Ethernet Controllers (GECs). The DMSC module receives/sends data to the Input/Output Modules, receives/sends data to the GECs, and performs message scheduling, assembling and disassembling. The GECs are responsible for transmitting/receiving data on the GEDMS fiber optic networks and for sending/receiving data to the DSMC.

The Input/Output Modules (IOMs) are the circuit cards that provide DMS with the different types of interface capability (i.e. Signal Data Converters). The IOMs receive and/or send data to the connecting systems in the system's format.

4.1.3.21.3.1.2 Communications Equipment Interface Units

The Communications Equipment Interface Units (CEIUs) provide access to the gigabit fiber optic backbone of GEDMS. Input IOMs convert analog, discrete and message words into GEDMS message packets containing unique routing information taking the messages from source to receiver, which are transmitted across the GEDMS network via the CEIUs.

4.1.3.21.3.1.3 Next Generation Maintenance Group

The Next Generation Maintenance Group (NGMG) is an upgraded Maintenance Group, located in IC Gyro Room No. 2 and is used to conduct system performance checks, GEDMS updates, fault localization, and access to the GEDMS Technical Manual. The NDMG cabinet contains a UNIX compatible Themis processor, a laser printer, and a keyboard and trackball to provide the operator interface with the system.

4.1.3.21.3.2 Shipwide Interior Wireless Communication System

The AN/SRC-59 Shipwide Interior Wireless Communication System (SIWCS) is a Maritime Hull, Mechanical and Electrical (HM&E) Commercial-off-the-Shelf and Non-Developmental Items (COTS/NDI) equipment suite that provides shipwide, ship-to-ship, and ship-to-shore communications. For shipwide communications, the SIWCS consists of a system of 25-watt repeaters (internal to the ship), connected to the Consolidated Antenna System (CAS) used to tie together 1.5-watt hand-held transceivers (HTs) in either simplex or half-duplex mode using the commercial UHF radio frequency bands between 400MHz-500MHz.

To allow the crew to communicate with ship’s Force Protection (FP) personnel outside the skin of the ship, additional SIWCS equipment includes a topside antenna, an inline manual cutout switch for the topside antenna used for EMCON Plan execution, the SIWCS FP Equipment Rack, containing a cross-band repeater to translate the incoming and outgoing transmissions between the SIWCS below deck radios (400MHz-500MHz band) and the FP topside radios (380MHz-399.9MHz band), and additional Hand-Held Transceivers, pre-programmed for specific frequency pairs that have been chosen to ensure the isolation of each group, keeping Force Protection communications totally separate from all other SIWCS radio communications.

4.1.3.21.3.3 Integrated Audio Distribution System

The Integrated Audio Distribution System (IADS) is a voice intercommunication system that includes the AN/SIA-129 Digital Integrated Announcing System (DIAS) Intercommunications Set and the AN/STC-3 Integrated Voice Communications System (IVCS). The IADS is used by the ship's crew, including CIC,

supply, and engineering personnel, to communicate between individual stations on board ship via selected dialing or predetermined network voice circuits.

4.1.3.21.3.3.1 Digital Integrated Announcing System

The AN/SIA-129 Digital Integrated Announcing System (DIAS) Intercommunications Set is used by CIC personnel for voice communications. This system is a multiplex communications network that provides CIC console operators with inter-console communications, and has access to EXCOM radios and IVCS. Redundant DIAS equipment sets are located in the Forward and Aft IC & Gyro Rooms for survivability. Other Combat System operators have remote intercommunications units that are similar to those in CIC. IVCS trunks allow the CIC operators access to IVCS for communications with ship stations outside of CIC.

The DIAS is the ship's 1MC (Main Circuit) General Announcing System. This one-way announcing system provides a means of transmitting general information, orders, and alarms in all ship spaces as well as topside. The 1MC is also used during casualty to give damage control information as well as alarm the crew of any dangers such as chemical attack, collision, and flight deck crash. The General announcing system also interfaces with the other announcing systems on board: 2MC (Engineering spaces), 3MC (Hanger Deck Areas), 5MC (Flight Deck), and 6MC (Bullhorn).

4.1.3.21.3.3.2 Integrated Voice Communications System

The AN/STC-3 Integrated Voice Communications System (IVCS) is a computer-controlled, circuit switching communication system that consists of interconnected switching centers (forward and aft), maintenance consoles, net jackboxes, and digital, compact, and Plain Old Telephone Service (POTS) terminals. Net Jackboxes provide communications to all connected terminals, and the other terminals perform line-to-line connections, network calls, conference calls, access to the ship's announcing system, and connection to shore telephone lines when in port. The design provides redundancy of critical functions for single point of failure protection to assure uninterrupted and survival operation.

4.1.3.21.3.4 Moriah Wind System

The Moriah Wind System (MWS), is a fully solid state digital wind system providing reliable, accurate and maintenance free raw and damped wind data. The MWS consists of two Ultrasonic Wind Sensors, a Wind Processor Unit (WPU), and several High End Displays (HED) and Low End Displays (LED). The system outputs relative wind speed and direction, true wind speed and direction (if receiving ships speed and heading information) and wind sensor status.

The two Ultrasonic Wind Sensors are solid state anemometers consisting of two orthogonally-mounted pairs of ultrasonic transducers. The transducers alternatively transmit and receive sound pulses and measure the time taken for the pulses to travel. The WPU automatically selects the best sensor, then calculates windspeed and direction.

The MWS feeds data into GEDMS via a 100BFX Ethernet interface for distribution to ships systems. GEDMS, using RS-422 interfaces, in turn sends the wind data to numerous flat panel High End Displays (HED) and Low End Displays (LED), traditional indicators, and NAVSSI. HEDs are located in the Helo Control Station, four in the Pilot House, and two in the CIC. Weather proof flat panel LEDs, are located on both Bridge Wings and Director and DER #1. LEDs and HEDs display all of the data available for the traditional indicators on three concurrent screens, including Relative/True Wind Speed and Direction, Ship's Speed, Course, Roll and Pitch. Each installation of MWS is certified by NAVAIR because it affects aircraft safety. LEDs and HEDs are Multi-Function Color Repeaters (MFCR).

4.1.3.21.4 Element Interfaces

Table 4.1-19 Interior Communications System Interfaces

Element	Interface Description	IDS
01 SPY/AEG	SPY interfaces with ICOM to provide alarms for Electronic Equipment Water Cooler or Air Removal Assembly equipment malfunctions.	NA (Warning Alarm)
02 C&D/SVS	The Integrated Voice Communications System interfaces with the Secure Voice System in Command and Decision to provide interior voice communication to the display consoles.	WS-35407
07 ORTS	ORTS has a pair of 10base-2 interfaces from DMS to the DTS-B Remote NO. 1 9-port 10base-2 switch for sharing of Integrated Survivability Management System (ISMS) Data.	NA (Mission Readiness Data)
09 SSRS/SPS-73	DMS provides synchro ownship's heading information to the Antenna Controller in the SPS-73 System. This data is used by the Antenna Controller for performing relative to true bearing conversion, and provided to SPS-73. Navigational digital data from the WSN-7 is also provided via DMS to the SPS-73 Signal Processor Cabinet.	NA (Nav Data)
10 IFF/UPX-29	The UPX-29 and the OE-120A Antenna Group of IFF both receive roll, pitch, and heading from Navigation System via DMS.	NA (Nav Data)
11 EWS/DLP	Wind speed and direction are provided to the DLP by the Moriah Wind System in ICOM via GEDMS (ICOM) to support decoy launch calculations.	NA (Moriah Wind Data)
11 EWS/SLQ-32	The Countermeasures Set AN/SLQ-32 interfaces with the Navigation System via DMS to receive ownship's heading, and speed, to receive wind speed and direction.	NA (Nav Data)
12 US&CS/SQQ-89	The SQQ-89 system receives NAV messages OD4, OD5, Wind (direction and speed), and Depth data via an NTDS-E connection to DMS.	NA (Nav Data)
12 US&CS/UQN-4A	The AN/UQN-4A Sonar Sounding Set (Depth Sounder) sends depth data via an RS-422 serial interface to DMS.	WS-33498
14 NAV/DHYSL	DMS receives ownship speed from the Digital Hybrid Speed Log rodmeter sensor for distribution to NAVSSI.	NA (Nav Data)
14 NAV/MORIAH-2	DMS provides navigation data from NAVSSI and Moriah to the Multifunction Color Repeaters, High End Displays, and Low End Displays within NAV.	NA (Nav Data)

Element	Interface Description	IDS
14 NAV/NAVSSI-1	For elements configured to receive NAV data from NAVSSI, Navigation data, real or simulated if in training, is received from NAVSSI for distribution via DMS to various combat system elements. Simulated Navigation is sent to NAVSSI from BFTT, of the Advanced Training Domain, via DMS for use in training exercises. Rodometer ownship speed is sent from DHYSL to NAVSSI via DMS.	NA (Nav Data)
14 NAV/NAVSSI-2	Wind speed and direction are sent to NAVSSI via DMS as received from Moriah.	NA (Moriah Wind Data)
14 NAV/RLGN-1	For elements configured to receive NAV data from WSN-7, Navigation data is received from WSN-7 for distribution via DMS to various combat system elements.	NA (Nav Data)
14 NAV/RLGN-2	System Fault—RLGN (FWD and AFT) system faults are transmitted via DMS of ICOM to the IC/SM alarm panel.	NA (FD/FI)
14 NAV/TACAN	The Tactical Air Navigation (TACAN) Beacon receives ownship heading from NAVSSI via DMS.	NA (Nav Data)
15 EXCOM	The Communication Control Group NMT receives heading (synchro data) from NAV via DMS for transmittal to the UHF Satellite Antenna Group antennas. Latitude and Longitude are provided to the NMT Electrical Equipment Cabinet, and Roll and Heading are received.	NA (Nav Data)
18 PWS	Own Ship Heading (OSH) is supplied from the Navigation System, via DMS, to each of the two Local Control Stations in PWS.	NA (Nav Data)
23 CSSE	Summary fault alarm signals are sent to the IC/SM system alarms whenever a faulty condition occurs in the Solid State Frequency Converter.	NA (FD/FI)
25 GWS/GMCS	The tone generator circuit in the 5" gun mount Control Panel (EP2) interfaces with the sound-powered telephone lines. The tone generator outputs a (640 Hz & 1,600 Hz) warble tone on the phone lines when a cease fire command is issued and a (1,600 Hz) continuous tone in response to a salvo warning command. The GCSC will order the gun mount to sound the correct tone for the period of time required.	NA (Warning Alarm)
26 CCSS/SRS-1	Roll, pitch, heading, and speed are transmitted via DMS to the SRS-1 Processor Group.	NA (Nav Data)

Element	Interface Description	IDS
28 CEC	(FOUO) The Black side of the Data Terminal Processor of CEC receives OD19 messages from the FWD and AFT RTS via DMS (part of 21 ICOM).	NA (Nav Data)
32 VLS	The VLS Local Status Panels interface with ship's damage control via DMS to provide alarm data on critical VLS functions to the IC/SM alarm panels.	NA (FD/FI)
34 ATD-1	The NAVSIM component of the Advanced Training Domain sends simulated ownship position and motion data via DMS to NAVSSI for use in training exercises. NAVSSI provides real pitch, heading, roll, latitude, and longitude data for use in maintaining ships reference.	NA (Nav Data)
34 ATD-2	The Secure Voice System interfaces with the Battle Force Tactical Training component of the Advanced Training Domain via IVCS to provide interior voice communication during training exercises.	NA (Voice)
39 ACI	ICOM receives the Battleshort Relay Closure from ACI	NA (Battleshort Relay Closure)
39 ACI/SPQ-15	The SPQ-15 DDS receives RS-422 NMEA-183 from the NAV via DMS. The NMEA-183 messages are used to convert relative bearing (received from the SPQ-9B ACP ARP) to true bearing, which is then distributed to the consoles. The NMEA-183 is also used to provide DDS with navigation data (OSH, OSS, and position data), which is then sent to the SPA- 25H.	NA (Nav Data)
91 SC&BS	ICOM interfaces with the IC/SM Status Panel of the Steering Control & Boat Systems to provide status from ACS elements, including NAV, VLS, and US&CS.	NA (FD/FI)
EXT/FPP	The SIWCS provides wireless communications (400MHz-500MH) between shipboard operators, and to external Force Protection personnel (380MHz-399.9MH) ashore and on other ships.	NA (Voice)

4.1.3.21.5 Design Approach/Rationale/Constraints

Changes are identified for Aegis BL10 due to SPY-6 integration.

SPY-6 integration requires METOC data to be calculated by the Moriah Wind System.

4.1.3.22 Logistics Support System (22)

4.1.3.22.1 Purpose
The Logistics Support System (LSS) provides storage, tools, and several devices to support the systems that in turn support the combat system. This equipment is generally classified as falling under the heading of Peculiar Support Equipment and as such does not interface with any of the active elements of the Combat System.

4.1.3.22.2 Requirements Satisfied
The LSS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.14.

4.1.3.22.3 Description
The logistics equipment as listed in the Ship Combat System Equipment List (CSEL) consists of storage cabinets, maintenance equipment, microfiche reader-printers, and a video display terminal for several elements of the Combat System.

The Logistics Support System is depicted in Figure 4.1-21.

Figure 4.1-21 22 LSS

4.1.3.22.4 Element Interfaces
No element interfaces exist.

4.1.3.22.5 Design Approach/Rationale/Constraints
No changes are identified for Aegis BL10. However, any changes determined to be needed during detailed design will be included in a future version of the SSDD.

4.1.3.23 Combat System Support Equipment (23)

4.1.3.23.1 Purpose
Combat System Support Equipment (CSSE) consists of equipment that supplies common support for the Combat System.

4.1.3.23.2 Requirements Satisfied
The CSSE Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.15.

4.1.3.23.3 Description
CSSE is represented by multiple subsystems to include:

- Solid State Frequency Converter
- Electronic Equipment Water Cooler
- Waveguide Switches & Test Set
- Cease Fire Alarm
- Salvo Alarm
- Vent Closure System
- Radar Alignment Verification Equipment
- Consolidated Afloat Networks and Enterprise Services
- C2 Data Dissemination and Transformation Service

The Combat System Support Equipment is depicted in Figure 4.1-22.

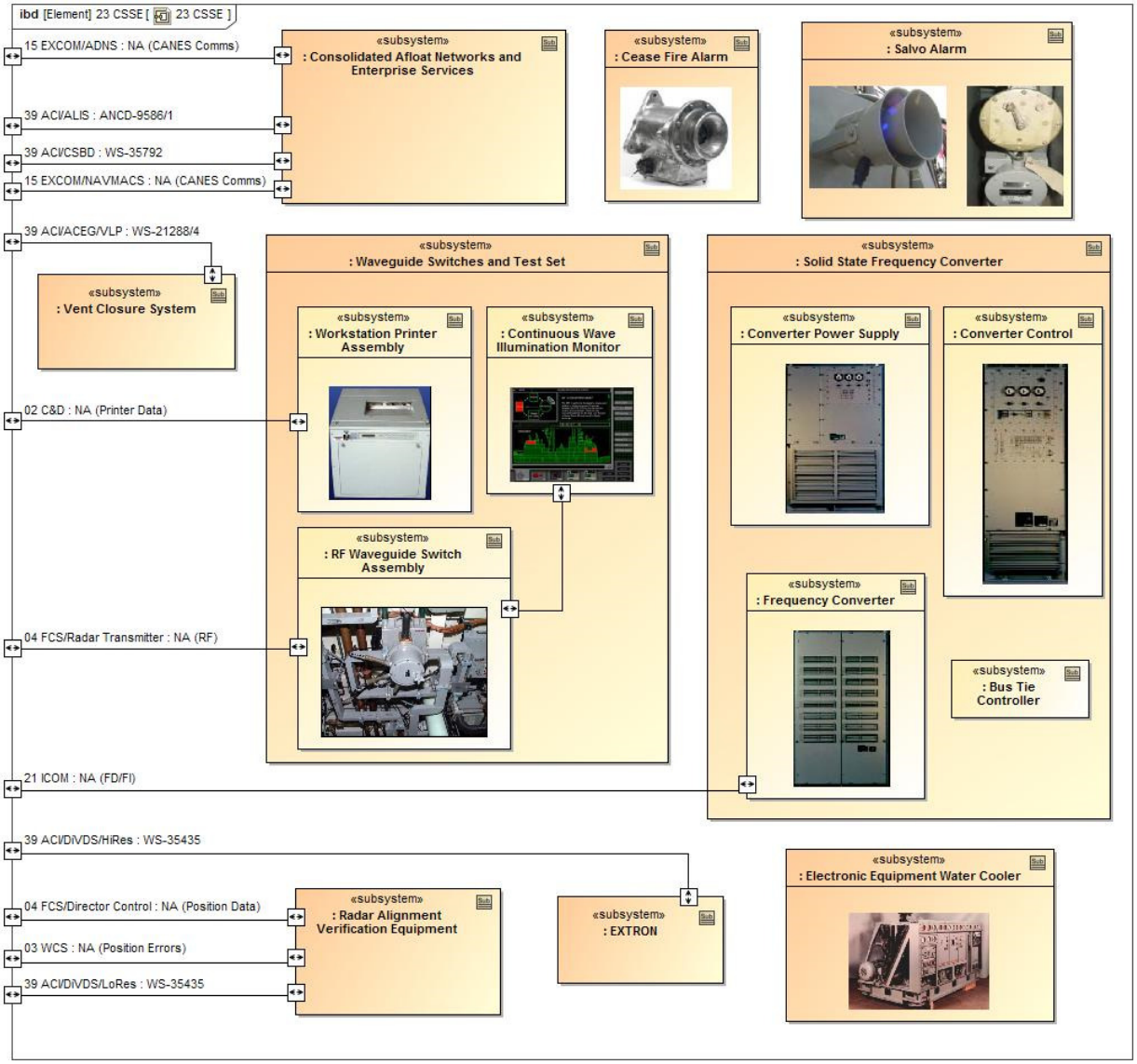

Figure 4.1-22 23 CSSE

4.1.3.23.3.1 Solid State Frequency Converter

The MK 84 Mod 1 Solid State Frequency Converter (SSFC) is an air-cooled, solid-state 400 Hz power supply capable of producing 410 KVA, three-phase, delta output regulated at 450 VAC from a 440 VAC, three-phase, 50-60 Hz input. It is designed for shipboard installations. The units that make up the SSFC are:

- Converter Power Supply
- Frequency Converter
- Converter Control
- Bus Tie Controller

These units provide conversion of the three-phase 60-Hz input into a three-phase 400-Hz output. First, the 60-Hz input is converted into DC and then the DC is inverted into a three-phase 400-Hz output. The SSFC is capable of being operated in parallel (with load sharing) and may be combined with other SSFCs to supply additional 400 Hz power when required.

In addition to the above listed units, Split Bus Controllers are included as a component of the SSFC. These controllers provide a means for automatic and manual reconfiguration of power supply sharing lines for split bus or common bus operation. Also, the controllers are able to isolate the 400 Hz power supply sharing lines for maintenance purposes.

4.1.3.23.3.1.1 Converter Power Supply

The Converter Power Supply converts the 440 VAC, three phase, 50-60 Hz input to a regulated DC voltage of 350 volts. Regulation is accomplished by controlling the phase angle gating to silicon controlled rectifiers in three-phase bridge rectifiers. The DC output is filtered by inductor-capacitor networks, meters, status indicators, and a mimic bus. Switches provide for selection of operate/standby mode, local power control, meter ranges, meter phase monitoring, and temperature monitoring.

4.1.3.23.3.1.2 Frequency Converter

The Frequency Converter unit inverts the DC voltage produced by the Converter Power Supply into a regulated 450 VAC, 400 Hz, three phase power as commanded by signals from the Converter Control unit. Voltage regulation is accomplished by vector summing of the outputs of two different sets of transformers and is controlled by gating signals from the Converter Control unit to maintain a constant voltage output. This unit has no front panel controls. The Converter Control unit performs all control.

4.1.3.23.3.1.3 Converter Control

The Converter Control unit contains the system operating controls and monitoring devices, and produces the gating signals that convert the high power DC voltage to a 400 Hz, three phase output, regulated at 450 VAC. When paralleling two or more SSFCs for load sharing, the voltage, current, and phase sensors are provided in order to match output of an off-line system to that of an on-line system prior to actually making the paralleling connections. Once the paralleling connections are established, the load is shared equally by the two or more power supplies that are in parallel.

4.1.3.23.3.1.4 Bus Tie Controller

The Bus Tie Controllers are included as a subsystem of the SSFC. These controllers provide a means for automatic and manual reconfiguration of power supply sharing lines for split bus or common bus operation. When in the automatic mode, and not manually bypassed, the bus is reconfigured into either split or common bus, depending on operator command from the ship's EPCC panel, without interruption of power on the respective buses. The controllers are able to isolate the 400Hz power supply sharing lines for maintenance purposes.

4.1.3.23.3.2 Electronic Equipment Water Cooler

The Electronic Equipment Water Coolers are palletized assemblies containing the following major subsystems:

- Heat Exchangers (2)
- Pump Assemblies (2)
- Expansion Tank
- Purity Loop
- System Flow Meter
- Temperature Control Valve
- Pump Control Panel
- Alarm Panel
- Instrument Panel

The water cooler is used to continuously cool, purify, filter, recirculate, and control temperature up to 210 gpm of demineralized water at 70 to 76 degrees Fahrenheit for up to 187 KW electronic equipment heat dissipation. One unit per ship provides the purified cooling water for various displays, EXCOM, FCS, and ACI cabinets (MCEs). Each unit is approximately 113 inches wide, 61 inches deep and 73 inches high. The cooler weighs 9658 pounds and is resiliently mounted for structure-borne noise isolation. A separate Sonar water cooler (Unit HD-1077/SSQ) provides cooling for the SQS-53C(V)1 Sonar and UWS equipment.

4.1.3.23.3.3 Waveguide Switches and Test Set

The units that make up the Waveguide Switches and Test Set include:

- RF Waveguide Switch Assembly
- Continuous Wave Illumination Monitor
- Workstation Printer Assembly

4.1.3.23.3.3.1 RF Waveguide Switch Assembly

The RF Waveguide Switch Assemblies permit RF energy from the FCS Transmitters (forward and aft) to be monitored by the Continuous Wave Illumination (CWI) monitors for noise characteristics to ascertain proper operation of FCS.

4.1.3.23.3.3.2 Continuous Wave Illumination Monitor

Two Mark 666 Mod 2 Continuous Wave Illumination (CWI) Monitors provide manual on-line monitoring of the CWI transmitter noise characteristics to ensure proper performance. The CWI monitors contain the equipment necessary to measure AM and FM noise spectrum over certain ranges of frequency. One monitor serves the forward CWI transmitter via a RF waveguide switch. The other monitor serves the two aft CWI transmitters via a RF Waveguide Switch.

4.1.3.23.3.3.3 Workstation Printer Assembly

The Workstation Printer Assemblies are ruggedized COTS Laser printers used for hard copy printouts of computer programs and data information. There are a total of three printers with one in each of the following locations: CSER1, CSER2, and CSER3. The RBC/NGPs are used as the operator control devices for the Combat System computers and send print data from the Combat System computers to the Workstation Printers.

4.1.3.23.3.4 Cease Fire Alarm

The Cease Fire System provides audible signal and notification utilizing ten strategically placed horns topside. This system is triggered by five (5) pushbutton stations located as follows:

- Pilot House
- Combat Information Center
- Two Starboard Officer of the Deck (OOD) duty stations
- A Port OOD duty Station

4.1.3.23.3.5 Salvo Alarm

The salvo alarms are manually activated by the TWS, AAW, or VLA console operators in conjunction with the normal launch procedure. The salvo alarm must be activated to alert ship personnel that an impending firing is to occur. The Gun Weapon System sends “out of battery” signal to C&D, and C&D in turn passes this on to WCS.

4.1.3.23.3.6 Vent Closure System

The Vent Closure System prevents the ship ventilation and air conditioning systems from ingesting toxic gases generated by gun and missile firings. It is activated automatically by all Gun Weapon System firings and all missile firings from VLS. Manual activation of the Vent Closure System is required in the event of Chemical, Biological, or Radiological (CBR) combat operations or drills. Once activated selected fresh air intakes remain closed for approximately two minutes after each initiation.

4.1.3.23.3.7 Radar Alignment Verification Equipment

The Radar Alignment Verification Equipment (RAVE) provides the equipment to support Combat System collimation and battery alignment and provides means at-sea to check alignment of the FCS Directors Mark 82 with the position data provided by SPY Radar.

The radar alignment verification equipment consists of a TV Camera and mounting base that can be installed on any FCS director, a TV control unit, a TV monitor, and a portable microprocessor assembly. When the TV Camera universal tracking combination and mounting base are installed on the director, they are mounted on the camera platform and plug connections made to the currently existing TV camera

connectors. There are two TV camera units that may be shared by the directors.

A portable test set is provided which consists of a Remote Control Unit and a TV Tracker Microprocessor. The director cables are connected to the TV Control Unit during test to provide the means to select and control the camera/lens assembly mounted on the selected director, and when not in use, the cables can be stored in the terminal box. The Video Monitor connects to the TV Control Unit and displays the video from the selected camera.

For at-sea alignment verification, a target is tracked by SPY and a FCS director assigned for illumination. On the TV monitor, the TV reticle is observed relative to the target. The reticle is the same as the illuminator beam. If the target falls within the reticle, the target could be illuminated by the director. A FCS computer program provides a means of using a TV Tracker with the TV camera.

4.1.3.23.3.8 Consolidated Afloat Networks and Enterprise Services

The Consolidated Afloat Networks and Enterprise Services (CANES), also known as AN/USQ-208(V), is a high-speed information network that provides communications to shipboard personnel via Local Area Networks (LANs) and direct interfaces with other systems and external communication channels. The system consists of a fiber-optic connected backbone of high-speed switches that inter-connect a number of shipboard LANs. CANES hosts the Navy Tactical Command Support System (NTCSS), which provide users with tactical and support information. CANES hosts the Global Command and Control System-Maritime (MTC2) and provides a Data Base Manager (DBM) rack, located in CIC, that houses the three MTC2 workstations (DBM, TAO, and Alternate DBM) which are used for client services and system administration of the MTC2 network. The DBM workstation works with a corresponding keyboard, mouse, and flat-panel display. The Alternate DBM and TAO workstations are used with a virtual terminal (via VNC®) on ADS consoles. The DBM rack provides MTC2 video from the TAO workstation to the Digital integrated Video Distribution System (DiVDS) for display on the ADS consoles and allocated Flat Panel Displays. CANES provides off-ship communications by interfacing with the Automated Digital Network System (ADNS). The CANES system includes Unclassified, SECRET, SECRET Releasable and Special Compartmented Information (SCI) network security enclaves.
The CANES SECRET network security enclave provides the physical interfaces between MTC2 interface and other Aegis Combat System elements. It also provides redundant data centers and backbone switches in support of the MTC2 system mission assurance requirements.

The CANES SECRET network security enclave provides the physical interfaces between MTC2 interface and other Aegis Combat System elements. It also provides redundant data centers and backbone switches in support of the MTC2 system mission assurance requirements.

The C2 DDTS provides various capabilities that are driven by the data flows passing from the Combat System Secured Domain to another enclave. The C2 DDTS provides the ability to perform data filtering and decimation based on a pre-defined rule set as well as data translation from one model format to another. A secure file server is also present within CSSE to support bulk data transfers in support of the CS BDTS.

4.1.3.23.3.9 EXTRON

EXTRON is a PC (Laptop) that provides analog video data to DiVDS.

4.1.3.23.4 Element Interfaces

Table 4.1-20 Combat System Support Equipment Interfaces

Element	Interface Description	IDS
02 C&D	The CSSE printers provide hardcopy data of the C&D computer program data reduction.	NA (Printer Data)

Element	Interface Description	IDS
03 WCS	The WCS IOP No. 1 interfaces with the TV control unit of the RAVE for verification of selected director position errors.	NA (Position Errors)
04 FCS/Director Control	The FCS Mark 82 Director interfaces with the TV Control Unit of the RAVE Kit to provide means of checking FCS Director alignment with respect to position data.	NA (Position Data)
04 FCS/Radar Transmitter	The FCS Radar Transmitters interface with the CSSE CWI Monitors via a Waveguide Switch Assembly to receive RF samples of X Band CWI transmitter energy for purposes of AM/FM noise measurements.	NA (RF)
15 EXCOM/ADNS	The ADNS provides a multimedia data delivery service of Tactical/ Administrative/Intelligence information to/from all data user resources (Navy, Allied and Joint) via Slice Radio and ITP. ADNS comprises three functional elements: Integrated Network Management (INM), Routing and Switching (R&S), and Channel Access Protocols (CAPs). In the initial build multiple security levels from unclassified to Top Secret SCI will be enforced by cryptographic separation using the COTS Network Encryption System (NES). In successive ADNS builds the NES will be replaced by the Embedded INFOSEC Product (EIP). Users may also interface directly to ADNS via Multiple Level Secure (MLS) LANs or embedded MLS products.	NA (CANES Comms)
15 EXCOM/NAVMACS	This interface provides access to NAVMACS data from connections on CANES. NAVMACS provides for the processing of tactical messages and distribution through CANES.	NA (CANES Comms)
21 ICOM	Summary fault alarm signals are sent to the IC system alarms whenever a faulty condition occurs in the Solid State Frequency Converter.	NA (FD/FI)
39 ACI/ACEG/VLP	WCS interfaces with the Vent Closure Panels via the Vertical Launch Processor (VLP) to control the ship's intake vents to prevent the ingestion of toxic gases from missile and gun firings.	WS-21288/4
39 ACI/ALIS	Interface between CSSE and ALIS.	ANCD-9586/1

Element	Interface Description	IDS
39 ACI/CSBD	The C2 DDTS within CSSE interfaces with the ACI CS DDTS to facilitate secured data exchanges from the Combat System Secured Domain to external systems. The Bulk Data Transfer Services (BDTS) will interface with CSSE CANES/ISNS to push or pull data files into the Combat System Secured Domain.	WS-35792
39 ACI/DiVDS/HiRes	EXTRON laptop sends analog PC video to DiVDS.	WS-35435
39 ACI/DiVDS/LoRes	RAVE camera is used to verify FCS illuminator alignment and sends analog camera video feeds.	WS-35435

4.1.3.23.5 Design Approach/Rationale/Constraints

Changes to CSSE have been identified for Aegis Bl10 due to cybersecurity.

CSSE has cybersecurity implications based on interactions with ACI for bulk data transfer.

4.1.3.24 Towed Sonar System (24)

4.1.3.24.1 Purpose
The Towed Sonar System (TSS) is an array of sensors streamed and towed from the stern of the ship and shipboard equipment to receive and process underwater acoustic signals that support detection, bearing estimation, and classification of ASW Targets.

4.1.3.24.2 Requirements Satisfied
The TSS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.16.

4.1.3.24.3 Description
The TSS includes the Multi-Function Towed Array (MFTA/TB-37), MFTA Tow Cable, OK-410 Handling and Stowage Group (H&SG), and the Towed Array Power Supply (TAPS).

The Towed Sonar System is depicted in Figure 4.1-23.

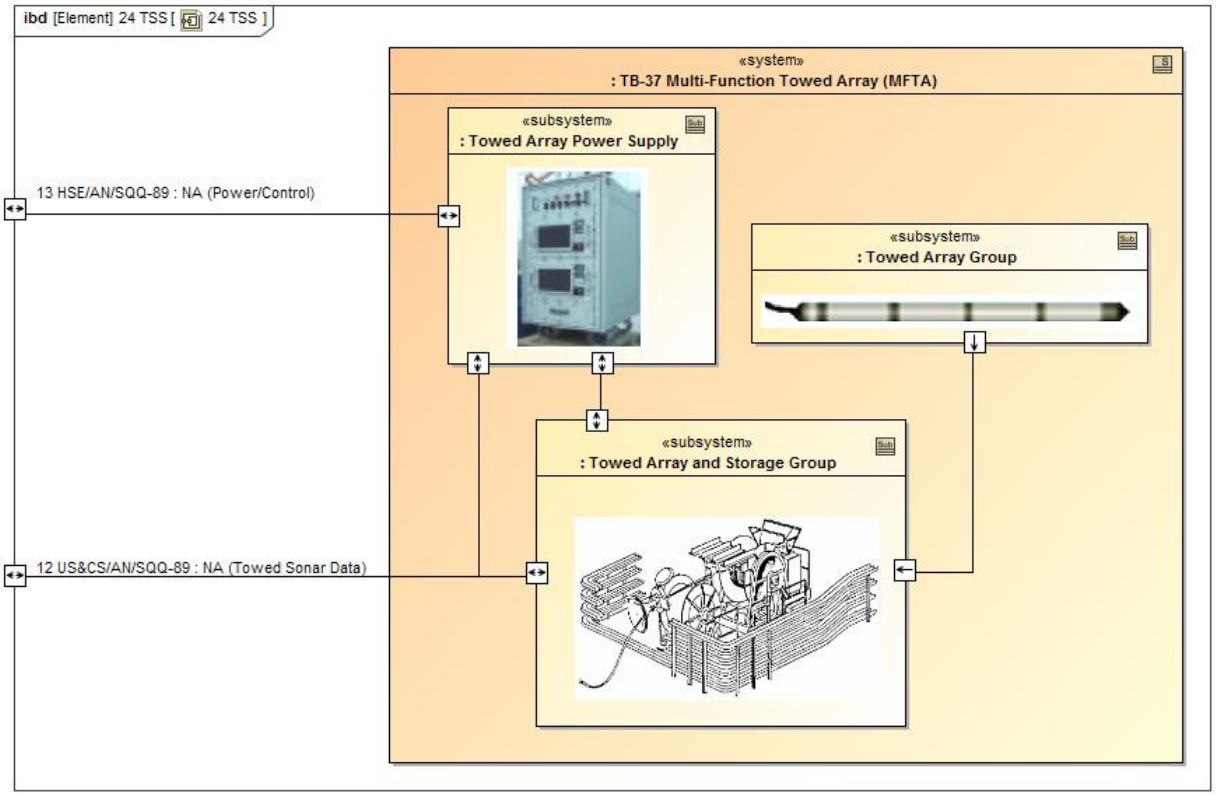

Figure 4.1-23 24 TSS

4.1.3.24.3.1 AN/SQR-20 Multifunction Towed Array

The Multifunction Towed Array (MFTA), TB-37, replaced the legacy TSS often referred to as the AN/SQR-19 Tactical Towed Array Sonar (TACTAS). The MFTA is a 610 ft long, 3.35 inch diameter array that is towed behindDDG-51 Arleigh Burke and CG-47 Ticonderoga Class ships. The MFTA offers several enhancements compared to the previous towed array systems enabling greater coverage and increased capability and reliability. It contributes to the capability of surface ships to detect, localize and prosecute undersea threats, and is a critical sensor for the ship's combat systems suite. It also provides an active bi-static receive capability when utilized with the ship's AN/SQS-53C bow sonar as well as an acoustic intercept capability.

4.1.3.24.3.1.1 Towed Array Group

The Towed Array Group receives acoustic and non-acoustic data from the array and supplies power and commands to the array. The Towed Body and the Towing Assembly cable makeup the Towed Array Group.

4.1.3.24.3.1.2 Towed Array and Storage Group

The Towed Array and Storage Group, OK-410(V)4, contains multiple units to include a Level Wind Assembly, Power Distribution Panel Assembly, Maintenance Kit, Overboarding Fairlead Assembly, Control Console, and a Winch Assembly. The Level Wind Assembly consists of a carriage and drive which provides layering of the tow cable and array onto the drum during retrieval. The Power Distribution Panel (PDP) controls application of power to the system. The Maintenance Kit is a lockable, watertight container holding special tools for the towed array. The Overboarding Fairlead provides a cable path through the ship's transom.The Control Consoleprovides all control for deploying, towing and retrieving the tow cable and array. The Winch Assembly provides tow point, stow, deploy, and retrieve functions for the tow cable and array.

4.1.3.24.3.1.3 Towed Array Power Supply

The Towed Array Power Supply (TAPS) receives MTFA status and communicates this data to the AN/SQQ-89A(V)15 processors. TAPS has a fiber optic control and status interface and sends analog MFTA sensor data to the Underwater Surveillance and Communications System (US&CS) transmitter I/O processor.

4.1.3.24.4 Element Interfaces

Table 4.1-21 Towed Sonar System Interfaces

Element	Interface Description	IDS
12 US&CS/AN/SQQ-89	The US&CS (AN/SQQ-89A(V)15) transmitter I/O processor has a fiber optic interface with the MFTA Winch assembly. US&CS also has a fiber optic control and status interface and receives analog MFTA sensor data from TAPS.	NA (Towed Sonar Data)
13 HSE/AN/SQQ-89	The Shipboard Equipment Rack (Unit 871) has a power and control interface with TAPS. Equipment Rack (Unit 871) functionally supports AN/SQQ-89A(V) but is allocated as a HSE (Element 13) piece of equipment. TAPS is interfacing with AN/SQQ-89 but the equipment rack is allocated to HSE.	NA (Power/Control)

4.1.3.24.5 Design Approach/Rationale/Constraints

The TSS Element is derived from the BL9 TSS element. No changes are identified in Aegis BL10.

4.1.3.25 Gun Weapon System (25)

4.1.3.25.1 Purpose

The Gun Weapon System (GWS) is a manned weapon system that supports primary ship missions in Surface Warfare System (SUW), Anti-Air Warfare (AAW), Naval Surface Fire Support (NSFS), Anti-Terrorism Force Protection (ATFP), and Missions Other Than War/Maritime Interdiction Operations (MOOTW/MIO).

4.1.3.25.2 Requirements Satisfied

The GWS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.17.

4.1.3.25.3 Description

The GWS is comprised of the MK 34 GWS . The MK 34 GWS is not integrated into the AEGIS Weapon System (AWS), but is an interfaced element of the AEGIS Combat System (ACS).

The Gun Weapon System is depicted in Figure 4.1-24.

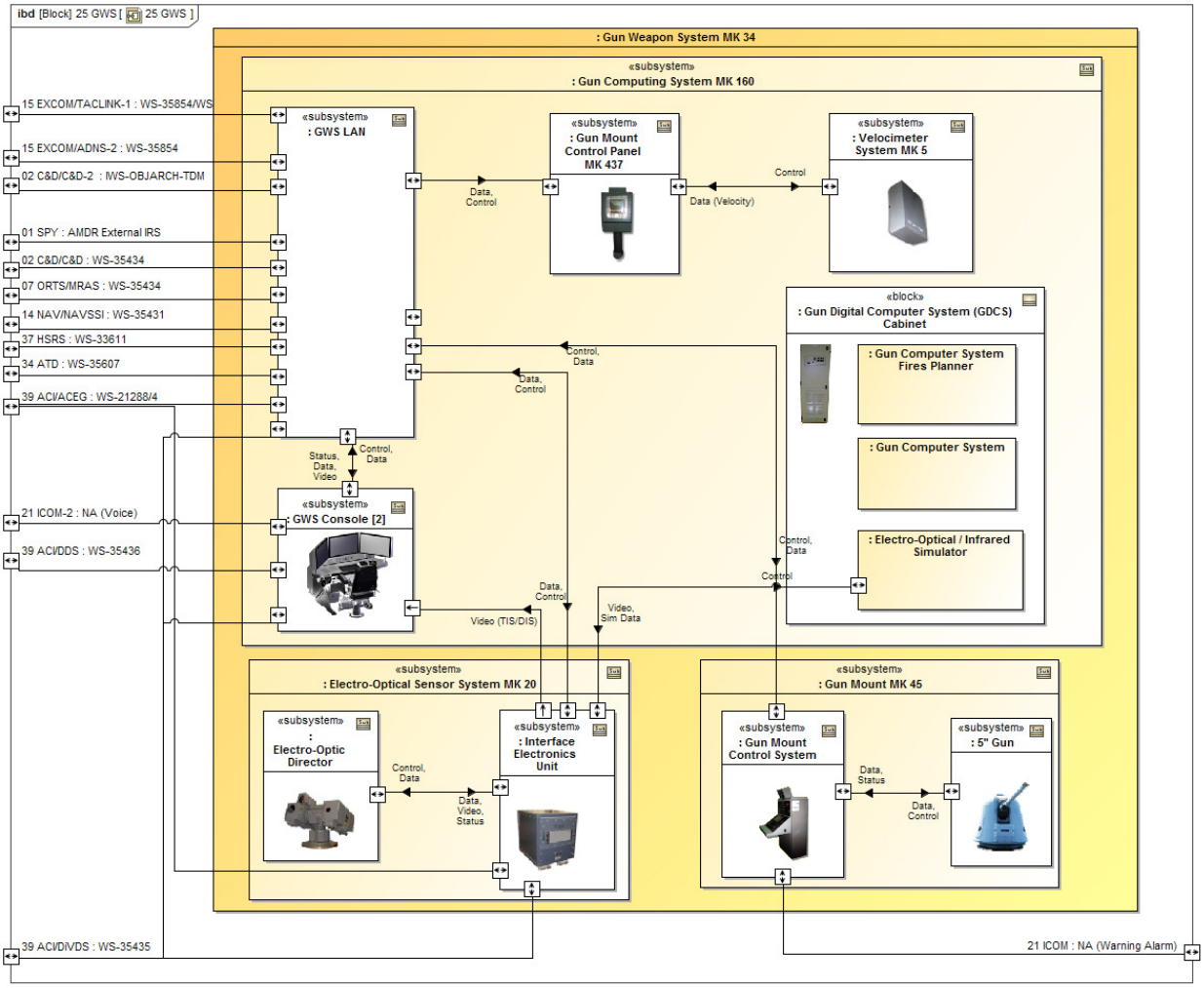

Figure 4.1-24 25 GWS

4.1.3.25.3.1 Gun Weapon System MK 34

The MK 34 GWS is a manned equipment complex that performs ASuW, AAW, and NSFS operational requirements.

The GWS accepts engagement orders, and doctrine from Command and Decision (C&D) and target data from shipboard sensors and off-board spotters. The GWS performs ballistic computations, provides smooth and updated orders to the gun mount, and delivers conventional munitions to the target. The GWS is also capable of performing self-testing, readiness assessment, and can support training as well as operate independently and conduct optically directed fires in the event of a combat system casualty.

4.1.3.25.3.1.1 Gun Computing System MK 160

The Gun Computer System (GCS) MK 160 consists of the following subsystems: GWS LAN; Gun Digital Computer System (GDCS) Cabinet; GWS Console; Gun Mount Control Panel (GMCP); and Velocimeter

4.1.3.25.3.1.1.1 Gun Digital Computer System (GDCS) Cabinet

The Gun Digital Computer System (GDCS) Cabinet is equipped with two independent processing enclosures that contain the processors, interfaces and network devices that support operations previously handled by AN/UYK-44 dedicated computers or specially designed VMD enclosures..

4.1.3.25.3.1.1.2 Gun Computer System

The processing within the GDCS run the operational program that supports the control and display of track engagement information between the GWS operator consoles and the combat system. The display of C&D track information, sensor data from SPY, Electro-Optical Sensor System (EOSS), Horizon Search Radar System (HSRS), and gun status and information is exchanged and processed by the GDCS cabinetIn addition, the operational program computes ballistic parameters based on targeting, track and environmental information and muzzle velocity data from the MK 5 Velocimeter via the MK 281 Electrical Control Panel-2 (EP2). Each independent processing enclosure within the GDCS accepts ownship attitude and Precision Time Protocol signals from the ACEGs. The GDCS provides stabilized pointing and fuzing orders to the gun and controls the function of the gun mount via the gun's Mk 281 EP-2. The MK 45 Mod 4 gun is controlled through a direct digital interface to the EP-2.

4.1.3.25.3.1.1.2.1 Electro-Optical / Infrared Simulator

The EO/IR Simulator interfaces with ATD via the Training LAN. The EO/IR simulator will provide status and data recording information to ATD. The EO/IR Simulator within GWS provides the Interface Electronics Unit of the EOSS MK20 system with simulated EO/IR video. The EO/IR Simulator generates video based on the simulated navigation and synthetic track data received from ATD over the Training LAN. The EO/IR Simulator also responds to control commands inputed by the operator or by GWS.

4.1.3.25.3.1.1.2.2 Gun Computer System Fires Planner

Starting with DDG-119 the Naval Fires Control System (NFCS) is integrated with GWS by rehosting NFCS onto computing resources provided by GWS and moving the TACLINK to the Radio Room. The NFCS program is known as the Gun Computer System Fires Planner. The NFCS computer program consists of the Fires Control Mission Planning System function and the Track Management function. The Fires Control Mission Planning System performs the mission planning function and communicates with the tactical links. The Track Management function, previously performed in the adjunct processor, receives friendly and enemy unit locations transmitted from the MTC2 and ensures that naval gunfire does not conflict with or endanger friendly forces on the sea, in the air, or on the ground.

4.1.3.25.3.1.1.3 GWS Console

The GWS Tactical Consoles are provided by PEO IWS 3 and give operators control and support of 5" Gun, AN/SPQ-9B control and target tracking and EOSS operations in various gun engagement scenarios. Destroyers are equipped with two GWS consoles.One console provides the Gun Fire Control Supervisor (GFCS) control and support of GWS engagements, typically target assignment in various combat system scenarios. The other console is for the Gun Engagement Console Operator (GECO) operation of their gun system including gun parameter selection, ammunition selection, target tracking, and gun firing sequences. A single GWS Console can perform both the GFCS and GECO roles as required, however only one GWS Console can be designated the GWS Supervisor at any time. One GWS Console can

control one EOSS and/or the gun mount. The GWS supervisor and GECO(s) have the capability to view the SPQ-9B video via direct DDS interface. EOSS TIS and DIS video is provided via a direct IEU to GWS console interface for optical target tracking, target verification and safety monitoring.

4.1.3.25.3.1.1.4 Gun Mount Control Panel MK 437

The Gun Mount Control Panel (GMCP) MK 437 provides operator interactions with the GDCS and the gun mount. The GMCP consists of a touch-screen interactive display panel and interfaces to the MK 45 Gun Mount through the GDCS to allow the local Gun Mount Operator to monitor the status and operation of the gun mount. In the event of a loss of operator control via the GWS operator consoles, the GMCP together with the GDCS can conduct gun engagements using gun orders calculated by the GDCS.

4.1.3.25.3.1.1.5 Velocimeter System MK 5

The Velocimeter MK 5 provides a measurement of the muzzle velocity of fired projectiles used to optimize ballistic computations. One Velocimeter antenna unit is mounted on the non-recoil portion of each gun barrel assembly, and emits RF signals along the projectile trajectory. A small part of this transmitted signal is reflected from the projectile and is received by the receiving antenna. The frequency of the transmitted signal is then compared with the frequency of the received signal and the difference existing between them is a low frequency Doppler signal, which is proportional to the velocity of the projectile. The Velocimeter interfaces to the GMCP and in turn to the GDCS.

4.1.3.25.3.1.1.6 GWS LAN

The GWS LAN enables development of modular systems conformed to Navy Open Architecture with highest level of common hardware, software, and functionality to support multiple GWS configurations. The GWS LAN also supports operation of the MK 34 GWS independent of AWS operation or casualty.

4.1.3.25.3.1.2 Gun Mount MK 45

The MK 45 Gun Mount stores, loads, aims, and fires 5-inch projectiles in response to GCS commands. The Gun Mount subsystems include the Gun Mount Control System and the 5-inch Gun. Destroyers are equipped with one (1) MK 45 Mod 4 Gun Mount located Forward.

4.1.3.25.3.1.2.1 Gun Mount Control System

The Mark 31 Gun Mount Control System consists of Power Panel (EP1), Control Panel (EP2), microprocessor control circuits, and position sensors (proximity and optical switches) that activate, control, monitor, and test operations of the gun mount.

- The Power Panel (EP1) distributes electrical power to the gun mount. Components of EP1 include circuit breakers, contactors, overload relays, manual switches, power supplies, batteries, indicating lights, transformers, and fuses. This power panel contains the electrical power distribution and power-converting components of the gun mount control system.
- The Control Panel (EP2) is the operation control unit for the gun mount. Components of EP2 include various switches and displays to control the gun mount. The EP2 contains the Lower Loading Station Display Panel (EP3), Elevation Digital Display Assembly (EP4), and Train Digital Display Assembly (EP5).
- The Train Digital Display Assembly (EP5) displays train position, train primary and secondary resolver positions, train stroke resolver position, status of stroke on neutral switch, and train stroke command.
- The Lower Loading Station Display Panel (EP3) is the loading control unit for the lower hoist. Components of EP3 include lights which indicate order to load (or offload) and cease load specific projectile / fuse type and case type. It also has an ORDER CHANGE ACKNOWLEDGE pushbutton. The ammunition handlers will acknowledge every change in the load orders.

4.1.3.25.3.1.2.2 5" Gun

Destroyers are equipped with one MK 45, Mod 4, 5-inch 62-caliber gun, located Forward.

4.1.3.25.3.1.3 Electro-Optical Sensor System MK 20

The Electro-Optical Sensor System (EOSS) MK 20 provides line of sight visual, thermal imaging, and laser range finding (LRF) in support of ASuW, NSFS, safety check sight, spotting and kill assessment, target identification, and target tracking. Destroyers are equipped with one EOSS located Forward. The EOSS consists of the Electro-Optical Director (EOD) and an Interface Electronics Unit (IEU) subsystem.

The Interface Electronics Unit will interface with the EO/IR Simulator component of GWS when the simulator is being used for training purposes.

4.1.3.25.3.1.3.1 Electro-Optic Director

The Electro-Optical Director is an Above Deck Sensor Unit (ADSU) comprised of a two-axis (elevation over azimuth) gyro stabilized director, a Daylight Imaging Sensor (DIS) assembly, a Thermal Imaging Sensor (TIS) Assembly, and an Eye-Safe Laser Range Finder (ELRF).

4.1.3.25.3.1.3.2 Interface Electronics Unit

The IEU generates stabilization data and translates positioning commands from the operator via the Gun Console. The IEU also supplies environmental support to the EOD for heaters, wipers and washer systems. The IEU receives ownship attitude and time data using Precision Time Protocol (PTP) via ALIS. The IEU provides EOSS video to DiVDS and directly to the Gun Consoles via the Common Electronic Module.

4.1.3.25.4 Element Interfaces

Table 4.1-22 Gun Weapon System Interfaces

Element	Interface Description	IDS
01 SPY	SPY provides the following functions to support the GWS gunnery functions: detection, acquisition and tracking of air and surface targets, own-ship gun projectile acquisition and tracking. SPY sends the following data to GWS via ALIS including tactical status data and target and projectile track data.GWS provides splash data to SPY for splash avoidance.	AMDR External IRS
02 C&D	C&D sends the following data to GCS including program initialization data, tactical status data, C&D track data, engagement orders, GWS doctrine, track number reassignment, element heartbeat via ALIS. GCS alerts C&D that the gun firing command has been sent, or that gun is out of battery, or that a misfire has occurred. The out of battery triggers the C&D message to WCS to support vent closure requirements.C&D coordinates radar tasking for GWS.	WS-35434
02 C&D/C&D-2	GWS receives track inputs from STM/TS for background track data for shore bombardment and deconfliction.	IWS-OBJARCH-TDM
07 ORTS/MRAS	The ORTS performs AEGIS Weapon System (AWS) on-line testing and evaluation. The GWS provides the Gun Computer System status to ORTS via ALIS.	WS-35434
14 NAV/NAVSSI	The FWD and AFT Real Time Sub-systems (OL-653(V)X/SSN-6) of NAVSSI using IP multicast provide GCS the own-ship's position, and other navigation data via ALIS. NAVSSI inputs to the GWS are: • Ownship position in latitude and longitude, velocity vectors north and east, ownship speed over ground from GPS • Ownship speed through water from Digital Hybrid Speed Log (KHYSL) • Ships inertial velocity north and east, ship's dead reckoned position, and calculated ocean current from the AN/WSN-7 Ring Laser Gyro Navigator (RLGN).	WS-35431
15 EXCOM/TACLINK-1	The GWS exchanges mission planning data with offboard AFATDS/TLDHS/PFED systems to support shore bombardment. Systems provide target and observer updates, ammo inventory and fire unit's status, HF Radio (voice) and/or UHF SATCOM.	WS-35854/WS-35814

Element	Interface Description	IDS
15 EXCOM/ADNS-2	The GWS exchanges mission planning data with offboard AFATDS system (thru CANES) to support shore bombardment. Systems provide target and observer updates, ammo inventory and fire unit's status, HF Radio (voice) and/or UHF SATCOM.	WS-35854
21 ICOM-1	The tone generator circuit in the 5" gun mount Control Panel (EP2) interfaces with the sound-powered telephone lines. The tone generator outputs a (640 Hz & 1,600 Hz) warble tone on the phone lines when a cease fire command is issued and a (1,600 Hz) continuous tone in response to a salvo warning command. The GDCS will order the gun mount to sound the correct tone for the period of time required.	NA (Warning Alarm)
21 ICOM-2	The Virtual Console Multi-channel terminal (VCMT) next to the GWS Consoles interface with the Secure Voice System for voice communications.	NA (Voice)
34 ATD	The EO/IR Simulator interfaces with ATD via the Training LAN. The EO/IR Sim will provide simulated EOSS video based on the synthetic track data and navigation data received from ATD.	WS-35607
37 HSRS/SPQ-9B-1	For SPQ-9B Equipped Ships, the AN/SPQ-9B radar assists the multipurpose SPY-6 radar in horizon search operations on SPQ-9B equipped ships. The interface provides the track data to Gun Computing System Cabinet (GCSC) via ALIS.	WS-33611
39 ACI/ACEG	The GCSC(s) receives system time using the Precision Time Protocol via ALIS. The GWS receives redundant ownship's attitude data (heading, roll and pitch) via ALIS from both the forward and aft GDP.	WS-21288/4
39 ACI/ASAN	The Advanced Storage Area Network (ASAN) provides data storage to the GWS through the ALIS. The ASAN can be used by the GWS for storage space for GWS Data Extraction files. The interface shall be through the ALIS using the Ethernet interface type and made available to the GWS as if the ASAN were an additional local hard drive.	
39 ACI/DDS	The GWS Console receives a direct AN/SPQ-9B radar video feed via the AN/SPQ-15(V) Data Distribution System (DDS). The DDS provides various radar videos to gun consoles GFC via the CEM which is part of the Data Display Group.	WS-35436

Element	Interface Description	IDS
39 ACI/DiVDS	The MK 34 GWS EOSS DIS and TIS video is provided to ALIS via the Distributed Video System (DiVDS). DiVDS receives the Command Summary Display video from the Gun Computer System Fires Planner.	WS-35435

4.1.3.25.5 Design Approach/Rationale/Constraints

Changes have been identified to GWS due to the Mk 160 upgrades.

4.1.3.26 Cryptologic Combat Support System (26)

4.1.3.26.1 Purpose

The Cryptologic Combat Support System (CCSS) monitors the major communications bands in order to provide near real time information especially in littoral environments. It is a highly automated, minimally manned, and versatile Electronic Support Measures (ESM) System that provides signal acquisition and Direction Finding (DF) capabilities for Naval Combatants. Cryptologic Combat Support System can be operated either in a standalone mode or in conjunction with other fixed and mobile platforms with similar capabilities, via secure communications, to support naval operations.

4.1.3.26.2 Requirements Satisfied

The CCSS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.18.

4.1.3.26.3 Description

The CCSS is comprised of the Ships Signal Exploitation Equipment Increment F (SSEE-F) system. The CCSS is depicted in Figure 4.1-25.

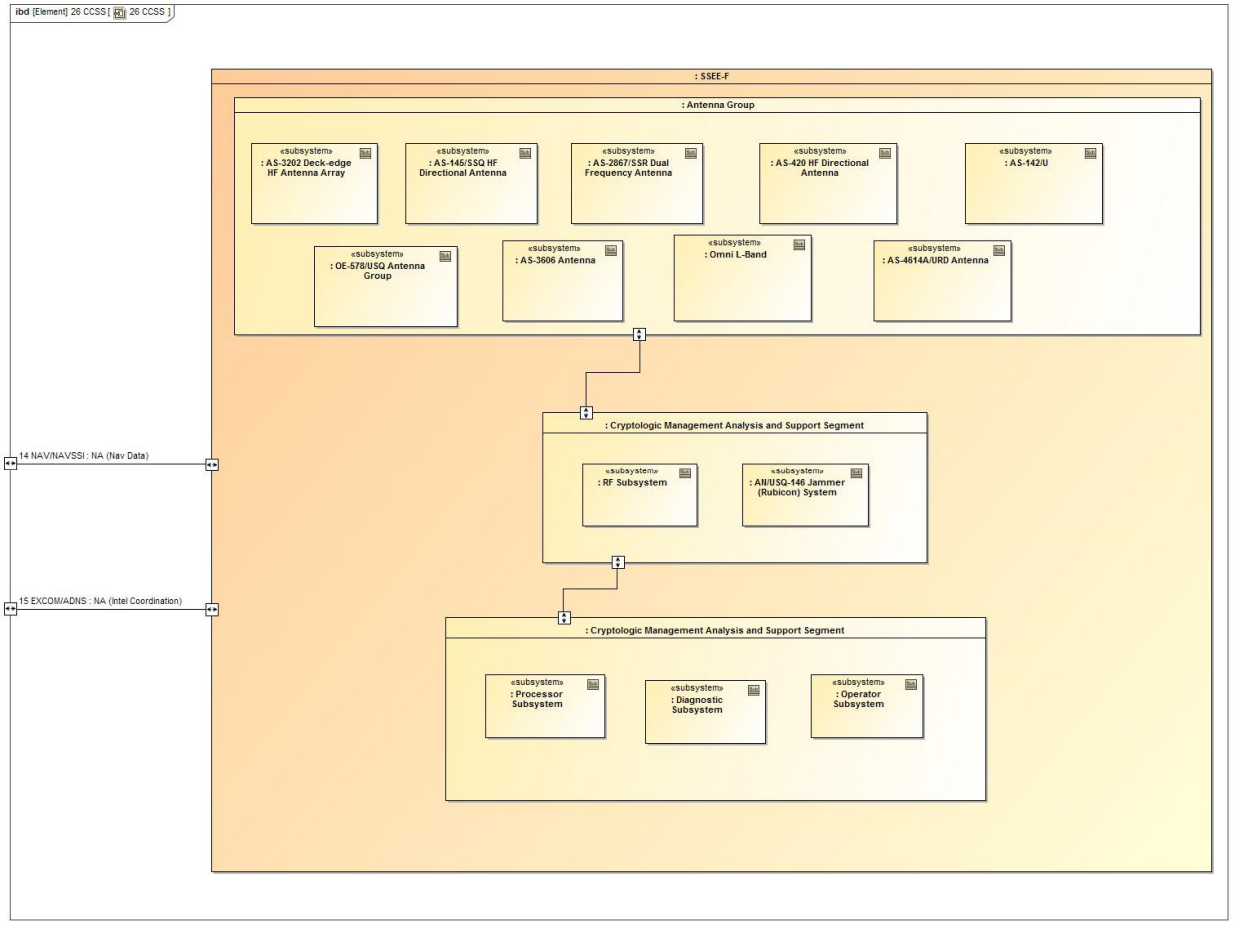

Figure 4.1-25 26 CCSS

4.1.3.26.3.1 SSEE-F

SSEE-F can perform cryptologic mission management, signal/intercept analysis, RF distribution, HF/VHF/UHF signal detection, HF/VHF/UHF direction finding, manual or automatic receiver control, audio distribution and recording. The functional groups composing the SSEE-F are the Antenna Group,

Cryptologic Electronic Support Segment and the Cryptologic Management Analysis and Support Segment (CMASS).

4.1.3.26.3.1.1 Antenna Group
The SSEE-F contains a variety of antennas which are utilized for signal/intercept, signal detection, and direction finding.

4.1.3.26.3.1.1.1 AS-3202 Deck-edge HF Antenna Array
There are two HF Direction Finding deck-edge antenna arrays; FWD and AFT. Each consists of eight AS-3202/SRD-19 Antennas, eight J-3464/SRD-19 Interconnection Boxes, and a Distribution Box J-4944/SRS-1(V). This array provides unidirectional reception of signals for 360 degrees of coverage.

4.1.3.26.3.1.1.2 AS-145/SSQ HF Directional Antenna
The AS-145/SSQ is a single band omnidirectional antenna covering frequency bands from 30-150MHz. Six are being used with this system.

4.1.3.26.3.1.1.3 AS-2867/SSR Dual Frequency Antenna
The AS-2867/SSR is a dual-band, VHF/UHF, omnidirectional antenna covering frequency bands from 30 to 150MHz and 150 to 1000MHz.

4.1.3.26.3.1.1.4 AS-420 HF Directional Antenna
The AS-420 is a low profile dual-band, VHF/UHF, omnidirectional antenna.

4.1.3.26.3.1.1.5 AS-142/U
The AS-142/U is an HF monopole omni-directional antenna.

4.1.3.26.3.1.1.6 OE-578/USQ Antenna Group
The OE-578/USQ consists of two broadband, directional, shipboard antennas. The OE-578 antenna system provides transmit and receive capability.

4.1.3.26.3.1.1.7 AS-3606 Antenna
The AS-3606 is an active omni-directional antenna covering the frequency band 0.5-32MHz. The base mount contains the active RF amplifier.

4.1.3.26.3.1.1.8 Omni L-Band
The Omni antenna is a low profile dual band, VHF/UHF, omni-directional antenna.

4.1.3.26.3.1.1.9 AS-4614A/URD Antenna
The AS-4614A/URD is a taper slot array antenna. This is a VHF/UHF two-tier receive antenna located on the mast to provide an unobstructed 360 degrees of coverage.

4.1.3.26.3.1.2 Cryptologic Electronic Support Equipment
The Cryptologic Electronic Support Segment consists of the RF Subsystem and the AN/USQ-146 Jammer (Rubicon) System.

4.1.3.26.3.1.2.1 RF Subsystem
The RF subsystem contains the hardware responsible for receiving and directing RF in the system. It contains the RF patch panel, RF distribution units, tuners, receivers and notch filters.

4.1.3.26.3.1.2.2 AN/USQ-146 Jammer (Rubicon) System
The AN/USQ-146 jammer is a spot and react communications jammer. The AN/USQ-146 provides single focus manual jamming which focuses all of the output power toward a single target. In the reactive mode the AN/USQ-146 automatically detects and jams on preselected thresholds. Increasing the number of receivers, exciters and power amplifiers allows for multiple target jamming. It can also detect, track and jam frequency hopping systems.

4.1.3.26.3.1.3 Cryptologic Management Analysis and Support Segment

CMASS consists of the Processor Subsystem, the Diagnostic Subsystem and the Operator Subsystem.

4.1.3.26.3.1.3.1 Processor Subsystem

The processor subsystem contains the hardware that processes the energy coming in through the RF subsystem. It contains the HF, VHF and UHF processing units. The CMASS servers utilize common database formats, analytical tools and operator interfaces. CMASS application software has been developed to automatically extract intelligence from sensor data, to automate alerts, to perform an immediate analysis on the data and to generate reports, freeing operators and analyst to concentrate on situational events. CMASS users are presented with a common operational picture.

4.1.3.26.3.1.3.2 Diagnostic Subsystem

The diagnostic subsystem contains the hardware used for testing the CMASS system.

4.1.3.26.3.1.3.3 Operator Subsystem

The operator subsystem contains operator controls and the hardware responsible for the timing and routing data required by the operator. The primary operator positions are manned at the Console, in an event of a Console failure, the operator can man the positions at designated equipment racks. It also contains audio patch panel, printer, time and frequency distribution units, workstations, keyboards and displays, servers, switches, and video and audio switching.

4.1.3.26.4 Element Interfaces

Table 4.1-23 Cryptologic Combat Support System Interfaces

Element	Interface Description	IDS
14 NAV/NAVSSI	Navigation data from the WSN-7 (consisting of ship's roll, pitch, heading and speed) are sent via NAVSSI (p/o Navigation). Additionally, NAVSSI is providing clock data to SSEE-E.	NA (Nav Data)
15 EXCOM/ADNS	Sensitive Compartmented Information Automated Digital Network System (SCI-ADNS) provides data delivery service to/from all data user resources (Navy, Allied and Joint Services) via Slice Radio and the Integrated Terminal Program (ITP) for satellite service.	NA (Intel Coordination)

4.1.3.26.5 Design Approach/Rationale/Constraints

Spectral (SSEE Increment F follow-on) will be proposed for DDG-128 and follow. No specific design information on Spectral is available.

4.1.3.27 Not Used (27)

The number is used for the Identification System (e.g. SARTIS) on CG 52-58 only. Element 27 is not applicable to Aegis Baseline 9 or BL10.

4.1.3.28 Cooperative Engagement Capability (28)

4.1.3.28.1 Purpose

(FOUO) The Cooperative Engagement Capability (CEC) AN/USG-2B system enables all CEC equipped, Anti–Air Warfare (AAW) weapon systems in a network to operate as a single distributed AAW weapon system. This is accomplished by providing timely sharing of fire control quality sensor data, common IFF and ID data, and AAW weapon system engagement status data via the Time Division Pairwise Access (TDPA) Data Distribution System (DDS). The data is processed independently by the CEP on board each Cooperating Unit (CU) to construct a detailed track and status database in real time, and to provide required remote data to and from the on–board AAW system elements (modified for CEC).

Note: Per [OPNAVINST S5513.3B-(119.10), the CEC Security Classification Guide, the CEC Block Diagram, element descriptions, and interfaces are FOUO. See section 6.A.1.s.

4.1.3.28.2 Requirements Satisfied

The CEC Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.20.

4.1.3.28.3 Description

(FOUO) The CEC System consists of three functional groups: Antenna Array, Data Processing, and Ancillary Equipment. The Antenna Array houses the Antenna Environmental Control Unit and Planar Array Assembly. The Data Processing Group Consists of the following units: Signal Data Processor (SDP), Power Distribution Media Converter (PDMC), Time Code Generator, Red Technician Control Device (TCD), and Black TCD. The Antenna Array houses the Antenna Environmental Control Unit and Planar Array Assembly.

The Cooperative Engagement Capability is depicted in Figure 4.1-26.

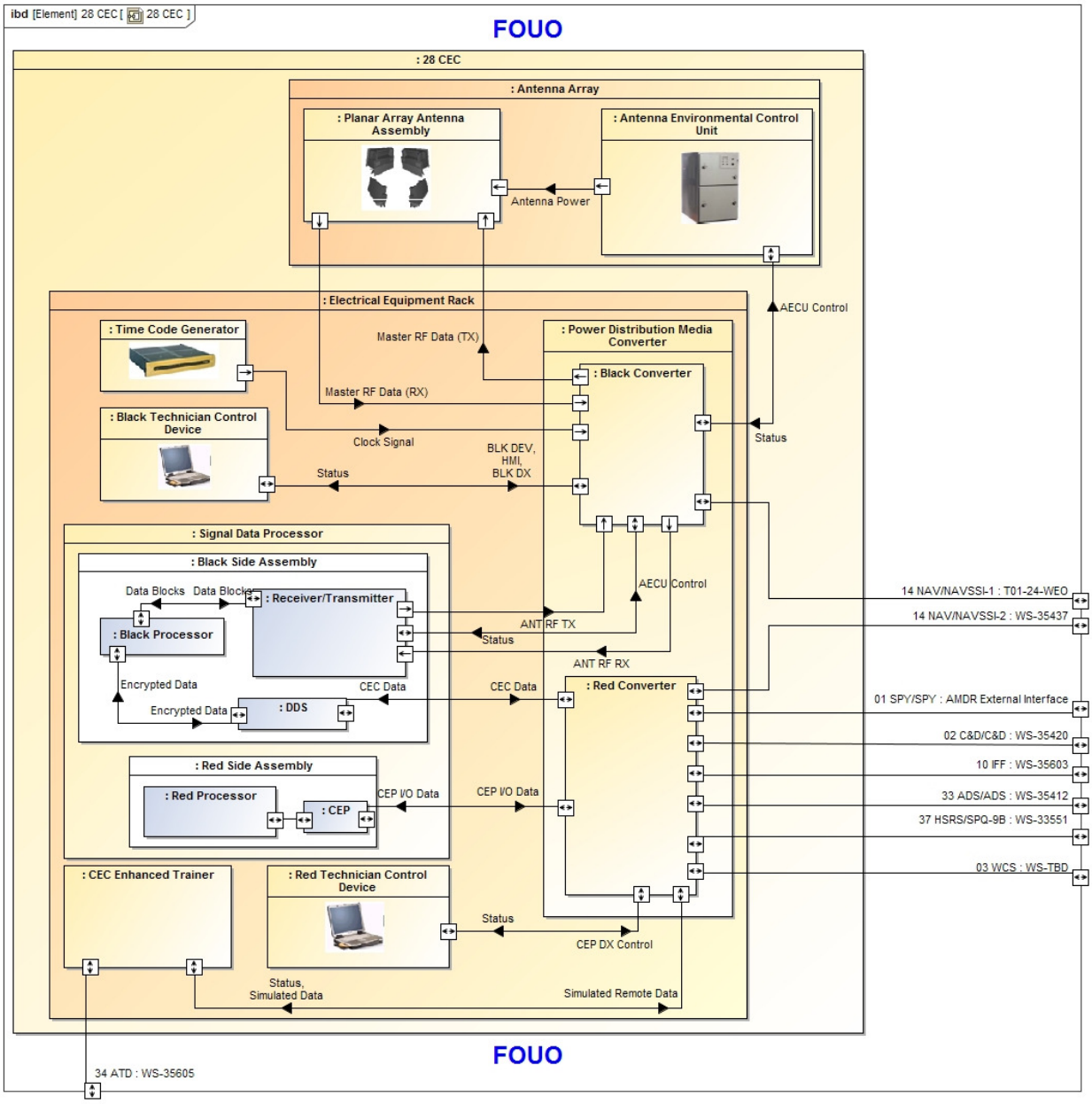

Figure 4.1-26 28 CEC

4.1.3.28.3.1 Electrical Equipment Rack

(FOUO) The Electrical Equipment Rack Consists of the following units: Signal Data Processor (SDP), Power Distribution Media Converter (PDMC), Time Code Generator, Red Technician Control Device (TCD), and Black TCD. The Electrical Equipment Rack houses the components of the Data Processing Group.

4.1.3.28.3.1.1 Signal Data Processor

(FOUO) The Signal Data Processor (SDP) houses both Cooperative Engagement Processor (CEP) and Data Distribution System (DDS) subassemblies. These units perform the core mission critical CEC operations.

4.1.3.28.3.1.1.1 Red Side Assembly

(FOUO) The Red Side of the SDP consists of the Red DDS Subassembly and the CEP Subassemblies.

4.1.3.28.3.1.1.1.1 Red Data

(FOUO) The Red DDS Subassembly houses a Crypto Control Module, processors and Red power supplies.

4.1.3.28.3.1.1.1.2 CEP

(FOUO) The Cooperative Engagement Processor (CEP) performs the primary function as a message processor aboard ship. The CEP obtains ownship radar, navigation data (GPS) and position, and weapons system sensor reports. This information is shared with other CEPs and similar information is obtained from other ships via the CEC DDS. This collective information is used by the CEP to create a composite air/surface picture for the areas surrounding the Strike Group. All participating units share this composite picture.

(FOUO) The major functions and capabilities provided by the CEP are as follows:

- Track Management. Ensures composite database congruency with other participants.
- Gridlock. Determines coordinate conversion parameters.
- Control. Provides module interaction and control.
- Update. Performs track state update and data coordination.
- Sensor Interface. Interfaces with local sensors.
- Combat System (CS) Interface. Interfaces with local command and control.
- DDS Interface. Interfaces with local DDS.

4.1.3.28.3.1.1.2 Black Side Assembly

(FOUO) The Black Side of the SDP consists of the Black Processor Subassembly and the DDS Receiver/Transmitter Subsystem.

4.1.3.28.3.1.1.2.1 Black DDS

(FOUO) The Black DDS performs the distributed network operations for the CEC. The Black DDS is responsible for esablishing and maintaining the secure network with other CEC participating units, including all control functions and, via the Antenna Array and Receiver/Transmitter, all transmit, recieve functions.

4.1.3.28.3.1.1.2.2 Black Processor

(FOUO) The Black Processor Subassembly connects directly to the antenna and only performs control functions. It does not hold classified information and all interfaces to CEC except the crypto interface are in the SDP black side.

4.1.3.28.3.1.1.2.3 Reciever/Transmitter

(FOUO) The Receiver/Transmitter Subsystem performs the functions necessary for transmission and reception of data to/from the Antenna Array, specifically RF signal reception, transmit amplification, modulation/demodulation, and frequency selection.

4.1.3.28.3.1.2 Time Code Generator

(FOUO) The Time Code Generator provides high precision timing and frequency signals to provide time of day (TOD) and synchronization signal to the SDP. The Time Code Generator works in conjunction with the SDP and the DDS tactical computer program to control the internal timing of CEC.

(FOUO) In the event that GPS time inputs are not available, the internal CEC Time Standard can perform as the Time Reference Unit (TRU) so that the CEC terminal can continue to operate normally.

4.1.3.28.3.1.3 Red Converter

(FOUO) The Red Side of the PDMC provides digital-to-digital data processing in support of the Red Media interfaces required between the SDP and TCD (Computer), and various Shipboard systems.

4.1.3.28.3.1.4 Red Technician Control Device

(FOUO) The Classified Red Technician Control Device (TCD) provides control, status, operational and maintenance data to a CEC technician. The TCD stores program images for the Startup, Tactical, and

Maintenance programs that run within the SDP Terminal. The Red TCD supports an Ethernet interface and DVD rewritable drive.

4.1.3.28.3.1.5 Black Technician Control Device

(FOUO) The Unclassified Black Technician Control Device (TCD) provides control, status, operational and maintenance data to a CEC technician. The TCD stores program images for the Startup, Tactical, and Maintenance programs that run within the SDP Terminal. The Black TCD supports an Ethernet interface and DVD rewritable drive.

4.1.3.28.3.1.6 Power Distribution Media Converter

(FOUO) The Power Distribution Media Converter (PDMC) provides power distribution and media conversion capabilities for CEC. The PDMC contains digital-to-digital data processing for the Black Side Assembly and for the Red Side Assembly.

4.1.3.28.3.1.6.1 Black Converter

(FOUO) The Black Side of the PDMC provides digital-to-digital data processing in support of the Black Media interfaces required for connection between the SDP and other CEC components.

4.1.3.28.3.1.7 CEC Enhanced Trainer

(FOUO) The CET supports the Advanced Training Domain (ATD) during TTCT mode via the Training LAN. The interface provides a simulated CEC network as a tool for training operations. The CET provides simulated remote data for injection into a single shipboard Cooperative Engagement Processor (CEP) using the CEP/Data Distribution System (DDS) interface of the CEP. The simulated remote data injected into the CEP by the CET is coordinated with the data injected into shipboard sensors and the combat system by the ATD. The CET supports the interface to the ATD by accepting simulated, simulated Cooperating Unit (CU) navigation data, simulated track data, and simulated engagement requests. The CET simulates the DDS Interface to the CEP and provides CU Identifications (ID) and CEP Track Numbers (CEPN's) to simulate track number pairings to the ATD .

4.1.3.28.3.2 Antenna Array

(FOUO) The Antenna Array is composed of the Antenna Environmental Control Unit and Planar Array to enable data exchange with other CEC units.

4.1.3.28.3.2.1 Antenna Environmental Control Unit

(FOUO) Antenna Environmental Control Unit, - The Antenna Environmental Control Unit (AECU) provides cooling and conditioned regulated power to the antenna arrays. It houses a liquid cooling system controller, which maintains and controls the antenna internal temperatures.

4.1.3.28.3.2.2 Planar Array Antenna Assembly

(FOUO) Planer Array Antenna Assembly (PAAA), AS-4558/USG-2 - The Planner Array Antenna Assembly antenna consists of four Polyalphaolefin (PAO) liquid cooled antenna arrays, connected in series. The four antennas are used for both the transmitting and receiving of CEC data.

4.1.3.28.4 Element Interfaces

Table 4.1-24 Cooperative Engagement Capability Interfaces

Element	Interface Description	IDS

Element	Interface Description	IDS
01 SPY	(FOUO) The Cooperative Engagement Processor (CEP) exchanges track data with the SPY Computer Suite via ALIS. This interface makes SPY measurement data available to CEC where measurements from local and remote sensors are fused to create a common composite track database.	AMDR External IRS
02 C&D	(FOUO) C&D interfaces with CEC via ALIS to allow C&D to receive periodic updates on CEC composite tracks that are composed of data from both on and off board sensors.	WS-35420
03 WCS	(FOUO) WCS interfaces with CEC via ALIS to obtain measurement data for remote tracks to support engagements.	WS-TBD
10 IFF	(FOUO) CEC provides interrogation control and receives IFF Target Reports from the Processor Controller of IFF via ALIS	WS-35603
14 NAV/NAVSSI-1	(FOUO) The Black side of the Data Terminal Processor of CEC receives OD19 messages from the FWD and AFT RTS via DMS (part of 21 ICOM).	T01-24-WEO
14 NAV/NAVSSI-2	(FOUO) The Red side of CEC (CEP) receives redundant 100BaseFX OD12 and OD19 messages from the FWD and AFT RTS via ALIS.	WS-35437
33 ADS	(FOUO) ADS interfaces with CEC via a network interface via ALIS. CEC sends track ID data, network and system status data, and network status and alerts to ADS. ADS supplies operator action requests, including data entry requests, to CEC. This interface also supports the interactions required for defining, activating, and modifying composite ID doctrine. Classified as FOUO by CEC SCG [OPNAVINST S5513.3B-(119.10)]	WS-35412
34 ATD	(FOUO) The Advanced Training Domain interfaces with the CEC Enhanced Trainer (CET) to support training exercises. The CET integrates with the Advanced Training Domain during Tactical Team Coordination Training (TTCT) mode. The interface allows the following communication: report mode and configuration status, the ability to accept, process, and report on simulated engagements, simulate DDS interface to CEP, and accept simulated ownship navigation data from the Advanced Training Domain.	WS-35605

Element	Interface Description	IDS
37 HSRS/SPQ-9B	(FOUO) The SPQ-9B radar provides track data to CEC to be integrated into its composite track reports to the combat system. Classified as FOUO by CEC SCG [OPNAVINST S5513.3B-(119.10)]	WS-33551

4.1.3.28.5 Design Approach/Rationale/Constraints

Changes are identified for Aegis BL10 due to SPY-6 integration.

SPY-6 integration requires CEC to have a new interface to the radar (SPY) and WCS.

4.1.3.29 Global Comand and Control System - Maritime (29)

4.1.3.29.1 Purpose
The Global Command and Control System – Maritime (GCCS-M) provides the commanding officers with a timely, authoritative, and fused common operational picture (COP) that also includes integrated intelligence services, databases, and environmental information. GCCS-M enables the fleet to view a comprehensive picture of the battle space by combining tactical information received via network interfaces, standard Navy communications channels, and operator input with strategic data derived from national databases. A wide range of mission applications allows the user to analyze and correlate the available data to support mission planning and execution.

4.1.3.29.2 Requirements Satisfied
The GCCS-M Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.21.

4.1.3.29.3 Description
GCCS-M is a single, integrated and scalable Command, Control, and Intelligence system that receives, processes, displays, and maintains information on the geographical location of friendly, hostile, and neutral land, sea and air targets for the fleet. This information contributes to an integrated Over-the-Horizon (OTH) tactical display that provides Command, Control, Communications, Computers, and Intelligence (C4I) support to the officers in command.

The Global Command and Control System - Maritime is depicted in Figure 4.1-27.

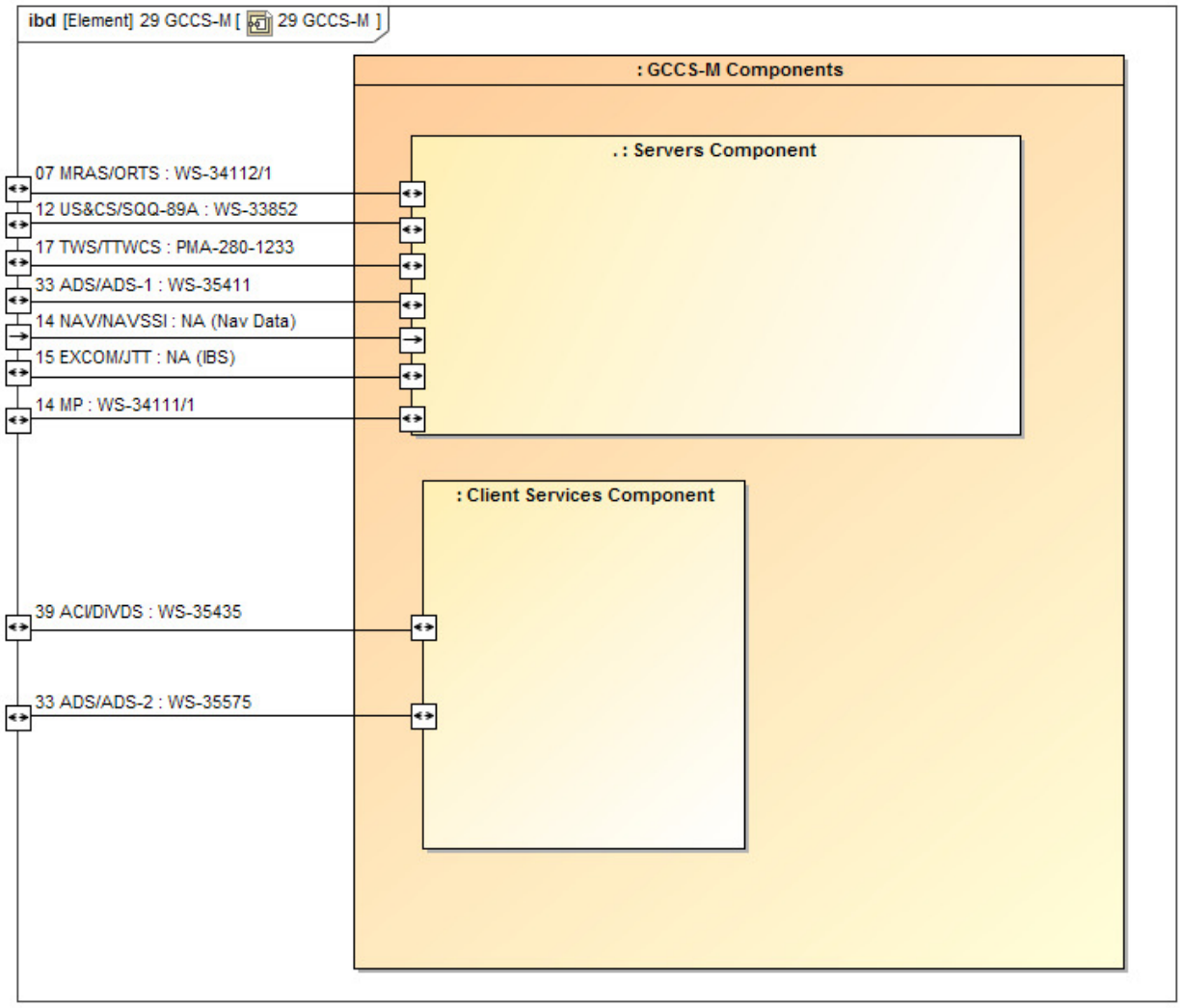

Figure 4.1-27 29 GCCS-M

4.1.3.29.3.1 GCCS-M Computer Program Components

GCSS-M is a software only element composed of a Client Services Component and Server Component.

4.1.3.29.3.1.1 Client Services Component

The Client Services component provides client and system administration services.

4.1.3.29.3.1.2 Server Component

The Server component includes a COMMS server and a WEB server. The COMMS server controls the I/O communication with the EXCOM channels. The WEB Server hosts the Weblogic application server, which is used to serve system documentation, in extensible mark-up language format to GCCS-M users. The WEB server also typically acts as the print Server for the GCCS-M system.

4.1.3.29.4 Element Interfaces

Table 4.1-25 Global Command and Control System - Maritime Interfaces

Element	Interface Description	IDS
07 ORTS/MRAS	ORTS interfaces to GCCS-M via ALIS and CANES. GCCS-M provides web services to ORTS in order for ORTS to receive satellite data (Two Line Element (TLE) and Satellite Situation Report (SSR), and satellite ephemerides data) required for SPY to perform Sensor Calibration using Satellites (SCUS).	WS-34112/1
12 US&CS/SQQ-89A	SQQ-89 interfaces to GCCS-M via ALIS and CANES. The AN/SQQ-89A(V)15 network provides a path to exchange track and overlay data between CADRT and MTC2 .	WS-33852
14 NAV/NAVSSI	The Navigation interface provides the GCCS-M system with ship's position (Latitude and Longitude) and Coordinated Universal Time (UTC) (sometimes referred to as Universal Time Code) via redundant serial interfaces. This data is used by the GCCS-M system to establish an ownship's reference icon on the GCCS-M displays. The data is periodically updated at a 1Hz rate.	NA (Nav Data)
15 EXCOM/JTT	JTT interfaces to GCCS-M via a serial interface. JTT provides GCCS-M with the JTT for Integrated Broadcast Service (IBS) data.	NA (IBS)
17 TWS/TTWCS	TTWCS interfaces to MTC2 via the CANES. MTC2 supports TTWCS by providing the Common Operational Picture (COP) tracks to TTWCS and allowing a two-way overlay exchange.	PMA-280-1233
33 ADS-1	ADS interfaces to GCCS-M via ALIS and the CANES. The GCCS-M/ADS interface provides a two-way exchange of tracks between ADS and MTC2 .	WS-35411
33 ADS-2	ADS interfaces to GCCS-M via ALIS and the CSSE. GCCS-M provides the Alternate DBM and TAO workstation displays and controls to ADS consoles via a VNC® connection.	WS-35575
39 ACI/DiVDS	DiVDS interfaces with the GCCS-M TAO workstation to receive analog video.	WS-35435

4.1.3.29.5 Design Approach/Rationale/Constraints

GCCS-M is a software-only program and will be migrated from software version 4.0.3.6 to GL 4.1.X

4.1.3.30 Shipboard Gridlock System (30)

4.1.3.30.1 Purpose
The SGS/AC is an integrated software system designed to automatically correlate remote track reports to locally held tracks and simultaneously gridlock air and surface tracks. The objective is to provide the Strike Group with improved Anti-Air Warfare (AAW) defense capabilities in an open ocean environment.

4.1.3.30.2 Requirements Satisfied
The SGS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.22.

4.1.3.30.3 Description
The Shipboard Gridlock System with Automatic Correlation (SGS/AC) correlates the incoming remote air tracks to the system track file. The correlation is transmitted between surrounding units participating to ensure accurate correlation. The accuracy enables participating units to quickly and effectively locate and engage potential targets.

The Shipboard Gridlock System is depicted in Figure 4.1-28.

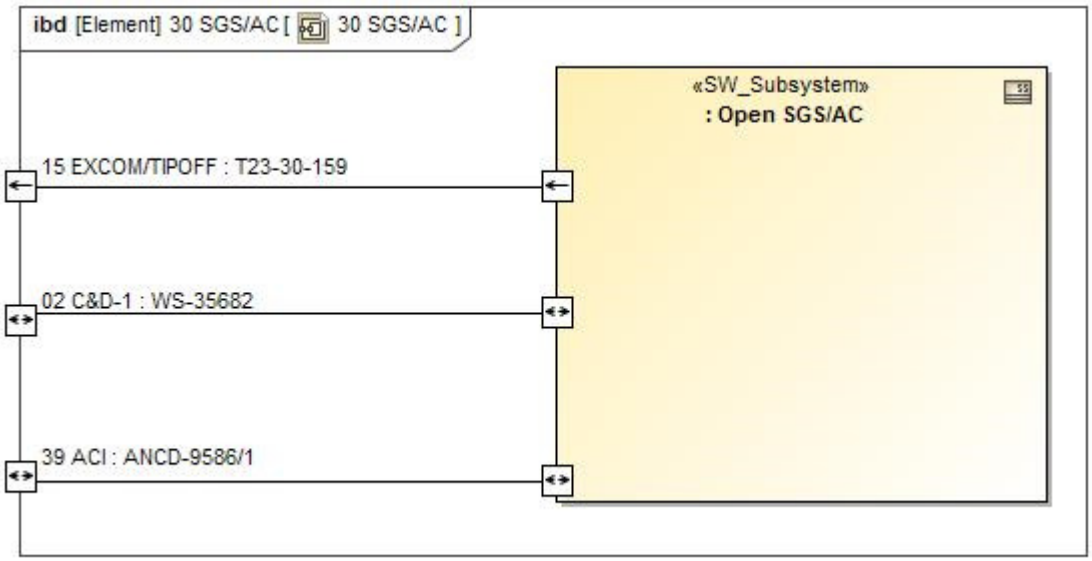

Figure 4.1-28 30 SGS/AC

4.1.3.30.3.1 Open SGS/AC
Open SGS/AC is a Computer Program running on a Core Computing System (CCS, part of 39 ACI) that provides Data Registration among units in a Strike Group, and provides ownship-to-remote correlation and decorrelation recommendations.

The process for estimation and correction of track position and orientation biases of the radar track data transmitted among units of a Strike Group is known as gridlock and is based on linkage via EXCOM with a specific Gridlock Reference Unit (GRU). Due to the resulting positional and velocity differences in these track reports, it is not obvious to the ships in the Strike Group that two track reports actually represent the same object (i.e., a missed correlation). This could lead to saturation of the data link due to multiple reports for each track, confusion as to the actual tactical picture, and inappropriate engagement of the target by several ships. Similarly, positional and velocity differences between two ships' reports on the same track may cause two tracks to be considered as one (i.e., a false correlation) resulting in one or both targets being under-engaged or not engaged at all.

SGS is designed to provide gridlock for Link 11 and Link 16 exchanges. Each Participating Unit (PU), Link 11, maintains a System Coordinate Center (SCC) in latitude and longitude. This position is the PU best estimate (from Navigation systems or other means, i.e., Gridlock) of the PU position. This position is the center of an X/Y Cartesian coordinate system tangent to the earth's surface with positive X oriented East and positive Y oriented North of the PU. It is used for all tracks, points, and pointers maintained in X/Y coordinates within the PU database. During PU track data exchanges, the SGS/AC performs real-time estimation and correction of systematic misalignment errors for the shipboard SCC. On Link 11, each PU reports its SCC and its tracks, points, and pointers in their X/Y coordinates relative to its SCC. Each PU receiving these reports, transforms the X/Y positions from the reported SCC into the coordinate frame located at its own SCC.

SGS also provides Automatic Local-to-Remote Track Correlation for the combat system. SGS evaluates local and remote track stores to identify tracks that represent the same object, and provides correlation recommendations to C&D. Similarly, if previously correlated local and remote tracks are evaluated to no longer represent the same object, SGS provides the decorrelation recommendation to C&D. This process is performed continuously on both new and existing tracks.

In order to gridlock the track data, C&D will provide incoming TDL messages from the C2P to SGS prior to processing. Similarly to incoming messages, C&D will provide outgoing TDL messages to the SGS for gridlocking prior to transmission to the C2P.

4.1.3.30.4 Element Interfaces

Table 4.1-26 Shipboard Gridlock System Interfaces

Element	Interface Description	IDS
02 C&D-1	C&D interfaces with SGS/AC via ALIS to provide system controls, ownship navigation data, ownship tracks, and correlation/deorrelation/PAD controls for SGS/AC. SGS/AC provides status, correlation/decorrelation recommendations, and PADs to C&D. The SGS receives TDL data via C&D to receive remote Link track reports in order to compute PADs and to determine correlation and decorrelation recommendations. This interface provides ownship local and remote datalink track and engagement status information exchange for coordination among battlegroup participants via Link 11 and/or Link 16.	WS-35682
15 EXCOM/TIPOFF	The SGS/AC sends track data (one way) to EXCOM/TIPOFF, via an Ethernet connection, for transmittal over the Integrated Broadcast System (IBS).	T23-30-159
39 ACI	This provides the physical interface for ACI connectivity for the ACI interface to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1

4.1.3.30.5 Design Approach/Rationale/Constraints

No changes are identified in Aegis BL10.

4.1.3.31 Not Used (31)

The number was previously used for the Countermeasures System, which was removed by SHIPALT CG 47-00745K.

4.1.3.32 Vertical Launching System (32)

4.1.3.32.1 Purpose

The Vertical Launching System (VLS) Mk 41, is a multi-purpose missile launching system used to both stow and launch guided missiles. The weapon system supports the AEGIS Weapon Control System (WCS) for Anti-Air Warfare (AAW), Anti-Submarine Warfare Control System (ASWCS) for Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASuW), and it supports the Tactical Tomahawk Weapon Control System (TTWCS) for Strike Tomahawk Weapon (STW) missions. The VLS operates in conjunction with these four warfare areas with the responsibility of storing, activating, and firing of all SM-2, SM-3, SM-6, ESSM, TLAM, and VLA missiles. The VLS automatically selects, or allows the user to select, the proper missile cell or the missile type required to launch, and performs the initialization and launch of the missiles from orders received from the WCS, TTWCS, and ASWCS computers. The VLS provides the prioritization and scheduling of missile launches to ensure a coordinated, and simultaneous, multi-mission operation. The VLS is also responsible for missile inventory status, automated detection of equipment failures, and status reporting to each of the weapon systems.

For BMD missions, the Mark 41 VLS will support missions employing the SM-3 Selective Availability/Anti-Spoofing Module (SA/ASM), CRYPTO Key Load Capability, and VLS select algorithm.

4.1.3.32.2 Requirements Satisfied

The VLS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 2, Section 3.2.7.

4.1.3.32.3 Description

The VLS system is composed of two Launch Control Units, two Missile Launch Modules, two Local Status Panels, a Fire Inhibit Switch, and a Remote Launch Enable Panel.

The Vertical Launching System is depicted in Figure 4.1-29.

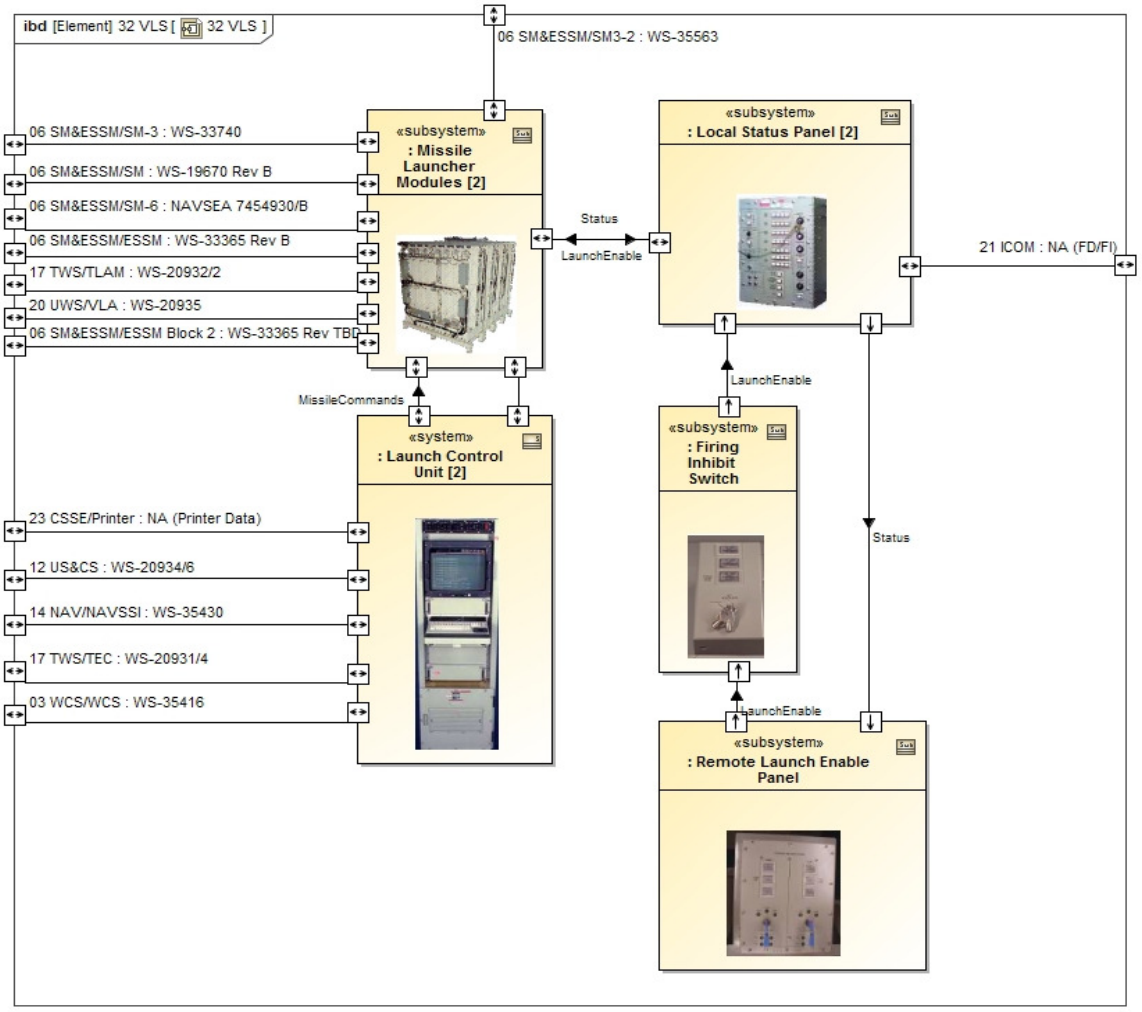

Figure 4.1-29 32 VLS

4.1.3.32.3.1 Firing Inhibit Switch

The Firing Inhibit Switch (FIS) Mk 165 is a key-operated manual switch located at the Commanding Officer's (CO) console in the CIC. It provides the positive single point control of the launch enable signal to both forward and aft launchers. This switch provides the CO with the means to directly inhibit all VLS launches regardless of system or operator action and recommendation via manual interruption of the Launch Enable signal from the RLEP.

4.1.3.32.3.2 Missile Launcher Modules

VLS contains two Missile Launcher Modules (MLM), one forward and one aft. Each MLM may operate independently and each is supplied with its own power, interface and control equipment. The forward VLS launcher (MLM) consists of four LSEQs, four Motor Control Panels (MCP), eight Programmable Power Supplies (PPS), two Power Distribution Panels (PDP), one Fiber Optic Distribution Box (FODB), one Fiber Optic Interconnection Boxes (FOIB), four Single Module Junction Boxes (SMJB), and thirty two missile cells. The aft VLS launcher (MLM) consists of eight LSEQs, eight MCPs, sixteen PPSs, two Power Distribution Panels (PDP), one Fiber Optic Distribution Box (FODB), one Fiber Optic Interconnection Boxes (FOIB), eight SMJBs, and sixty four missile cells. Each MLM structure consists of subsystem modules with each module divided into further subsections or cells in which canistered missiles are stored. Each cell is covered with a weather-tight, sealed hatch from which the missile will egress when fired. The initial missile flight is vertical or perpendicular to the deck plane of the ship.

There are a total of 96 missile cells that can contain a mix of SM-2, SM-3, SM-6, and ESSM missiles. The forward MLM (Mk 177) has a maximum capacity of 32 individual missiles and consists of one 8-cell baseline VII system module, and three standard 8-cell baseline VII modules. The aft MLM (Mk 176) has a maximum capacity of 64 individual missiles and consists of one 8-cell baseline VII system module, and seven standard 8-cell baseline VII modules.

The MLM structure makes up the body of the launcher and supports the electrical assemblies and canistered missiles. It is modular in construction. Each module is comprised of three main parts; a deck structure, an intermediate structure, and a base or plenum structure. The structure forms the cells into which the canistered missiles are loaded, supports the armored deck, and provides for equipment mounting. The deck structure and hatches make up the VLS weather deck, consisting of deck platforms, eight deck hatches, and one uptake hatch.

The deck platform supports the upper end of missile canisters and seals exhaust gases from the Launcher. Individual steel hatches are located over each cell, or missile canister position. These hatches are open only for the short period necessary to launch that particular missile, or during reload operations. A separate steel hatch covers the exhaust uptake opening, where rocket motor gases are vented to the atmosphere. Each hatch is individually powered by an electric motor and contains electric resistance heaters for anti-icing purposes.

The intermediate structure forms the midsection of the module and is part of the gas management system. It is comprised of a flue-like uptake section, outboard assemblies which support the hatch motors, electrical assemblies, deluge control valves, and structure beams which act as canister guide rails.

The base structure serves both as the base of the launcher and as the plenum for the gas management system. It is coated with an ablative material to protect it from the missile exhaust gases. The center of the plenum connects to the uptake section which directs the missile gases to the external environment.

One Launch Sequencer is provided with every VLS module. The LSEQ provides the interconnection point between the canistered missiles, the LCU processors, MCPs, and the module power supplies. The LSEQ main function is to expedite the pre-launch sequence of events during missile activation. During a missile pre-launch sequence, the VLS LCU orders the selection of a missile to the LSEQ. Once directed, it then performs the timed actions of relay closures and signal routing for the initialization and firing of the missile. This includes such items as pre-launch power application, battery activation, and firing signals to the DTRM or missile booster.

4.1.3.32.3.3 Local Status Panel

The Local Status Panel is a local control and monitoring interface device that provides launch control, system hazard reporting and maintenance functions to and from each launcher. There is a single panel associated with each launcher, one forward and one aft. The front of the status panel has five key operated switches for each of the following functions: Remote or Local control, Local application of Launch Enable, Launcher Power, Strikedown Enable, and Power De-icing. The unit also contains a number of push button switches, indicators, and other launcher related controls. Launcher hazards and module status can be obtained from the status panel indicators on the front of the unit, and are also routed to the ship Central Control Station via Interior Communications, and to the Remote Launch Enable Panel (RLEP).

In the event of a failure of the FIS or RLEP, the Local Status Panel can apply the Launch Enable signal locally via key operated switches, when the panel has been placed in Local control.

4.1.3.32.3.4 Launch Control Unit

Each LCU consists of an COTS based OJ-721(V) UYQ-70 Rack-Based Console (RBC), which contains mass storage devices, housekeeping support cards, fast Ethernet switching components and a 20 card VME chassis containing Single Board Computer (SBC) processors and NTDS Type B, D, and E interface cards. The NTDS Type E interfaces provide communications to the Weapon Control System (AWCS, TTWCS) computer programs and to the Anti-Submarine Warfare (ASW) Weapon Control System

(ASWCS) computer program.

Each LCU contains a Launch Control Computer Program which monitors launcher inventory, and missile and equipment status for reporting to WCS, TWS, and UWS. The LCCP receives SM/ESSM, VLA, and TLAM missile selection, initialization, arming and launch commands from those systems, as well as flight plan data from TWS, and forwards this data to the selected missile cells. The LCCP also prioritizes launches and resolves launch conflicts for multi-mission and/or multi-missile launches.

The LCU also contains the VLS/GPS Integrator (VGI) system. The VGI system receives RF L1/L2 GPS satellite data from NAV, then transmits GPS Hot Start data to the SM-3, SM-6 Block IA, and SM-6 Dual II missilesin the both Vertical Launchers via the Fiber Optic Distribution Boxes (FODBs). The VGI provides the missiles with GPS timing via Time Mark Strobe, GPS data, black cryptographic keys for GPS processing and transmission, and resetting messages to overwrite the cryptographic keys.

4.1.3.32.3.5 Remote Launch Enable Panel

The Remote Launch Enable Panel, located in the CIC, provides remote control and status reporting of the Launch Enable and launcher power functions of the VLS Status Panel. Both forward and aft launcher functions are contained within one unit. Functions performed are Launch Enable, launcher power, and status indication of each launcher. When the AEGIS Weapon System is configured to automatically detect, evaluate, and engage threats based on predetermined doctrine, the RLEP may be configured to apply the launch enable signal via a Weapon Control System (WCS) controlled, remotely activated launch enable relay closure.

4.1.3.32.4 Element Interfaces

Table 4.1-27 Vertical Launching System Interfaces

Element	Interface Description	IDS
03 WCS	Each VLS LCU computer interfaces with the WCS/FCS IOPs to receive SM/ESSM missile initialization data and select/activate commands and to provide missile and VLS status. ORTS interfaces via WCS with VLS to receive readiness/assessment data. The WCS Computer Suite provides VLS with Block IB KW frequency and crypto variable for SM-3 missile initialization.	WS-35416
06 SM&ESSM/ESSM	VLS interfaces with the ESSM to provide initialization and launch data, and to request Built-In-Test (BIT) data from the ESSM in response to commands from WCS. The ESSM provides status and BIT responses to VLS. All communication is serial in accordance with MIL-STD-1553B.	WS-33365 Rev B
06 SM&ESSM/SM	VLS interfaces with the Standard Missiles to provide initialization and launch data and to receive missile status. Applicable to SM-2, SM-3, and SM-6. All communication is via unidirectional coax interface with the exception of SM-3 Block IIA. SM-3 Block IIA communiation is in accordance with MIL-STD-1553B.	WS-19670 Rev B

Element	Interface Description	IDS
06 SM&ESSM/SM-3	On SM-3 equipped ships, the VLS MLM interfaces with SM-3 to provide GPS satellite data for GPS Hot Start.	WS-33740
06 SM&ESSM/SM-6	The VLS interfaces with the SM-6 missile to provide initialization data in support of organic and IFC engagements.	NAVSEA 7454930/B
06 SM&ESSM/SM-3-2	On SM-3 Block IIA equipped ships, the VLS MLM interfaces with SM-3 Block IIA to provide GPS satellite data for GPS Hot Start.	WS-35563
12 US&CS	There are three bi-directional NTDS-E interfaces between the AN/SQQ-89A(V) system and the VLS. One of the interfaces is between the Transmitter I/O (Unit 859) and VLS LCU No. 2. The other two are between the Receiver I/O (Unit 858) and VLS LCU No. 1 and No. 2. These interfaces provide the AN/SQQ-89A(V) system the capability to initiate a Vertically Launched ASROC (VLA) missile launch and to monitor the status of the VLA prior to launch.	WS-20934/6
14 NAV/NAVSSI	The VLS LCU interfaces with NAVSSI to receive GPS satellite data for GPS Hot Start to the SM-3.	WS-35430
17 TWS/TEC	The two Tomahawk Equipment Cabinets (TEC) interface with each LCU of VLS via an NTDS Type E interface to provide launch commands and information, and receive status.	WS-20931/4
17 TWS/TLAM	The VLS Missile Launcher Module's Launch Sequencer interfaces with the TLAM contained in the Launcher to provide initialization and launch commands, and receive missile status.	WS-20932/2
20 UWS/VLA	The VLS Launch Sequencer interfaces with the VLA to provide initialization and launch commands, and receive missile status.	WS-20935
21 ICOM	Status/Alarm data from the launch status panel is sent via the ICOM Data Multiplex System to the ship's Damage Control Console IC/SM alarm panel.	NA (FD/FI)
23 CSSE/Printer	The Launcher Control Panels connect to printers in ACI via an ALIS Ethernet connection.	NA (Printer Data)

4.1.3.32.5 Design Approach/Rationale/Constraints

No changes are identified for Aegis BL10. However, any changes determined to be needed during detailed design will be included in a future version of the SSDD.

4.1.3.33 Aegis Display System (33)

4.1.3.33.1 Purpose
The AEGIS Display System is a software and hardware system that provides a Human-Computer Interface (HCI) that allows the operators to monitor the tactical environment and to issue orders. It provides the capabilities to organize, display, and summarize data drawn from other elements of the combat system. The data, supplemented with manually entered data, may be selected by operators for display. The display information includes weapon, sensor, propulsion and communication status, track histories, geographic maps with political boundaries, airways, and other operator-defined patterns.

4.1.3.33.2 Requirements Satisfied
The ADS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 2, Section 3.2.8.

4.1.3.33.3 Description
The AEGIS Display System (ADS) Element is comprised of the AEGIS Display System (ADS) computer program, and applications that are hosted on the Common Display System (CDS), the Digital Video Distribution System (DiVDS), and the AN/SPQ-15 Data Distribution System (DDS). The ADS computer program is composed of nine software subsystems housed in ACI hardware that, together with the CDS consoles, provide the controls and displays for the operators.

The Aegis Display System is depicted in Figure 4.1-30.

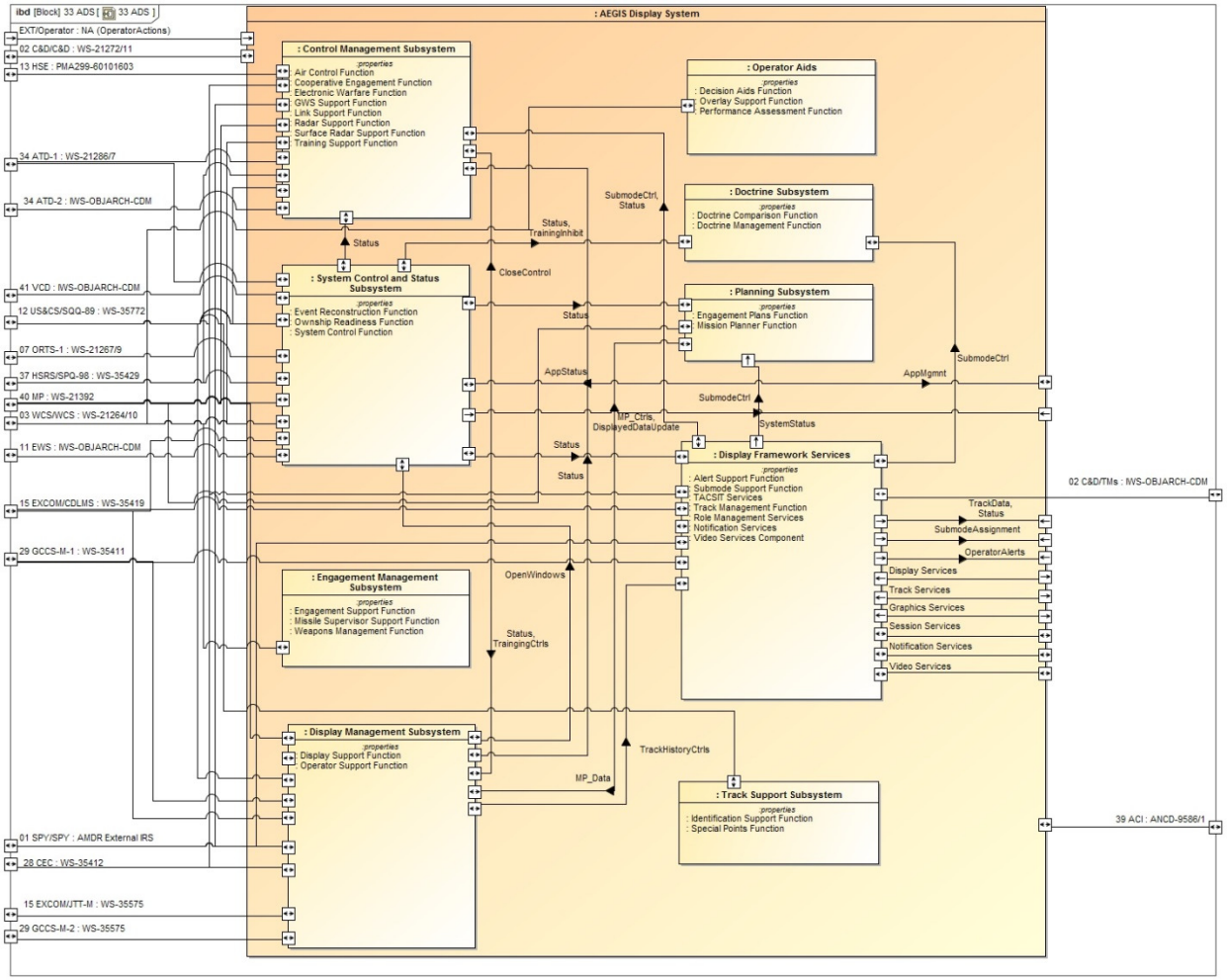

Figure 4.1-30 33 ADS

4.1.3.33.3.1 Aegis Display System

The AEGIS Display System is the software system that drives the HCI for Combat Information Center (CIC) watch standers. It is composed of the software subsystems described below.

4.1.3.33.3.1.1 Control Management Subsystem

The Control Management Subsystem (CMS) provides the display of information and processing of operator input necessary for Air Control, Sensor Management, Link Management, control of the EWS and GWS, and Training Support. The CMS processes and displays input from sensor systems (SPY, CEC, SPQ-9B, SPS-73, EWS) to the appropriate operator, including A-Scope and F-Scope displays and system statuses, and provides for operator control of each sensor. The CMS provides status and processes operator input for Link management, and provides status displays of the GWS. For the Electronic Warfare Supervisor, the CMS provides the interface for EW track display, entry, and modification, and EWS parameter display and modification. For the Training Supervisor, the CMS provides the capability to designate consoles for training, and to initiate, control, review, modify, and terminate training exercises.

The Control Management Subsystem software subsystem contains the following software components:

a. Air Control Function – The Air Control (ACF) component provides the calculation and display of information in support of air control awareness. ACF also provides support for MH-60R and the ASTAC submode.
b. Cooperative Engagement Function – The Cooperative Engagement (CEF) component provides the display requirements to support the digital interface between ADS and the Cooperative Engagement Processor (CEP). This component processes CEP data and serves as the interface to the rest of the ADS.
c. Electronic Warfare Function – The Electronic Warfare (EWF) component provides operator support to initiate EW bearings and fixes and display their parameters, to display and modify reporting controls for the AN/SLQ-32 and MH-60R ALQ-210 ESM systems, and supports special electronic warfare display capabilities on the TACSIT.
d. GWS Support Function – The GWS Support (GSF) component provides gun system related displays that include the Gun Train Line, GWS Target Summary, NGFS Target Coordinates, and gun target symbology.
e. Link Support Function – The Link Support (LSF) component supports transfer of link control inputs (operator actions) and link control outputs (display data) between ADS and C&D. LSF informs C&D of operator link control actions.
f. Radar Support Function – The Radar Support (RSF) component provides support for the SPY interface and all operator support for the RSC submode. RSF determines the format and content of information provided to the RSC windows. RSF is responsible for updating the A-Scope and F-Scope displays and toggling the TACSIT display between PPI mode and RHI mode.
g. Surface Radar Support Function – The Surface Radar Support (SRF) component provides display support for AN/SPQ-9B. SRF also forwards High Data Rate requests (HDR) and responses between SPQ-9B and C&D.
h. Training Support Function – The Training Support (TSF) component provides Training Supervisor (TNGS) with the operator facilities required to designate the consoles to be manned by trainees and to initiate, control, review, modify, and terminate a training exercise. TSF also provides the Training Supervisor Assistant (TNGA) with the operator facilities required to review and modify a training exercise.

4.1.3.33.3.1.2 Display Framework Services

The Display Framework Services (DFS) subsystem provides the core services for operator displays to other subsystems within ADS. DFS provides services for Alert queuing and surfacing, notifications, and submode assignment and management.

The DFS provides TACSIT services, which provide a graphical representation of pertinent data (as determined by the ADS subsystems) on the consoles. This includes presenting and updating

geographical maps, providing overlays, adjustments to range scale, bearing and range calculations of the primary hook and cursor to Ownship, and display of position and history of tracks.

DFS provides Track Management services. The DFS subscribes to track data messages (via the Enterprise Track Server) defined in the PEO IWS Common Track Data Model, and other track data from C&D. DFS also receives track data from MTC2 and SPY, and merges all data into a composite picture for display at the consoles. DFS maintains the position and kinematic data for each track, as well as track history and associations (both inside ADS and from external sources) between tracks.

The Display Framework Services software subsystem contains the following software components:

a. Alert Support Function – The Alert Support (ASF) component provides common alert queuing and surfacing services commonly utilized by all ADS components as well as AWS elements.
b. Submode Support Function – The Submode Support (SSF) component provides submode assignment services for the consoles and distributes submode assignment status to other Aegis elements as required.
c. TACSIT Services – TACSIT Services provides a graphical presentation of dynamic track data and other pertinent data on a console's Tactical Situation (TACSIT) display and controls required for a specific operator.
d. Track Management Function – The Track management (TMF) component receives all track data by either a Direct to Server Distribution Service or a Direct to Console Distribution Service as means to provide a track server capability to ADS. TMF also includes a track merge capability of associating both remote air tracks received from JMCIS and supplementary tracks received from CEP, with real time air tracks received from the C&D Track Server (TS). C&D, CEP, JMCIS tracks and associations, and ADS associations are provided for display.

   TMF receives SPY track data in a Database Transfer to support the Radar System Controller (RSC) and other operators. This data is not used in correlation/association.

   Since there is more than one possible source of track data to make up the composite track picture at ADS, TMF is responsible for receiving track data from all sources and merging it into a composite picture for display at the consoles. All tracks in the master track file can have up to four components. The possible components a track may have are a Common track component, an OTH (over the horizon) component, a C&D component, and a CU component. Every track must have at least two components, one of which is always a Common track component, which contains all of the positional and kinematic data for the track.

   The Situation Report messages are exchanged periodically between ADS and JMCIS to maintain track database synchronization. ADS uses the ADS Situation Report to request retransmission of a missed track, based on a comparison of the data contained in the JMCIS Situation Report with the contents of the current ADS database.

   TMF provides for the display of track histories, tactical summaries, burnthrough, manual track entry, and LAMPS IFF entry controls and status.
e. Role Management Services – Role Management Services provides the appropriate set of user capabilities to allow the user to execute the roles assigned to that user.
f. Notification Services – Notification Services queues notification requests for each user signed in to the system and distributes those notifications to their ultimate destination, which is one or more user components.
g. Video Services Component – The Video Services Component (VSC) provides the capability to receive process, control cameras, configure, record, and distribute video to tactical consoles, thin client displays, Multi-Mission Display (MMD) and external displays. The VSC also provides the capability to manage EOSS video streams from GWS.

4.1.3.33.3.1.3 Display Management Subsystem

The Display Management Subsystem provides the capabilities needed for operator interaction with the ADS. The subsystem provides for display of windows and information, including close control management, ball tab movement, window management (e.g., display offset, range scale, display filters, window update, etc.), ASTAB controls, range/height line display, window paging, geographic controls, Video Wall control, Mission Planner interface initialization, radar sweep graphics, and display of specific Mission or Element windows (e.g., BMD or SPY). The subsystem also provides for receipt and routing of operator actions, management of VAB arrays, data entry, menu management, closing windows, submode training program initiation/termination, and X-windows and Remote Desktop Protocol connections (including the C4I Desktop, JTT-M, MTC2 CO/TAO Workstation, and MTC2 Alternate Database Manager workstation).

The Display Management Subsystem software subsystem contains the following software components:

a. Display Support Function – The Display Support (DSF) component provides all functions necessary for control of a console, thin client display, and the MMD.
b. Operator Support Function – The Operator Support (OSF) component provides the following capabilities to operators: Operator action receipt, routing and confirmation, VAB array management, data entry management, pushbuttons, window quit, menu management, confirm/negate, submode training program initiation and termination, PMA initiation and termination and remote-x windows.

4.1.3.33.3.1.4 Doctrine Subsystem

The Doctrine Management Subsystem provides authorized operators with the capability to enter, review, activate, and deactivate doctrine. The doctrine groups available are Weapon, Non-Weapon, Normal, Saturation, BMD, and Mission Planner. The submode also provides for review of doctrine, and the automatic comparison of the current SPY operating region to the C&D Weapon Selection Doctrine, IFF Doctrine, and ID Doctrine. Training doctrine may also be created and maintained independent of Tactical doctrine.

The Doctrine Subsystem software subsystem contains the following software components:

a. Doctrine Comparison Function – The Doctrine Comparison (DCF) component provides an automated capability to compare the spatial match between C&D weapon selection doctrine regions and the SPY-6 operating region. DCF provides the HMI for operators to request the computations from C&D and display the comparison results that indicate when a mismatch in coverage exists between the doctrine region and the SPY operating region. DCF also provides for visual comparisons of ID and IFF doctrine regions to the current SPY radar operating region.
b. Doctrine Management Function – The Doctrine Management (DMF) component manages all C&D and ADS doctrine classifications. DMF provides authorized operators the capability to construct or activate doctrine statements and groups and allows all operators to review the doctrine status.

4.1.3.33.3.1.5 Engagement Management Subsystem

The Engagement Management Subsystem provides display support for engagement actions to be forwarded to C&D. The subsystem provides for the entry, display, and execution of ownship or force engagement, issues engagement orders to C&D, displays torpedo safety zones, surfaces engagement alerts, and provides aids for review of force weapon inventory. The subsystem provides support for the Missile System Supervisor including manual firing and illuminator assignment. The subsystem also provides support for the Electronic Warfare Supervisor for softkill engagement capabilities including decoy launch authorization.

The Engagement Management Subsystem software subsystem contains the following software components:

a. Engagement Support Function – The Engagement Support (ESF) component provides display support for engagement actions forwarded to C&D.

b. Missile Supervisor Support Function – The Missile Supervisor Support (MSF) component provides display support for the MSS submode by displaying engagement data from WCS.
c. Weapons Management Function – The Weapons Management (WMF) component provides support for entry, display, and execution of ownship/force engagements and non-IU engagement actions.

4.1.3.33.3.1.6 Operator Aids

The Operator Aids subsystem provides calculation and display of information in support of operator decisions, including determination of plot parameters, apparent wind, closest point of approach, maneuver information, range/bearing sectors, Four Whiskey information, and Position and Independent Movement. The subsystem also provides geographic data (e.g., World Vector Shoreline, Sovereign Territories, National Boundaries, Lakes, Airways, Cities, and Airfields) to other ADS subsystems and CEC, as well as operator definition of geographic components.

The Operator Aids software subsystem contains the following software components:

a. Decision Aids Function – The Decision Aids (DAF) component provides the following operator decision aids: Closest Point of Approach, Tactical Decision Aids, Four Whiskey, PIM, Screen Kilo, Range/Bearing Sectors, Trial Maneuver, Profile Plots, Maneuver Control, Station Keeping, CPA Monitoring, Apparent Wind Course, Torpedo Evasion, Recommended Course to Steer.
b. Overlay Support Function – The Overlay Support (OVF) component provides operators the ability to construct and store overlays for display on the TACSIT.
c. Performance Assessment Function – The Performance Assessment Function (PAF) provides capabilities associated with the Performance Assessment Suite and the Performance TACSIT (PTACSIT).

4.1.3.33.3.1.7 Planning Subsystem

The Planning Subsystem provides the operator capability for BMD mission planning. The subsystem presents plan parameters to the operator, displays plan geometries in the TACSIT window, and supports operator evaluation, approval, disapproval and deletion of plans and actions. The subsystem also provides authorized operators with the capability to create, modify, delete, and review BMD mission plans and components, evaluate plans, send plan data to Mission Planner, and display plans and outputs.

The Planning Subsystem software subsystem contains the following software components:

a. Engagement Plans Function – The Engagement Plans (EPF) component provides the interface between ADS and C&D to support operator actions and displays data .
b. Mission Planner Function – The Mission Planner (MPF) component provides authorized operators the capability to create, modify, delete, and review plans and plan components, to calculate/evaluate plans and to send plan data to Mission Planner. MPF provides the capability to display the plan components and the plan outputs derived from the plan calculations.

4.1.3.33.3.1.8 System Control and Status Subsystem

The System Control and Status subsystem provides functionality needed for control of the ADS, including initialization, reinitialization, and monitoring, and maintains the status of external computing elements. The subsystem performs Tactical Data recording of ADS data, and provides for replay/playback of combat system data at display consoles.

The System Control and Status Subsystem software subsystem contains the following software components:

a. Event Reconstruction Function – The Event Reconstruction (ERF) component performs the processing for Tactical Data Recording of ADS data and combat system data which is available only within ADS. To support testing and detailed reconstruction and analysis of system events, ERF supports the definition and extraction of recording data points.

b. Ownship Readiness Function – The Ownship Readiness (ORF) component maintains the status of the external computing elements and handles all navigational data entries.
c. System Control Function – The System Control (SCF) component performs the processing for ADS computer program initialization/re-initialization. The SCF is also responsible for monitoring the status of the ADS computer program and restarting it if it has failed, and handles reporting of the ADS Configuration to the external elements in response to login messages.

4.1.3.33.3.1.9 Track Support Subsystem

The Track Support subsystem provides for operator definition and control of Special Points and Tactical Zones, and supports operator track identification. The subsystem validates operator ID and IFF data entries and forwards the data to C&D, and also provides display of track ID histories.

The Track Support Subsystem software subsystem contains the following software components:

a. Identification Support Function – The Identification Support (ISF) component validates operator entries with regard to Identification and IFF data and forwards the entries to C&D. ISF first verifies that the track is an identifiable track which means the track's Identity value and it's IFF data can be modified by the operator.
b. Special Points Function – The Special Points (SPF) component provides the operator interface to C&D for the definition and control of Special Points, Tactical Zones, and Defended Assets.

4.1.3.33.4 Element Interfaces

Table 4.1-28 Aegis Display System Interfaces

Element	Interface Description	IDS
01 SPY	ADS interfaces with the SPY via a network interface to ALIS to provide SPY track data for display, and to allow operator control of the SPY system.	AMDR External IRS
02 C&D	ADS interfaces with C&D via a network interface to ALIS. Track data, tactical situation data, status data, and operational readiness data are sent from C&D to ADS. ADS sends engagement orders, manual tracks, operator actions (e.g., ID), controls (e.g. Doctrine), and status to C&D. ADS will also forward HDR requests from C&D to SPQ-9B and HDR responses from SPQ-9B to C&D.	WS-21272/11
02 C&D/TMs	The ADS subscribes for Track Data Messages defined in the data model. The messages are sent by system-level track managers within C&D.	IWS-OBJARCH-CDM
03 WCS	ADS interfaces with WCS via a network interface via ALIS for alerts, display data (engagements, doctrines, contours, etc.), and Window data.	WS-21264/10
07 ORTS	ORTS interfaces with AEGIS Display System (ADS) via network interfaces to ALIS to receive ADS readiness/assessment data. The ADS interfaces allow ORTS to initiate local diagnostics within the ADS processors, monitor heartbeat and make results available to ORTS.	WS-21267/9

Element	Interface Description	IDS
11 EWS	For ships equipped with SLQ-32(V)6, the EWS interfaces with ADS via ALIS to report system status (including inventory).	WS-35581
12 US&CS/SQQ-89	The AN/SQQ-89(V) system interfaces with ADS via the AN/SQQ-89(V) 1000Base-LR LAN interface to ALIS LAN. The AN/SQQ-89(V) system sends sonar performance prediction overlays to ADS.	WS-35772
15 EXCOM/CDLMS	CDLMS interfaces with the ADS via ALIS to display C2P/CDLMS/CSDTS HMI screens via X-Windows at the data link operator console. ADS sends X-windows control information to CDLMS, and CDLMS sends X-windows display graphics to ADS.	WS-35419
15 EXCOM/JTT-M	ADS interfaces with JTT-M via ALIS and CANES to provide the Alternate DBM and TAO workstation displays and controls via a Remote Desktop Protocol connection. JTT-M provides connection data and display frame buffers to ADS; ADS provides keyboard and mouse events to JTT-M.	WS-35575
28 CEC	(FOUO) ADS interfaces with CEC via a network interface via ALIS. CEC sends track ID data, network and system status data, and network status and alerts to ADS. ADS supplies operator action requests, including data entry requests, to CEC. This interface also supports the interactions required for defining, activating, and modifying composite ID doctrine. Classified as FOUO by CEC SCG [OPNAVINST S5513.3B-(119.10)]	WS-35412
29 MTC2 -1	The MTC2 /ADS interface provides the MTC2 displays using X- windows. The MTC2 /ADS interface will be an Ethernet interface using Transport Control Protocol/Internet Protocol (TCP/IP), via the CANES Classified network and ALIS.	WS-35411
29 MTC2 -2	ADS interfaces with MTC2 via ALIS and CANES to provide the Alternate DBM and TAO workstation displays and controls via a Remote Desktop Protocol connection. MTC2 provides connection data and display frame buffers to ADS; ADS provides keyboard and mouse events to MTC2 .	WS-35575
34 ATD-1	The TCP component of the Advanced Training Domain interfaces with ADS via ALIS to provide training control data, simulated track data, and respond to display requests, during training scenarios.	WS-21286/7

Element	Interface Description	IDS
34 ATD-2	The ADS interfaces with the Computer Aided Submode Trainer Open Architecture Suite (COAST) component of the Advanced Training Domain via a network interface via ALIS. ADS renders the COAST browser on the displays as a result of inputs from COAST. Inputs to COAST are sent directly to the X-Server.	WS-35548
37 HSRS/SPQ-9B	ADS interfaces with SPQ-9B via the ALIS network. ADS forwards High Data Rate (HDR) requests to SPQ-9B from C&D. SPQ-9B will report CANTCOs through ADS. ADS also provides radar controls and receives radar status.	WS-35429
39 ACI	This provides the physical interface for the ACI connectivity to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1
40 MP	ADS interfaces with MP via a network interface via ALIS. The display and operator control & interaction of Mission Planner functions is handled by ADS. MP sends plan data to ADS. ADS sends X-Controls and configuration data to the MP.	WS-21392
41 VCD	The VCD Computer Suite interfaces with the ADS via network interfaces to ALIS. Tactical situation data, status data and operational readiness data are sent from VCD to ADS. ADS provides VCD helo segment controls and status. ADS also sends handover requests to VCD.	IWS-OBJARCH-CDM
EXT/Operator	Operator Actions are provided to ADS via VAB Array and button presses, keyboard entry, and ball tab movement.	NA (OperatorActions)

4.1.3.33.5 Design Approach/Rationale/Constraints

Changes are identified in Aegis BL10 due to SPY-6 integration, Mk160 Upgrades, and CIWS Sensor integration.

SPY-6 integration impacts ADS for the RSC console with a new interface to SPY and new radar capabilities.

IAMD Mission Planner upgrades impacts ADS for new displays and controls of the mission planner.

Mk 160 upgrades impacts ADS for operator changes in capabilities of the GWS.

CIWS Sensor Integration impacts ADS for new source track type for CIWS sensor data.

4.1.3.34 Advanced Training Domain (ATD) (34)

4.1.3.34.1 Purpose

The Advanced Training Domain (ATD) will provide embedded Combat System (CS) team training capabilities commensurate with tactical capabilities through simulation and stimulation of sensors, data links, networks, and operator consoles. ATD controls the entry, exit and control over training elements based on the ship's safe condition for training. ATD will work with properly configured and selected stimulation/simulation training devices which will inject simulated ground truth environment conditions and entities into the combat system. ATD will provide relevant and timely feedback to trainees, including a dynamic exercise replay capability. ATD will provide the capability to prepare, conduct and assess organic training exercises and integrate platforms into distributed exercises and events.

ATD's design will provide coordinated, realistic shipboard multi-mission and multi-warfare training directly to the ship's Combat System Training Team (CSTT), Commanding Officers (COs), Afloat Training Organizations (ATOs), and Battle Force/Battle Group (BF/BG) commanders during organic or distributed events. ATD will provide a synthetic environment that includes electronically moving real ships and crews located in the same or separate ports within the common interactive synthetic environment. ATD interfaces directly to the Aegis Combat System (ACS) and their training elements during the Tactical Team Coordination Training (TTCT) during both organic and distributed exercises.

4.1.3.34.2 Requirements Satisfied

The Advanced Training Domain satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 2, Section 3.2.9.

4.1.3.34.3 Description

ATD provides on board training of individual or select teams while at sea or in port. ATD provides the connectivity for each ship with the Naval Continuous Training Environment (NCTE) to allow the team to participate in distributed training and events. ATD computer programs and software components reside on either the AN/USQ-T52 Interface Unit (IU) or resides on the common processor system provided with Aegis Computing Infrastructure. ATD will provide portable, non-tactical systems to shore facilities. The off-line capability provides the interactive work station for generation of scenarios for input to the TTCT mode.

ATD will provide the central control and coordination component used by the TTCT. ATD interfaces through the use of training code to the ACS element computer programs. ATD will activate, coordinate and monitor training exercises.

The Advanced Training Domain is depicted in Figure 4.1-31.

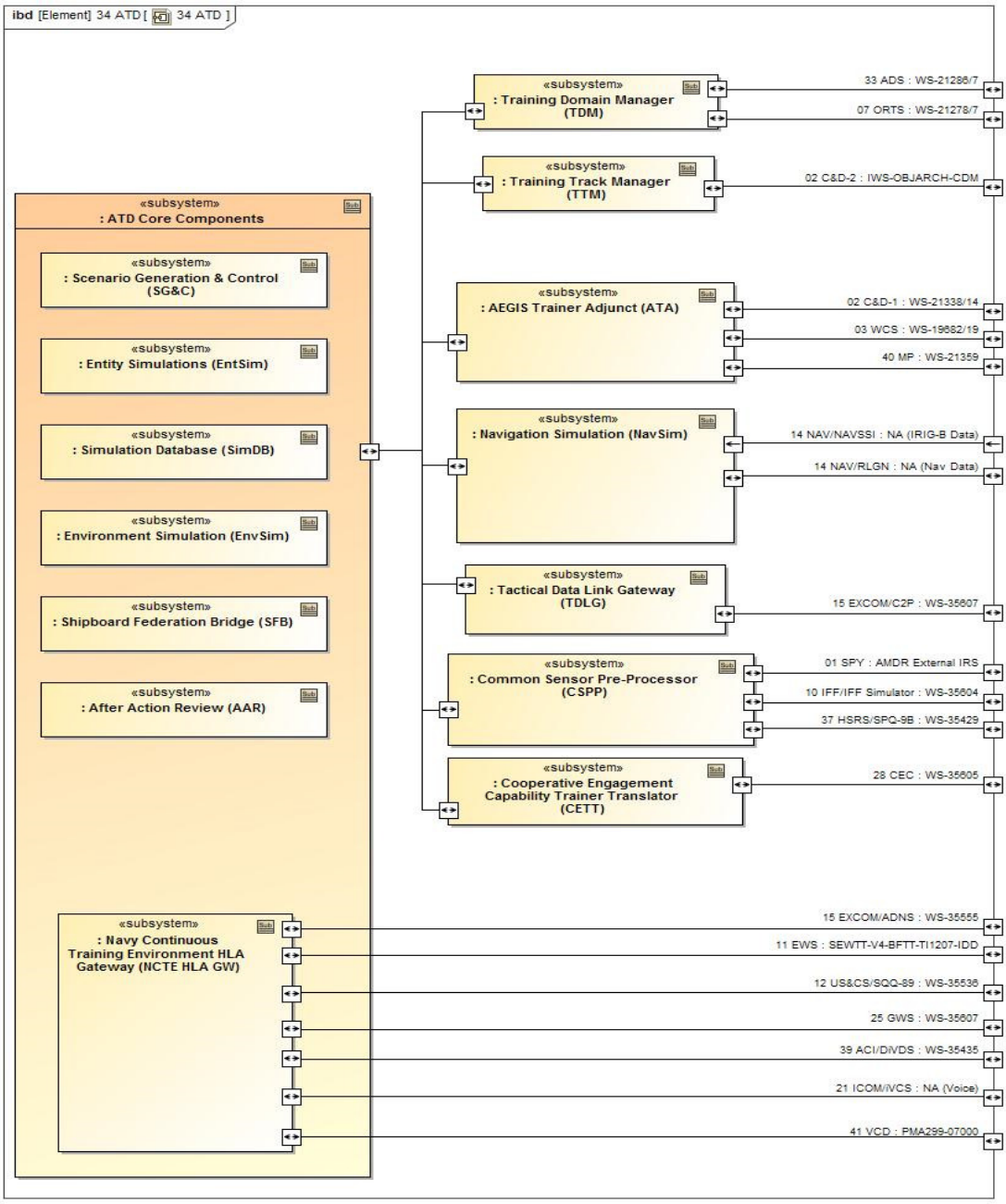

Figure 4.1-31 34 ATD

4.1.3.34.3.1 Training Domain Manager (TDM)

The Training Domain Manager (TDM) CSCI controls the organic total ship training capability systems, elements, and components entry into, execution of and exit from training and their status. TDM manages the exchange of status, training state, health and status diagnostics, data collection control, exercise control, and system shutdown information. TDM establishes the initial configuration for the ship, verifies the initial simulation states, and displays their status to the operator. During the exercise, TDM establishes the selected training configuration, responds to direction to start the training, controls the ship's CSTE, and updates the ship's training status. TDM generates operator displays and controls to define the training configuration required for the exercise, direct the ship's CSTE and update the status. Training Domain Manager communicates internally with all the ATD CSCI's. TDM communicates externally either directly or via other CSCIs.

TDM coordinates the ship's default training configuration after initialization completes. The ship defaults to organic training without permission to train. TDM directs each ship simulation to the inactive training state during the start-up. TDM receives status from the simulations and displays them on the training supervisor selected CS console. TDM shows the simulations able to participate and those not available to participate.
TDM manages the ship training configuration selected for the exercise. TDM responds to training configuration controls from the CS System Resource Manager (SRM) to start up and configure authorized training elements on the Training LAN prior to the start of a training exercise. TDM provides training configuration status to the SRM. TDM notifies SRM when the transition to the requisite training configuration completes. TDM notifies the SRM which simulations acknowledged participation and which ones responded unable to participate. TDM processes the PTT signal from the SRM and notifies the simulations to begin distributing simulated data. TDM coordinates requests to the stop exercise.

TDM coordinates the ship's training configuration shutdown. TDM receives direction from the SRM that the ship removed permission to train. TDM directs each ship simulation to the inactive training state prior to shut down. TDM receives status from the simulations and displays as they terminate in an orderly fashion, displays them on the training supervisor selected CS console prior to shutting down and relinquishes control of the selected console.

During the exercise TDM generates an automated real time system status display to provide improved situational awareness to the shipboard training team, allowing them to better maintain the system in training and more quickly troubleshoot casualties.
TDM communicates internally with all the ATD CSCI's. TDM communicates with them to provide direction and receive status. TDM communicates externally directly with the AWS/ACS, CDL GW and the MH-60R Simulation. TDM communicates with BEWT, SEWTT and SAST via the Shipboard Federation Bridge (SFB). TDM communicates with CIWS, NSSMS, and the TSSS via the DIS Gateway. ATD communicates with the SPQ-9B and the IFF Simulator via the CSPP. ATD communicates via the NCTE HLA GW to exchange status of shipboard training elements during distributed exercises.

4.1.3.34.3.2 Training Track Manager

The Training Track Manager (TTM) CSCI performs entity resolution pairing between each ground truth entity with the corresponding training system track and adds the entity ID to the product line Track Server. The TTM CSCI will associate ground truth entities (e.g., long range TDL and MH-60R-reported tracks) with the resulting training system tracks and provides the results to the CS via the product line Track Server. The results allow the training supervisor to interact with trainees using training system track numbers, supports data analysis and after action review, allows trainers to role play synthetic platforms, and allows missile simulators to know the entity ID of their targets to support realistic acquisition of the target. The TTM also supports future improvements in simulated track data tagging and correlation and use of that associated data for vehicle and missile simulations. TTM receives CS track data through the PLA's Track Server (as described in DN 16-05 IRS for ATD PL) and associates the CS track with the ground truth track.

4.1.3.34.3.3 Navigation Simulation (NavSim)

The Navigation Simulation (NavSim) CSCI accepts the ownship ground truth entity from the STF. The NavSim CSCI uses models of ownship and local environmental conditions to simulate ownship's navigation data. NavSim simulates the effect on positional and movement data for a simulated ownship. NAVSIM communicates externally to the navigation distribution systems. The navigation distribution systems provide ownship navigation data to the CSE and CSTE. NavSim receives real navigation data from the navigation distributions systems to use for the ownship constructive entity maintained within the synthetic environment.

4.1.3.34.3.4 Tactical Data Link Gateway (TDLG)

The Tactical Data Link Gateway (TDLG) CSCI emulates the TDL terminal to provide a permanently installed mechanism for exchanging TDL messages using SIMPLE protocol as defined by STANAG 5602. The TDLG interfaces internally with the MH-60R and the constructive Link-16 capable entities simulated by EntSim. The TDLG exchanges Link-16 with the external distributed units participating in an NCTE FST exercise via the NCTE HLA GW. The TDLG communicates on live links via CDLMS/C2P with other participants.

4.1.3.34.3.5 Common Sensor Pre-Processor (CSPP)

The Common Sensor Pre-Processor (CSPP) CSCI manages the synthetic environment for the IFF Simulator and SPQ-9B specific pre-processors. The CSPP will provide this service for the SPY-6 (AMDR) sensor specific pre-processors or CSTE. The CSPP maintains a common view for these sensors based on their collective performance boundaries, CS field of view, and simulation requirements. The CSPP determines which ground truth objects would be visible to the sensor. The CSPP translates between the DN 16-02 IRS for ATD STF and the Radar/IFF HLA FOM (DN 15-6). The CSPP does not require displays or controls. The CSPP communicates internally with each organic shipboard HLA FOM member. The CSPP communicates externally with the IFF Simulator.

The CSPP models and simulates the cumulative effects of the synthetic environment on the sensors. The CSPP accounts for the entities and environment attributes on the signal received by the sensor. The CSPP determines which ground truth entities within the sensor's field of view would be observable by the sensor given the simulated environment conditions (e.g., propagation effects, jamming), entity presentation (orientation) to the sensor, and instrumented performance of the sensor. The CSPP includes the entities target size, perspective and range, electronic countermeasures, clutter, terrain masking, and ducting impact on the signal received by the sensor. The CSPP considers the location of the ship with respect to the target, as well as the location of the sensor aboard the ship, in determining if the sensor may detect each target. The CSPP will use the training ownship position and will transform inputs to account for the difference in position, orientation and motion of the training ownship from the tactical ownship for those sensors that are capable of maintaining two ownship representations. This includes transforming object state vectors from the simulated gameboard to the sensor perspective.

The CSPP communicates internally via HLA with the ATD CSCI's and externally with the IFF Simulator. The CSPP processes ground truth entities and environmental conditions in accordance with the DN 16-02 IRS for ATD STF and by the Radar/IFF HLA FOM (DN 15-6). The CSPP connects to the HLA run time infrastructure using the Simulation Management Framework (SMF). The CSPP responds to simulation controls, including controls to enable and disable injecting synthetic data into the CS. The CSPP communicates internally with the TDM, EntSim, EnvSim, SFB, ATA, DIS GW, and the CETT CSCI's. The CSPP communicates externally with the IFF Simulator.

4.1.3.34.3.6 Cooperative Engagement Capability Trainer Translator (CETT)

The CET Translator (CETT) CSCI performs translation,and manages control, display, and status for the CET. The CETT CSCI translates between the organic shipboard interface for ATD STF and the interface with CET.

4.1.3.34.3.7 AEGIS Trainer Adjunct (ATA)

The AEGIS Trainer Adjunct (ATA) CSCI communicates with the command and control, weapon system, SPY and training components embedded within each CSE. ATA provides the interface for the ACS with ATD and performs the following operations: Initiate and terminate simulated engagements for ESSM, SM,

GWS, PWS, Mines, and VLA in response to data received from other elements; Compute simulated weapon trajectories for VLA ownship weapons based on predicted intercept information received from other elements; Compute simulated BM flight trajectories based on launch position, impact position, and burnout conditions; Evaluate engagements and simulate effects of hits and misses as appropriate; Exchange weapon launch, detonation, and collision information for engagements between ATD/NCTE controlled entities and ownship/ownship launched weapons. ATA will implement the STF and translate TCP/IP data exchanges with legacy AWS elements that contain AWS unique data that must be conveyed via HLA to ATD components and the over the NCTE. ATA communicates simulation data and status via the Training LAN in accordance with DN 16-02 IRS for ATD STF.

4.1.3.34.3.8 ATD Core Components

The ATD Core Components consist of SG&C, EntSim, SimDB, EnvSim, SFB, AAR, and NCTE HLA GW.

4.1.3.34.3.8.1 Simulation Database (SimDB)

The Simulation Database (SimDB) CSCI maintains the maps, terrain, physical features, entity and environmental models and attribute data required by SG&C, EntSim and EnvSim CSCIs to create the synthetic environment. SimDB responds to requests for data required for entity creation, motion and behavior modeling, and stimulation of organic sensors. The SimDB honors requests by retrieving data from the local repository. The data repository contains information derived from various authoritative and approved sources.

4.1.3.34.3.8.2 After Action Review (AAR)

The After Action Review (AAR) CSCI provides the metrics and objective quality evidence based products utilized by the ATG and CSTT to debrief the training audience. AAR assists the training team to assess and analyze training audience performance against the training objectives for single exercise events and to determine negative or positive trends in performance.

4.1.3.34.3.8.3 Entity Simulations (EntSim)

The Entity Simulation (EntSim) CSCI provides entity motion and behavior within the synthetic environment with authoritative kinematic and behavioral characteristics for each entity. EntSim provides the interactions between the distributed participants, constructive entities, and environments. The EntSim CSCI provides the constructive entity sensor and weapons event simulations. EntSim produces the system track database that represents the constructive ground truth entities' perception for use by the TDL GW CSCI and the entities interactions within the synthetic environment. The EntSim interfaces with the ATD CSCIs and the CSTE and provides the ground truth entities, attributes, events, interactions and updates.

4.1.3.34.3.8.4 Environment Simulation (EnvSim)

The Environment Simulation (EnvSim) CSCI provides Meteorological and Oceanographic (METOC) data via HLA for single ship exercises. The EnvSim GUI allows for selection of environmental data from 14 different regions. The EnvSim makes the same regions and data sets used for NCTE/FST events available to the organic simulations. The EnvSim provides the environmental METOC data to the stimulators/simulators that require environmental data.

4.1.3.34.3.8.5 Scenario Generation & Control (SG&C)

The Scenario Generation & Control (SG&C) CSCI generates synthetic environment and ground truth objects for organic shipboard training. The SG&C component provides the training operator displays and controls to create the types of objects and environmental effects required to meet training objectives. SG&C augments the common scenario data with higher fidelity effects and additional ground truth objects in order to meet mission specific training objectives. Objects managed by SG&C must be able to interact with objects generated by other simulations. SG&C also supports trainer operator interactions with the scenario. The SG&C CSCI interfaces with the Entity Simulation (EntSim), Environment Simulation (EnvSim) and Simulation Database (SimDB) CSCIs.

4.1.3.34.3.8.6 Shipboard Federation Bridge (SFB)

The Shipboard Federation Bridge (SFB) CSCI communicates internally with the TDM, EntSim, EnvSim, TTM, AEGIS Training Adjunct (ATA), TDLG, CSPP, DIS GW, and the Cooperative Engagement Capability (CETT) CSCI's. The SFB communicates externally with the BEWT II, SEWTT and the SAST. SFB translates between BEWT II, SEWTT, and SAST and the other members of the shipboard training federation. SFB does not require display or controls.

4.1.3.34.3.8.7 Navy Continuous Training Environment HLA Gateway (NCTE HLA GW)

The Navy Continuous Training Environment HLA Gateway (NCTE HLA GW) CSCI connects the organic TSTC capability with the NCTE. NCTE and ATD exchange information over the NCTE infrastructure to connect ships to external event synthetic environments including FST. They exchange information between the distributed participants, the organic total ship training capability systems, elements, and components (referred to as the ship) to form that shared synthetic environment. The NCTE HLA GW CSCI translates between the NCTE HLA FOM and the organic Interface Requirements Specification (IRS) for the Advanced Training Domain (ATD) Shipboard Training Federation (STF), DN 16-02- IRS for ATD STF, V1.0. NCTE HLA GW filters and prioritizes based on attribute controls which raise or lower the priorities of the NCTE and distributed participant provided synthetic environment for each Ship prior to distributing internally. NCTE HLA GW exchanges the Tactical Link 16 and Link 11 messages generated by or transmitted by other participants and constructive entities. NCTE HLA GW provides the Cybersecurity functionality required to allow the organic shipboard organic total ship training capability systems, elements, and components to communicate off ship. NCTE HLA GW generates operator displays and controls to limit and prioritize information received on-board each Ship received from external participants. The NCTE HLA GW communicates internally with each organic shipboard HLA FOM member. NCTE HLA GW communicates externally with the NCTE via the BDC.

The NCTE HLA GW exchanges status and controls, the shared synthetic environment, and provides data and protocol mediation between the NCTE FOM and the organic shipboard FOM. The NCTE GW allows each ship to function as a member of the NCTE federation which includes the JSAF FOMs and each distributed participants' organic shipboard FOMs. The ship registers to receive from and provide to the NCTE BOM which contain the critical aspects of the simulations and federations. They address status and controls and the synthetic environment, and the types of objects, attributes, and interactions. The Simulation Management (SIMAN) BOM provides the status and controls used in distributed events. The synthetic environment BOMs include the SimEntity, Sonobuoy Control, Emitter BOM, Transponder BOM, Underwater Acoustic BOM, METOC BOM, and Transponder BOM. The SimEntity BOM provides the representation and interactions between entities. The Sonobuoy Control BOM provides the sonobuoy representations and the sonobuoy command interactions. The Emitter BOM provides the electromagnetic emitter representations, systems that produce and detect them, and interactions. The Transponder BOM provides the IFF, AIS and TACAN representation and interactions. The Underwater Acoustic BOM provides the underwater acoustic emission representations and interactions required for acoustic based systems with active and/or passive sensors to detect, track and prosecute surface and subsurface constructive entities. The METOC BOM provides the environmental representations and interactions required for sensors.

The NCTE HLA GW mediation function decouples the NCTE and organic shipboard environments. The NCTE HLA GW isolates the impacts of Naval Warfare Development Command (NWDC)/JSAF/FOM changes from the internal shipboard environment and its FOMs and allows them to be assessed and controlled. Not all NWDC/JSAF FOM changes apply to the shipboard simulations. Abstracting the organic shipboard FOM from the NCTE FOM and associated requested changes allows them to be managed within the shipboard systems ACB and certification processes.

The NCTE synthetic environment reflects the theater-wide (world view) required to meet an exercise's objectives and the needs for each distributed participant and/or constructive entity based on their knowledge of themselves and the interactions between them. This includes not only their view of the simulated physical environment, their own view of themselves, the other entities in the synthetic environment, and of the effects of the other entities on themselves and the synthetic environment. Each ship maintains the simulated world (synthetic environment) from its own vantage point bounded by its

CS's performance, based on the results of its own simulation and processing of event messages received from all external entities. The ship will only be interested in those objects that are within its performance boundaries, cooperative engagement capabilities and data links. The NCTE HLA Gateway provides the mechanism for managing the exercise entities that the ship needs to see by establishing filters and priorities which reflect exercise's requirements and accounts for the processing load on the ship's hardware resources.

The NCTE HLA GW exchanges Link Data in the Standard Interface for Multiple Platform Link Evaluation (SIMPLE) format defined by STANAG 5602. The NCTE HLA GW receives the messages from the NCTE infrastructure and will route the information directly to the TDL Gateway and the MH-60R simulation. The NCTE HLA GW receives the messages in SIMPLE STANAG 5602 format and passes those messages on to the NCTE infrastructure for distribution for use by the distributed participants and the constructive entities.

The NCTE HLA GW utilizes the BDC between the CS and NCTE. The gateway uses the same technology used in the CS BDC that forms the CS interface to Consolidated Afloat Networks and Enterprise Services (CANES) and communication interfaces external to the ship.
The NCTE HLA GW provides the displays and controls to prioritize and limit the external constructive entities. The controls provide criteria based on capacity, BOM attributes and CS performance boundaries. The NCTE HLA GW defaults the capacity at 2000 externally received constructive entities and distributed participants.

Controls allow the NCTE HLA GW to filter out all constructive entities. The priority criteria defaults to distributed participants and constructive entities with friendly force identifier followed by those constructive entities closest to the ship. Attribute controls raise or lower priority criteria utilizing attributes included in the SimEntity BOM. NCTE HLA GW automatically filters events associated with filtered constructive entities or distributed participants.

The NCTE HLA GW communicates internally with the Training Domain Manager, EntSim, EnvSim, Shipboard Federation Bridge, TTM, ATA, Training Data Link Manager, CSPP, DIS GW, and the CETT CSCI's. The NCTE HLA GW communicates externally with the NCTE infrastructure and the MH-60R simulation on-board ship. It does not require display or controls.

4.1.3.34.4 Element Interfaces

Table 4.1-29 Advanced Training Domain Interfaces

Element	Interface Description	IDS
01 SPY	ATD exchanges data with SPY, to support training system operations, via ALIS. ATD provides SPY with training track data, such as simulated aircraft and missiles. ATD does not simulate ownship guided missiles.	AMDR External IRS
02 C&D-1	ATD exchanges data with C&D, to support training operations, via ALIS. During training operations, training control data and simulated track data are sent to C&D.	WS-21338/14
02 C&D-2	The C&D Computer Suite provides System Track data to the ATD.	IWS-OBJARCH-CDM

Element	Interface Description	IDS
03 WCS	ATD exchanges data with WCS to support training operations. The WCS interface with ATD accepts the designation and termination of TTCT mode from C&D. In addition, WCS supports VLS, FCS, and PWS during Team (TTCT) and Sub-Team training.	WS-19682/19
07 ORTS	ORTS supports an interface with ATD for the purpose of enabling ATD to report system status and fault isolation data.	WS-21278/7
10 IFF/IFF Simulator	ATD provides ground truth training entities to the IFF Sim component of IFF via the Training LAN. IFF Sim provides simulated IFF returns allowing for IFF challenges of synthetic tracks, and simulated IFF video.	WS-35604
11 EWS	ATD provides ground truth training entities to the SEWTT component of EWS via the Training VLAN. This data includes emissions, kinematics and control signals required to provide integrated training. SEWTT will then inject synthetic EW contacts into the EWS sensor resulting in sim EW tracks being generated in the Combat System.	SEWTT-V4-BFTT-TI1207-IDD
12 US&CS/SQQ-89	The SAST Component of the AN/SQQ-89A(V)15 interfaces with ATD via the Training LAN on ALIS. The SAST Component accepts simulated ASW target and environmental data from ATD and transmits it to Hull Sonar System (HSS) and Helo Support Equipment (HSE). The response from HSS and HSE are sent back to ATD. The USW-DSS Simulator of the AN/SQQ-89A(V)15 interfaces with ATD via the Training LAN on ALIS. The USW-DSS Sim allows for training ASW planning.	WS-35536
14 NAV/NAVSSI	ATD components receive IRIG-B time data.	NA (IRIG-B Data)
14 NAV/RLGN	The NAVSIM component of ATD provides the RTS with simulation data that is used to create the OD12 navigation training message. The NAVSIM interfaces with ICOM to distribute simulated navigation data during training exercises. To maintain ships reference, ICOM passes digital navigation messages containing pitch, ownship heading, roll, and Lat/Long to the NAVSIM. During training exercises, this navigation data is distributed to other AWS and ACS systems via NAVSSI.	NA (Nav Data)

Element	Interface Description	IDS
15 EXCOM/ADNS	The EXCOM TDL LAN provides the interface between the in port ships and the wide area network (WAN) gateway. The WAN gateway controls the flow of data between the shore sites and in port ships. Most of the WAN interfaces have been converted from copper to fiber optics. Several Atlantic coast ports have not been converted to fiber optics and can only support copper. Ships associated with these ports will require both copper and fiber TDL interfaces.	WS-35555
15 EXCOM/C2P	ATD provides ground truth training entities to the TDL Gateway via the Training LAN. The TDL Gateway provides the L-16 messages generated by the synthetic IUs that are injected into the Combat System.	WS-35607
21 ICOM/iVCS	The Secure Voice System interfaces with Battle Force Tactical Training component of the Advanced Training Domain via IVCS to provide interior voice communication during training exercises.	NA (Voice)
25 GWS	ATD provides ground truth training entities and simulated navigation to the EO/IR Sim via the Training LAN. The EO/IR Sim generates simulated EOSS video that can be viewed at the GUNS or ACI consoles.	WS-35607
28 CEC	(FOUO) ATD provides ground truth training entities and simulated navigation to the CEC Enhanced Trainer (CET) component of CEC. The CET provides simulated remote data for injection into a single shipboard Cooperative Engagement Processor (CEP) using the CEP/Data Distribution System (DDS) interface of the CEP.	WS-35605
33 ADS	ATD interfaces with ADS via ALIS to provide training control data, simulated track data, and respond to display requests, during training scenarios.	WS-21286/7
37 HSRS/SPQ-9B	SPQ-9B maintains a C&D interface, which provides the designation and termination of the TTCT mode. SPQ-9B can accept and process up to 32 dynamic air or surface tracks from ATD while concurrently processing tactical data.	WS-35429
39 ACI/DiVDS	DiVDS receives analog (RGB) Training Display video.	WS-35435

Element	Interface Description	IDS
40 MP	This interface allows MP to send training Launch and Impact point position data to ATD after a training scenario has been initiated. It consists of two-way TCP/IP connection over the ALIS network between the active MP Server and ATD.	WS-21359
41 VCD	The MH-60R Sim Component of ATD interfaces with the VCD Computer Suite system via ALIS. MH-60R Sim sends PMA299-07000 interface simulation for MH-60R to VCD. MH-60R component interfaces with ATD via the Shipboard Training.	PMA299-07000

4.1.3.34.5 Design Approach/Rationale/Constraints

Changes for ATD have been identified for SPY-6 integration and SUW/ASW training improvements.

SPY-6 integration for training involves ATD providing synthetic data to SPY-6 during training scenarios.

Additional SUW and ASW simulators are planned for integration as part of Mk160 upgrades and J3.4 integration.

4.1.3.35 Not Used (35)

This number was previously used for the Shipboard Non-Tactical Automated Data Processing Program (SNAP). SNAP is no longer part of Aegis.

4.1.3.36 Not Used (36)

The number was previously used for the Area Air Defense Commander (AADC). AADC no longer part of Aegis.

4.1.3.37 Horizon Search Radar System (37) (SPQ-9B Equipped Ships Only)

4.1.3.37.1 Purpose

The Horizon Search Radar System (HSRS), AN/SPQ-9B, provides simultaneous AAW horizon and SUW surface search and track surveillance capability for the detection and track of low-flying ASM, aircraft, and surface targets. The AN/SPQ-9B is an X-band Pulse-Doppler, track-while-scan radar that detects small, low altitude air contacts at the horizon in heavy clutter, and is used to supplement SPY for horizon search missions. . The AN/SPQ-9B with Periscope Detection and Discrimination (PDD) provides a long range periscope detection capability while maintaining the radar's track-while-scan functions. The radar has a Horizon (Air and Surface) mode of operation where air and surface waveforms are transmitted separately out the two antenna faces. It also has a Periscope mode of operation where air waveforms are transmitted out both antenna faces simultaneously for half of the antenna's scan and surface/PDD waveforms are transmitted the other half of the antennas scan.

The AN/SPQ-9B is one of the primary GWS detection and tracking sensor and provides all weather GWS target designation, target positioning, and projectile splash data (spotting) to support gun engagement of surface targets. Radar surface tracks are also provided to GWS operator consoles via DDS for GWS operator cueing of the Mk20 EOSS video tracking device used in operator visual target identification and EOSS optical target tracking and firing. C&D creates system tracks from AN/SPQ-9B radar data and also designates appropriate ACS/AWS weapon response. C&D may employ weapon responses against tracks held by SPQ-9B alone. AN/SPQ-9B also provides tracks directly to CEC via ALIS in support of shared situational awareness. Either C&D or the GWS may control the AN/SPQ-9B.

4.1.3.37.2 Requirements Satisfied

The HSRS Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 3, Section 3.2.24.

4.1.3.37.3 Description

The AN/SPQ-9B Radar Set, is a high-resolution, track-while-scan, pulse-Doppler X-band radar that provides rapid acquisition and automatic tracking of multiple targets. The radar detects sea skimming missiles and low altitude aircraft at the horizon even in heavy clutter while simultaneously providing detection and tracking of surface targets and periscopes when in Periscope mode. HSRS supplements SPY for horizon search missions by reporting appropriate contact and track data to SPY-6 via ALIS and C&D and also to CEC via ALIS. The Gun Weapon System (GWS) interface is a direct DDS (formerly LRAADS) connection.

The AN/SPQ-9B Primary functions are:

· Detect and Track Surface Targets
· Detect and Track Air and Sea Skimming Targets
· Provide Data to Cue AN/SPY-6 Radar to acquire Threat Targets
· Provide fire control tracking for local AAW engagements
· Provide fire control tracking and engagement support for GWS
· Detect periscopes and provide periscope alerts on dedicated displays
· Pass periscope alerts to CND once adjudicated by an operator as valid

The Self Defense Sector Function allows quick response detection of low-flying high-threat targets by the Air mode. When enabled by C&D, AN/SPQ-9B automatically detects, tracks, and reports any targets entering an operator defined Self Defense sector that meet Auto Special Clear doctrine requirements. AN/SPQ-9B is one of the sensor inputs to the two Electrical Equipment Racks for distribution of the video signals to the AWS Computing Infrastructure (ACI) and the Gun weapon System (GWS). Raw video is either unprocessed linear video or normalized videoSensitivity Time Control gain and flat range settings can be applied to the Raw videoeither at the Radar Set Control, at CND or at the GWS and the selection applies to all raw video outputs. Clear plot video is synthetic surface video and represents signals from a contact that have exceeded the Constant False Alarm Rate (CFAR) threshold level and passed scan-to-scan correlation criteria. Clear plot video is the video with the least amount of clutter and noise displayed.

Land and sea return are normally filtered out of clear plot video unless the returns are very strong and have Doppler coherency.

The Horizon Search Radar System is depicted in Figure 4.1-32.

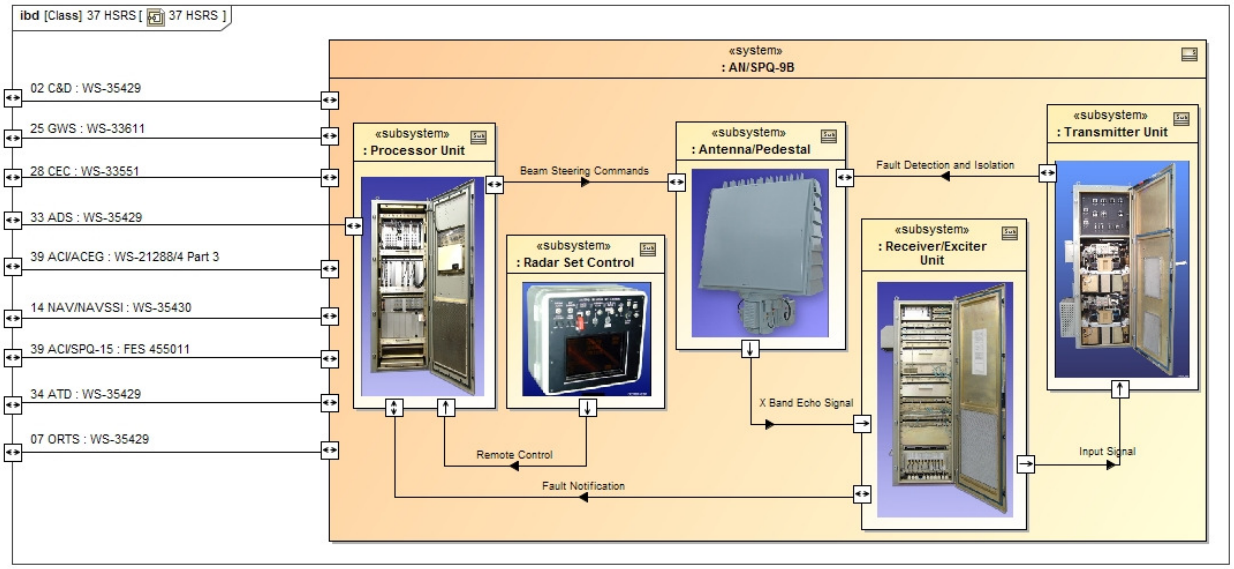

Figure 4.1-32 37 HSRS

4.1.3.37.3.1 AN/SPQ-9B

The AN/SPQ-9B is composed of a Radar Set Control, an Antenna and Pedestal, a Receiver/Exciter, a Transmitter Unit, a Processor Unit, and three Periscope Detection and Discrimination (PDD) monitors as described in the below sections.

4.1.3.37.3.1.1 Radar Set Control

The remote Radar Set Control (RSC), located in CIC, offers manual control of Antenna Scan, RF radiation out the antenna or in to dummy loads, enabling of Battle Short mode, remote control of radar power levels (Pre-Standby, Standby and Radiate), video output settings, and control of Radar operational mode. Video control include enabling and setting of Sensitivity Time Control (STC) range and gain and enabling/disabling of background video addition to Clear Plot video outputs. RSC also has menus to allow for selection of radar operating frequency group, selection/deselection of specific frequencies within a group, control of one RF blanking sector, control on one coherent/non-coherent surface sector (when operating in Horizon mode) and menus to monitor interface statuses.

4.1.3.37.3.1.2 Antenna/Pedestal

The lightweight antenna is a dual rotating back-to-back slotted stick array antenna. In horizon mode one face supports surface tracking and the other face supports air tracking. For critical tracking functions, e.g., high-data-rate fire control tracking in support of Air or Surface engagements, the opposite faced puts out air or surface waveforms in a narrow bearing region to double the radar update rate. The identical air and surface arrays are independently steered in elevation to maintain the radar beams on the horizon. The antenna's nominal rotation rate is 27.7 RPM. The Beam Steering Controller (BSC) and BSC Power Supply are mounted inside in between the Antenna arrays. The azimuth drive motor, pitch/roll rate gyro assembly, encoder assembly, slip ring/rotary joint and Pedestal Electronics Assembly (PEA) are mounted to the Antenna pedestal. The PEA houses the CH A/CH B Transmit/Receive Limiters, circulators, Antenna BIT and Interface CCA, the CH A, CH B, Aux and spare Low Noise Amplifiers (LNA), noise source assembly and waveguide switches to route received RF to the spare LNA. The PEA also houses dual redundant 9 and 15V DC power supplies.

4.1.3.37.3.1.3 Receiver/Exciter Unit

The Receiver-Exciter Unit contains a combiner, Transmit Test Modulators, Air and Surface Synthesizers, Common Frequency Generator, Stepped Exciter, Channel A, B, C and D Receivers, and the RF Distribution hardware.

4.1.3.37.3.1.4 Transmitter Unit

The Transmitter cabinet contains VME hardware and is an air-cooled unit. The unit contains an RF dummy load, servo-amplifier, linear power supplies, and waveguide switch. The unit is divided into upper and lower units with the upper unit housing the system power distribution circuits. The lower unit contains two transmitter assemblies with dual High Voltage Power Supplies (HVPSs) and Traveling Wave Tubes (TWT); along with RF switches, that allow graceful system degradation in the event of a TWT or HVPS failure.

4.1.3.37.3.1.5 Processor Unit

The Processor cabinet contains Versa Module Eurocard (VME) hardware and is an air-cooled unit. There is a Radar Control Panel (RCP) on the front of the unit that provides the same functions as the Radar Set Control (RSC) located in CIC. The RCP and associated touchscreen also allow for maintenance controls and features not available at the RSC. Inside the cabinet are three VME card buckets. The upper bucket contains four Receiver Interface Modules (RIMs) that receive radar I/Q data from the air, surface, Aux C and Aux D Receivers. The RIMs pass this data to onboard Digital Processor (DSP) CCAs associated to each radar channel. The contact data developed in the DSPs is passed via Ethernet to the middle card bucket to the air and surface trackers where tracks are formed and passed to C&D, CEC and the Gun Weapon System. . The Processor also contains a Scheduler board that determines radar waveforms to be used in the upper bucket and Local Interface processor in the middle bucket that receives Built In Test information from all units and controls communications with the RCP and RSC touchscreens. The middle bucket also contains a Land/Bathymetry Map and PDD Display processor with an internal hard drive installed that is used to store data extraction and a network switch that controls communication to C&D,

CEC, and GWS. The third VME bucket contains 3.3V DC, 5V DC, and 12V DC power supplies that provide power to the boards located in the middle and upper bucket. There are extra power supplies installed to ensure radar is still operational in the event of a power supply failure.

4.1.3.37.3.1.6 Periscope Detection and Discrimination Display Units

There are three identical 24" PDD displays utilizing a Linux Operating System. All functional operator display interfacing is accomplished with a mouse that is connected to the display. The only external connections are a copper Ethernet cable that provides communications with the radar processor and 115 VAC/60Hz power from the ships power distribution system.

The primary purpose of the PDD display is to provide the operator with the information required to accurately evaluate periscope exposures from environmental and biological clutter and surface contacts. This is accomplished via two screens: 1) The Main Screen consisting of a track Plan Position Indicator (PPI) system status, and hooked track data and 2) The Adjudication Plots Screen used to evaluate system alerts to determine if a periscope alarm should be declared and the PDD track manually entered in to the combat system.

4.1.3.37.4 Element Interfaces

Table 4.1-30 Horizon Search Radar System Interfaces

Element	Interface Description	IDS
02 C&D	The Radar supports a fiber Ethernet interface to C&D via ALIS to report Track Data and Antiship Missile targets. C&D provides sector control and target doctrine commands. Power PCs with I/O daughter boards are located within the Radar Data Processor Unit-101 to support these LAN interfaces. C&D also shares control of the radar with the GWS.	WS-35429
07 ORTS	ORTS interfaces via network interfaces to ALIS to receive AN/SPQ-9B readiness/assessment data.	NA (Test Request/Response)
14 NAV/NAVSSI	Digital Inertial Navigational Data from both RLGNs is transmitted to the AN/SPQ-9B Radar Data Processor via a multicast message from NAVSSI over ALIS.	WS-35430
25 GWS	The SPQ-9B has a direct interface to GWS via ALIS. The radar provides SPQ-9B track reports to the GCS computer and raw and clear plot video to the GWS consoles.	WS-33611
28 CEC	(FOUO) The SPQ-9B radar provides track data to CEC to be integrated into its composite track reports to the combat system. Classified as FOUO by CEC SCG [OPNAVINST S5513.3B-(119.10)]	WS-33551
33 ADS	ADS interfaces with HSRS via a network interface via ALIS. HSRS sends sector and system status to ADS. No True Bearing Indicator (TBI) signal is generated by AN/SPQ-9B, thus the ADS generates a simulated TBI signal. ADS sends high data rate requests to HSRS. SPQ-9B will report CANTCOs through ADS.	WS-35429

Element	Interface Description	IDS
34 ATD	The AN/SPQ-9B Radar Set supports ATD during the TTCT mode. AN/SPQ-9B maintains a C&D interface, which provides the designation and termination of the TTCT mode. AN/SPQ-9B can accept and process up to 32 dynamic air or surface tracks from TCP while concurrently processing tactical data.	WS-35429
39 ACI/ACEG	The ACEG provides mission critical and mission essential services to all the elements in the AEGIS Combat System. Within the Advance Processing Services (APS) suite of equipment are two ACEG cabinets – one identified as forward (FWD) and one identified as aft (AFT).	WS-21288/4 Part 3
39 ACI/SPQ-15	The AN/SPQ-15(V) interfaces with the AN/SPQ-9B to receive radar raw/normalized and clear plot video inputs, PPI trigger inputs, Azimuth Change Pulse (ACP) and Azimuth Reference Pulse (ARP) inputs and radar antenna synchro sweep information to allow for video/sweep generation. This data is distributed to ADS Consoles in CIC, Gun Weapon System Consoles, Integrated Bridge System, SPA-25G, and SPS-73 Stand Alone Processor consoles.	FES 455011

4.1.3.37.5 Design Approach/Rationale/Constraints

SPQ-9b has two updates for BL10: integration with SPY-6 and periscope detection mode.

4.1.3.38 Not used (38)

This number was previously used for the Naval Fires System (NFS)

4.1.3.39 AWS Computing Infrastructure (39)

4.1.3.39.1 Purpose

The AWS Computing Infrastructure supports the Open Architecture (OA) approach of multiple AWS elements sharing the same storage equipment, processing equipment, and network equipment. The ACI sub-assemblies that support the system requirements for C&D, WCS, FCS, ORTS, ADS, VCD and ATD consist of Servers, Input/Output (I/O) Processors, Core Switches, Edge Switches, Remote Storage, Local Storage, Removable Media, Projectors, Calibration Sensors, a Screen Assembly, and Operator Control Devices.

OA is a compatible set of largely standards-based COTS computing infrastructure components (hardware and software) that provides the computational framework upon which tactical and support applications are built under the guidelines of OA. The scope of OA includes technical architecture, standards and products.

4.1.3.39.2 Requirements Satisfied

The ACI Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 2, Section 3.2.10.

4.1.3.39.3 Description

The ACI element is comprised of the AEGIS Weapon System (AWS) Computing Infrastructure (ACI). ACI supports the functionality of multiple AWS Elements housed within Free Standing Units (FSU). Multiple AWS Elements share the same storage equipment, processing equipment, and network equipment. The ACI also provides for camera and radar video distribution to CDS consoles and other displays throughout the combat system. The ACI consists of the Processing Group and the Network and Conversion Equipment.

The AWS Computing Infrastructure is depicted in Figure 4.1-33 thru Figure 4.1-37.

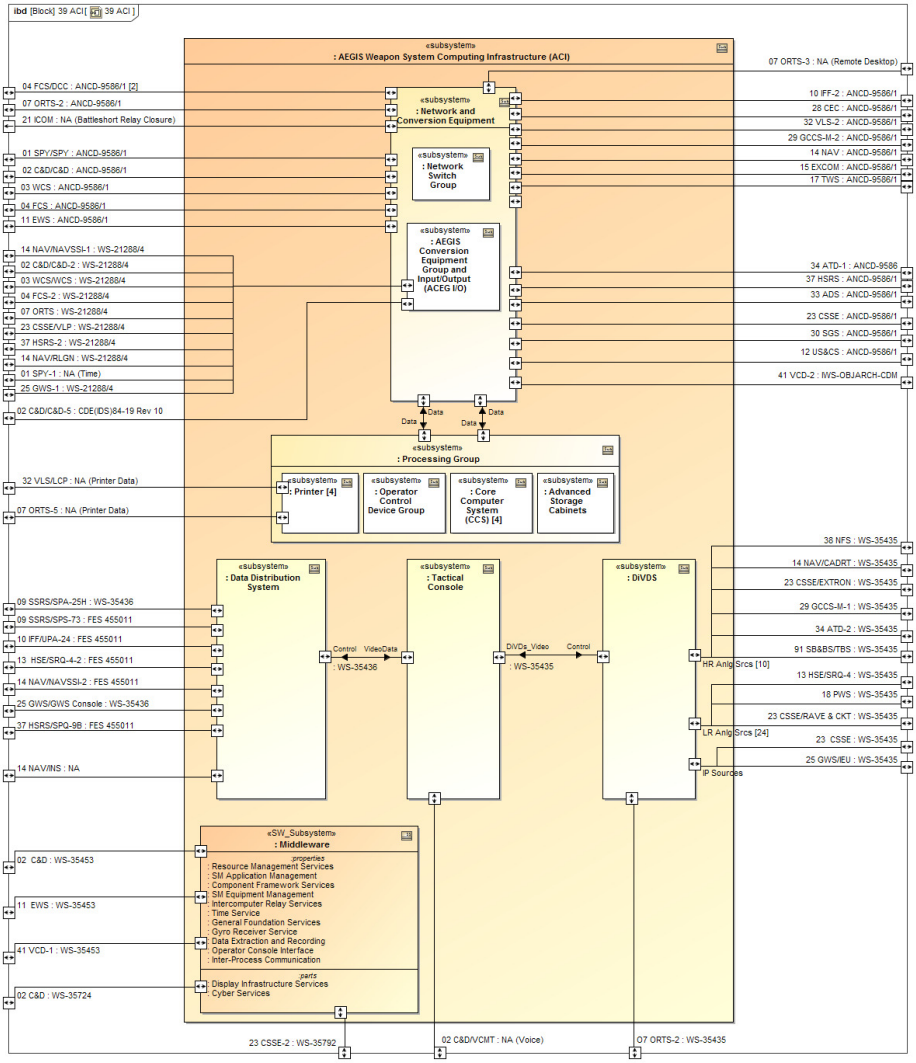

Figure 4.1-33 39 ACI

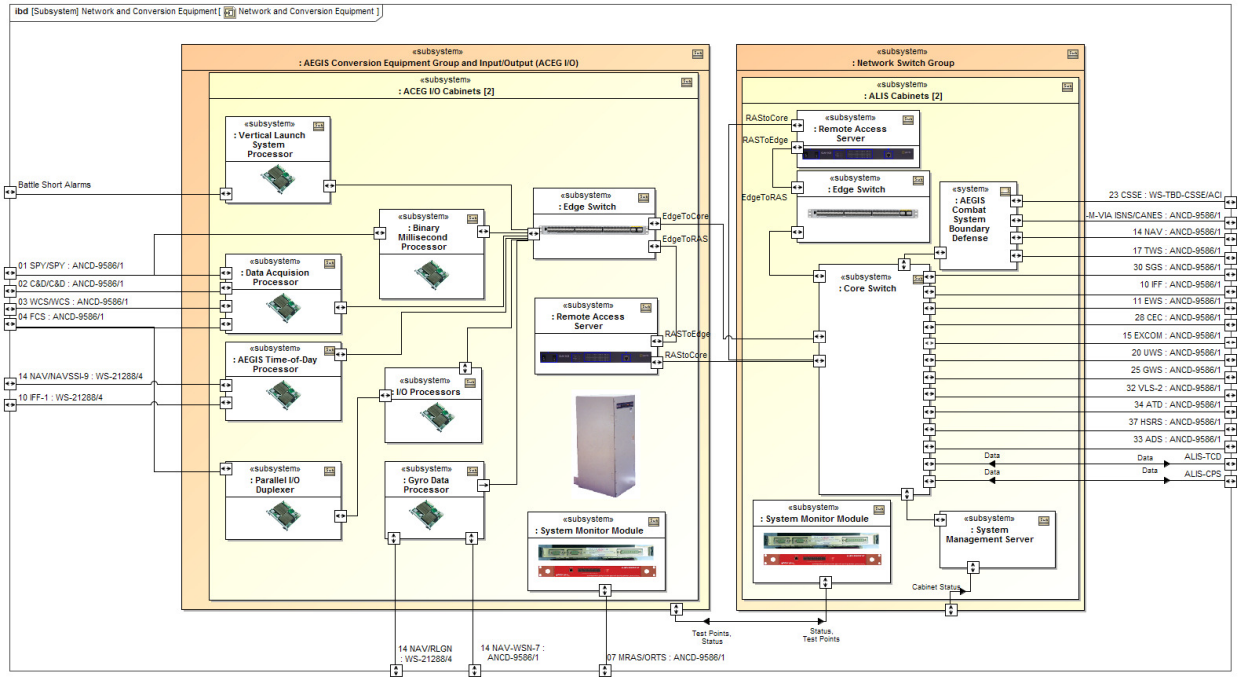

Figure 4.1-34 Network and Conversion Equipment

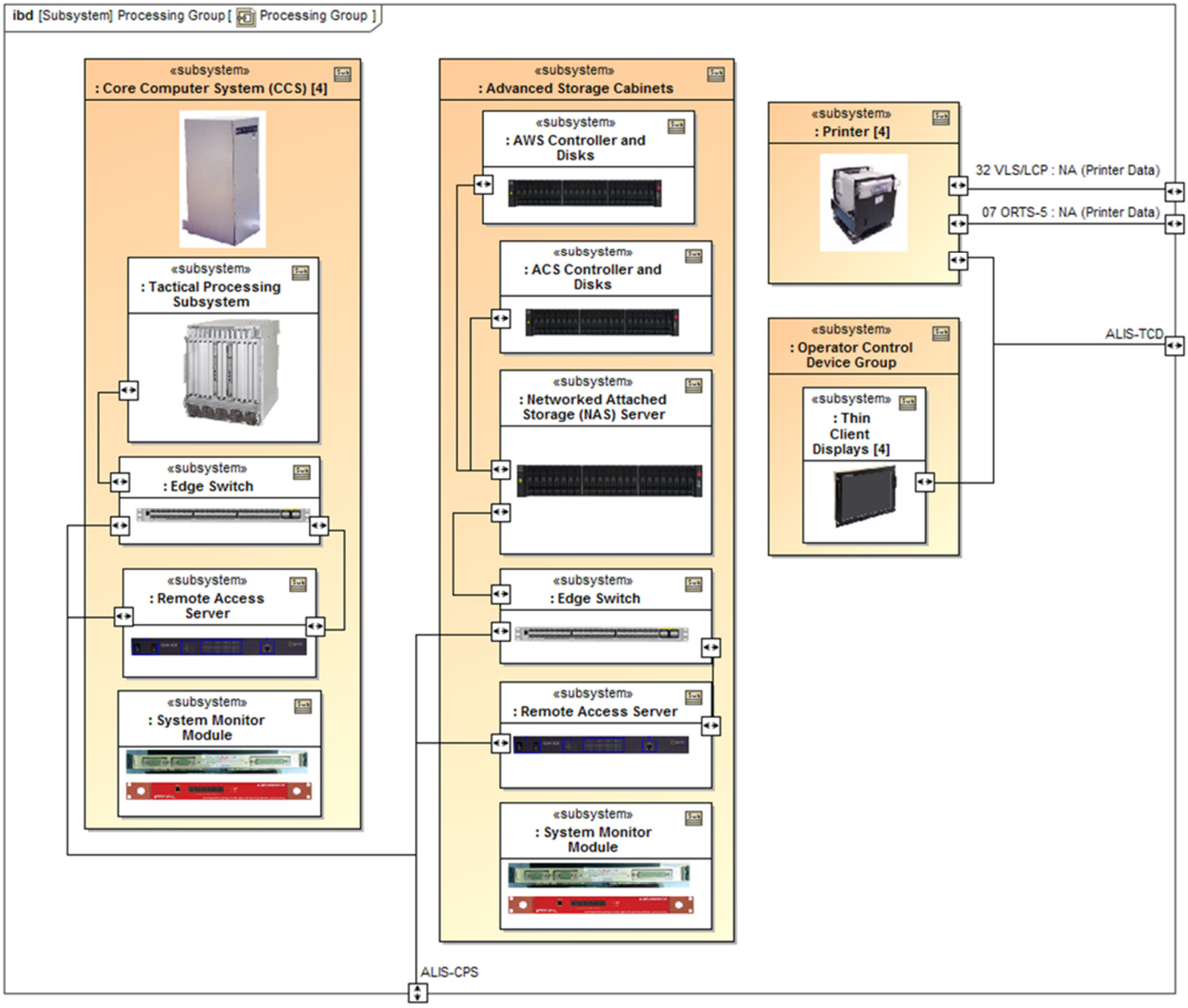

Figure 4.1-35 Processing Group

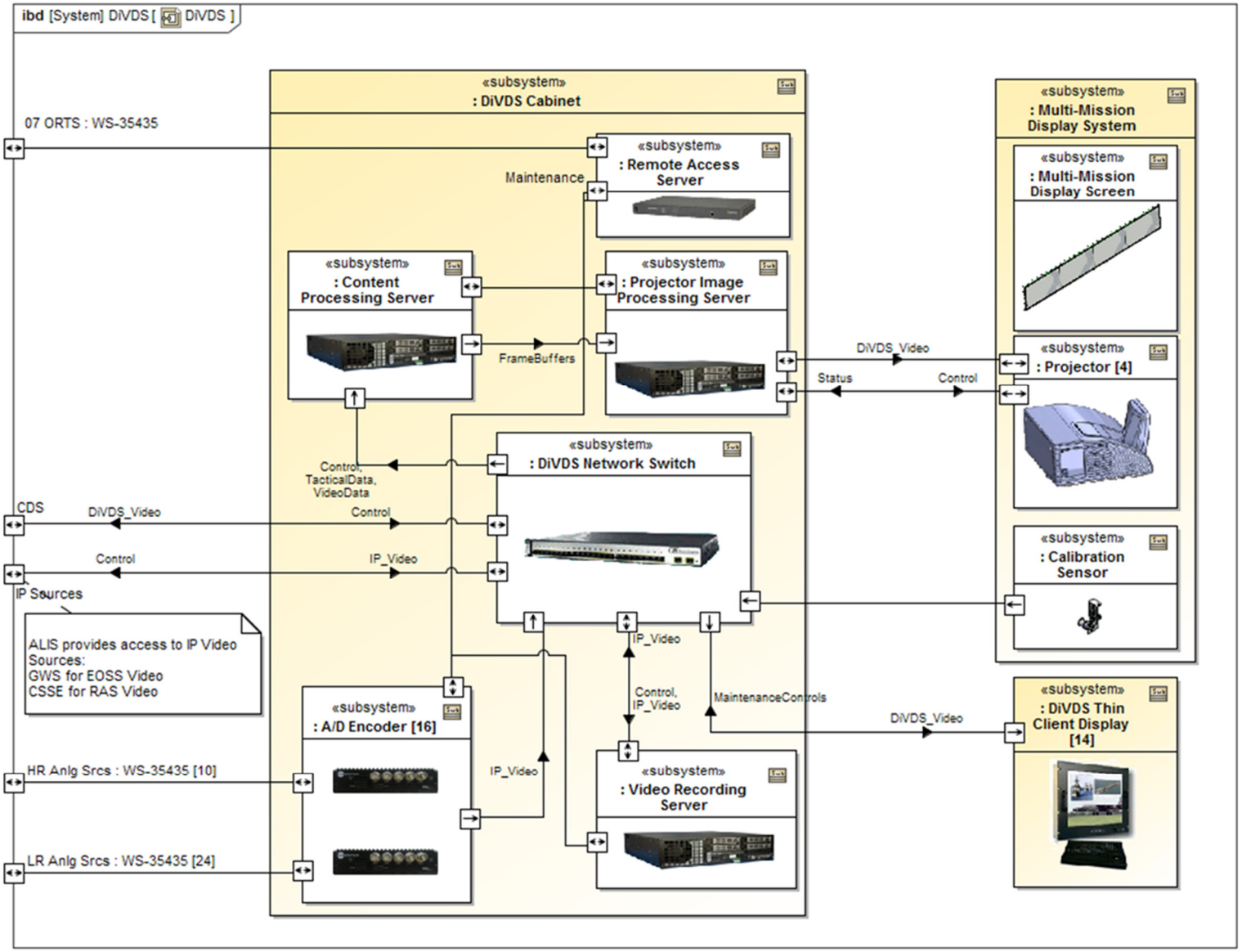

Figure 4.1-36 DiVDS

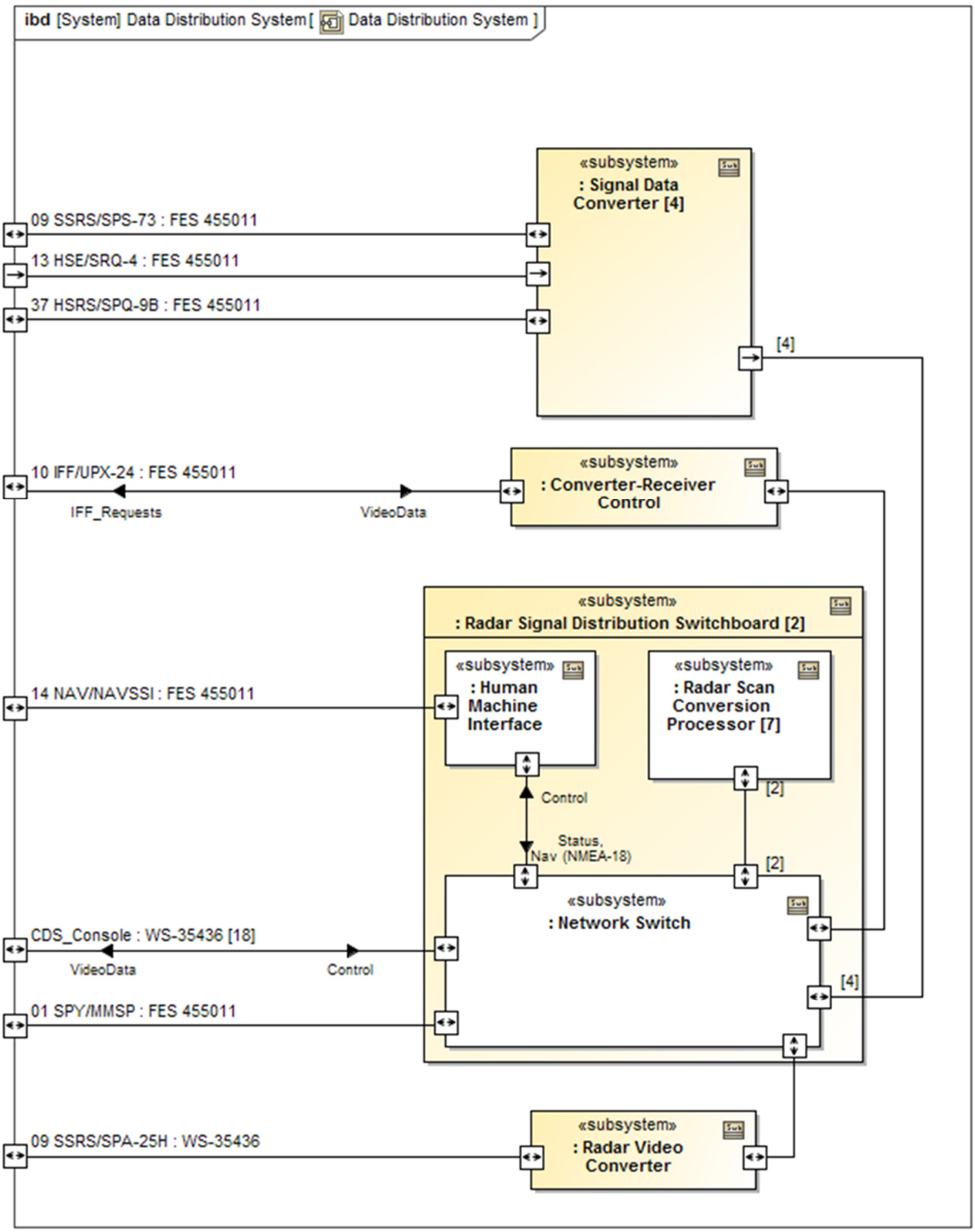

Figure 4.1-37 Data Distribution System

4.1.3.39.3.1 Aegis Weapon System Computing Infrastructure (ACI)

ACI consists of the Processing Group, the Monitor Display Group, the Network Switch Group, the ACEG, the Aegis Interface Processor Group, the Power Conditioning Equipment Group, the Digital Video Distribution System (DiVDS), and the Data Distribution System.

4.1.3.39.3.1.1 Processing Group

The Processing Group consists of the Core Computing System (CCS), the Operator Control Device Group, and Printers.

4.1.3.39.3.1.1.1 Core Computer System (CCS)

The Core Computing System, AN/UYQ-107, is an Advanced Telecommunications Computing Architecture (ACTA) Chassis housing multiple processors which have shared power, cooling and network infrastructure. The boards are thin servers inserted into a single rack-mounted chassis, containing processors, memory, integrated network controllers, operating system, application programs, and other I/O ports.

Cabinets 7 and 8 house ATCA Chasis. Each Chassis is populated with 12 ATCA servers, an Edge Switch, and a Cabinet System Monitor. All processing for C&D, WCS, ORTS, ADS, ATD, VCD and System Management is accomplished within the CCS. Each element requires a specified number of cores located on the servers, which can be located in multiple cabinets. Data is disseminated between the servers over ALIS

4.1.3.39.3.1.1.1.1 Tactical Processing Subsystem

The following AWS Elements are processed via ATCA Chasis located within the Digital Computer System (DCS) cabinets: C&D, WCS, ORTS, ADS, ATD, VCD, and System Management (SM). The FCS computer program is not as complex as the other computer programs and is executed in WCS/FCS I/O Processors instead of ATCA servers.

4.1.3.39.3.1.1.1.2 Edge Switch

These high-performance, high-density, ultra-low-latency Ethernet switches provide network connectivity between the components within the MCE, and between the MCE components and the ALIS Core Switch.

4.1.3.39.3.1.1.1.3 Remote Access Server

The CCS cabinet contains a RAS to support maintenance. The RAS provides network access to the RS-232 console interfaces on the Servers and network switches. The RAS has thirty-two RS-232 serial ports with single AC power supply.

4.1.3.39.3.1.1.1.4 Cabinet System Monitor Module

The Cabinet System Monitor accepts various cabinet status inputs and sends those status values to an external system monitor. The Cabinet System Monitor reports on the following values:

- Temperature
- Humidity
- Breaker Status
- Fan Power
- Battleshort On
- Battleshort Reset

4.1.3.39.3.1.1.2 Advanced Storage Cabinets

CCS cabinets No. 3 and 4 operate as the Advanced Storage Cabinets. These cabinets are used by the AWS for computer program loading and data recording. The cabinets consist of a Network Attached Storage (NAS) Server, a Storage Area Network, an Edge Switch, a RAS, and System monitor.

4.1.3.39.3.1.1.2.1 Networked Attached Storage (NAS) Server

The NAS server consists of a Network File System (NFS) server. The NAS provides the system with the information to support the tactical computer startup, program loading, and data recording. Each NAS server has one 100BTX and four 1000BT interfaces, one RS-232 connection to the RAS, two Gigabit Fiber Channel (FC) Host Bus Adapter interfaces to the SAN.

4.1.3.39.3.1.1.2.2 Storage Area Network

The SAN is composed of a Redundant Array of Independent Disks (RAID) Controller and Just a Bunch of Disks (JBOD). Each drive in the JBOD has a capacity to store 300 Gigabytes. The Storage Unit, which compromises the Storage Area Network (SAN), has 18 1 TB drives operating at 7200 RPM and six 300GB drives operating at 15000 RPM. The disk interfaces with two NAS Servers within the cabinet.

4.1.3.39.3.1.1.2.3 Edge Switch

These high-performance, high-density, ultra-low-latency Ethernet switches provide network connectivity between the components within the MCE, and between the MCE components and the ALIS Core Switch.

4.1.3.39.3.1.1.2.4 Remote Access Server

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4.1.3.39.3.1.1.2.5 System Monitor Module

The Cabinet System Monitor accepts various cabinet status inputs and sends those status values to an external system monitor. The Cabinet System Monitor reports on the following values:

- Temperature
- Humidity
- Breaker Status
- Fan Power
- Battleshort On
- Battleshort Reset

4.1.3.39.3.1.1.3 Operator Control Device Group

The Operator Control Group includes the Thin Client Displays (TCDs).

4.1.3.39.3.1.1.3.1 Thin Client Displays

Four (4) TCDs provide the Human System Integration (HSI) interface and display resources for the Aegis Advanced Operator Control Device (AOCD) application. Each of the four TCD is a multi-purpose information display peripheral which provides operator input communications to the Computer Suite from the operator workstation. The AOCD is used to communicate with storage in ACS elements and external systems. The TCD consists of an Ethernet interface, peripheral I/O modules, and keyboard/trackball, and monitor. Each TCD interfaces with the other three TCD via ALIS to provide operator redundancy and information sharing. Each TCD interfaces to the core switches in MCE No. 5 and 6 through a single 1000BLX interface. The TCDs are capable of accessing the printers via a 100BTX interface. The printers can be utilized for hard copy printouts of all data, including screen captures, log data and configuration files transmitted over the ALIS network. The AOCD TCD replace the legacy Rack Based Console (RBC) equipment.

4.1.3.39.3.1.1.4 Printer

Color printers are provided for hard copy printing of screen captures, log data, configuration files, and other user defined print needs. The AWS contains 4 color printers that are accessed as network based color printers.

4.1.3.39.3.1.2 Network and Conversion Equipment

The Network and Conversion Equipment Group consists of the Aegis Conversion Equipment Group and Input/Output (ACEG I/O), and Network Switch Group. Each group consists of two Mission Critical Equipment Cabinets (MCEs).

4.1.3.39.3.1.2.1 Aegis Conversion Equipment Group and Input/Output (ACEG I/O)

The ACEG I/O provides mission critical and mission essential services to all the elements in the Aegis Combat System, including distribution of synchronized time and Gyro data, interface to the VLS controls

for the Remote Launch Enable Panel and Vent Closure Control cabinets, I/O Duplexing, and interfaces to ACS elements that use NTDS interfaces. ACEG I/O is hosted within two ACEG I/O Cabinets.

4.1.3.39.3.1.2.1.1 ACEG I/O Cabinets

The two ACEG I/O cabinets, operating in a Primary/Alternate configuration, contain VERSA Module Eurocard (VME) based systems that provide the Aegis services of time synchronization in the Aegis Time Processor (ATP) and the Binary Millisecond Processor (BMP), gyro data distribution in the Gyro Data Processor (GDP), data acquisition in the Data Acquisition Processor (DAP), vertical launch processing in the Vertical Launch Processor (VLP), and NTDS I/O processing services.

- *Aegis Time Processor* - The ATP provides network time distribution/synchronization to the tactical computing nodes of the AWS. The ATP receives Coordinated Universal Time (UTC) via an Inter-Range Instrumentation Group (IRIG) interface from NAVSSI, which it converts to a modified POSIX timescale. Modified POSIX timescale differs from UTC in that it maintains monotonic time upon a leap second event and becomes offset from UTC. ATP uses the modified POSIX timescale to synchronize the Central Processing Unit's (CPU's) local clock. A Precision Time Protocol (PTP) daemon operating as a Stratum 1 Master Server is incorporated into ATP which uses the local clock as its time reference. The PTP Master Server then provides network time synchronization via ALIS to the PTP clients residing on the tactical nodes. The PTP clients synchronize their local CPU's system clocks with the synchronization messages received from the PTP server. A middleware service, called Time Services, is then utilized to convert the modified POSIX timescale from the local system clock to various time formats as requested by the Tactical Application (including Aegis F64, Aegis Time of Day (ATOD), UTC, etc). The ATP also provides support for Network Time Protocol (NTP v4.x) time distribution/synchronization per RFC-5905, which operates in the same manner as described for PTP.
- *Binary Millisecond Processor* - The BMP provides the legacy MK38/39 functionality of supplying Binary Millisecond (BMS) time via NTDS interfaces. The BMP utilizes a PTP daemon to synchronize the local system clock with the PTP Master Server residing in the ATP. System clock time is then converted to a 29-Bit Aegis Time-of-Day (ATOD) format and distributed via two NTDS interfaces.
- *Gyro Data Processor* - The GDP provides the ACS with gyro data. Redundant nodes reside in the Forward and Aft Converter Cabinets. The GDPs receive gyro information from corresponding WSN-7 gyros and distributes the information to ACS.
- *Data Acquisition Processor* - The DAP provides ORTS with Fault Detection/Fault Isolation (FD/FI) data in the form of network messages via ALIS. The FD/FI data includes test point and status data of the ORTS Data Bus and Electronic Equipment Water Cooler via the Data Acquisition and Control Electronics (DACE) modules, Radio Frequency Amplifier Driver status via NTDS interfaces.
- *Vertical Launch Processor* - The VLP provides WCS with peripheral equipment status and commands. VLP provides WCS with Remote Launch Enable Panel (RLEP), Fire Inhibit Switch (FIS) status and provides Forward and Aft Vent Closure Control Circuit (VCCC) which controls the environmental vents during a missile launch. The VLP receives ships environmental data from NAVSSI and repackages the information to C&D. The VLP also controls the Battleshort Alarms as commanded via messages from the DAP originating from a message from ORTS. Controls of these interfaces are done via A/D, D/A converters and Relay closure modules called Line Input Converter (LIC), Line Output Converter (LOC), and Relay, respectively.
- *NTDS I/O Processing* - NTDS I/O processing is provided by the Parallel I/O Processors and the I/O Processors.
    - *Parallel I/O Duplexers* - The parallel I/O duplexers are provided to switch NTDS-A/B single-port devices to two different computer I/O channels. The ACI provides duplexer capability for the Slaved Illuminator Data Converter (SIDC). The Duplexer configuration allows for common, normal and alternate parallel paths and improved data survivability of a single-port device. Two duplexers when connected in tandem, provide connection to any one of three computer I/O channels. The path selection is under computer channel control. A valuable feature of the duplexer is its known state during power failure and power up.

- *I/O Processors (I/OPs)* - There are two each twenty-slot VME chassis housed in the ACEG I/O Primary and Alternate Cabinets that are identified as I/OPs. The SBCs' network interfaces connect to ALIS via the cabinet's edge switch. The I/OPs provide the interface to other Aegis Combat Systems that utilize point-to-point interfaces such as NTDS-A/B/E and LAN interfaces such as Ethernet and Fast Ethernet. Each I/OP operates independently and utilizes ALIS for connectivity and communication with the Blade Servers. I/OPs for SPY, C&D, and WCS/FCS are redundant to improve the survivability of the normal and alternate channels to the Combat System. The respective Primary and Alternate ACEGIO Cabinets provide backup I/OPs for SPY, C&D and WCS/FCS.

Each ACEG I/O Cabinet also contains and Edge Switch, a Remote Access Server (RAS) and a System Monitor:

- Edge Switch - These high-performance, high-density, ultra-low-latency Ethernet switches provide network connectivity between the components within the MCE, and between the MCE components and the ALIS Core Switch.
- RAS - The RAS provides network access to the RS-232 console interfaces on the Servers and network switches. The RAS has one Ethernet port for uplink to a core switch. The Single Board Computers interface with the local RAS via an RS-232 interface to provide ORTS with the ability to initiate local diagnostic routines. The results of the diagnostics are returned to ORTS Computing Suite via the ALIS network. The RAS interfaces with the Edge Switch using RS-232 and the ALIS Core Switches using a GbE link.
- System Monitor Circuit Card Assembly - The purpose of the monitor is to function as a virtual Data Acquisition Converter (DAC) and is controlled by the Data Acquisition Converter Electronics (DACE) modules within the Data Acquisition Processor (DAP). The DAP, in turn, communicates the system monitor status and commands test point reads as requested by ORTS via the ALIS. At the cabinet level, the status test points include battleshort, temperature, subassembly power and enclosure power, while the command test points are comprised of battleshort set and reset. At the subassembly level, the status test points include voltage supply levels to the VME chassis, while the command test points include VME bus resets.
- Cabinet System Monitor – The Cabinet System Monitor accepts various cabinet status inputs and sends those status values to an external system monitor. The Cabinet System Monitor reports on the following values:
  - Temperature
  - Humidity
  - Breaker Status
  - Fan Power
  - Battleshort On
  - Battleshort Reset

4.1.3.39.3.1.2.2 Network Switch Group

The Network Switch Group includes two Aegis LAN Interconnect System (ALIS) Cabinets.

4.1.3.39.3.1.2.2.1 ALIS Cabinets

The Aegis LAN Interconnect System (ALIS) provides the mechanism for Combat System and external systems to communicate with Aegis Weapons System. ALIS also provides the core connectivity between cabinets that host Aegis Weapons System Elements. ALIS is comprised of management, network, and Information Assurance equipment hosted in a cabinet that provides a level of shock and vibration isolation, Electro-Magnetic Interference (EMI) shielding, power conditioning and cooling. There are two (2) ALIS cabinets that operate in a Primary/Alternate configuration. Each cabinet consists of a Core Switch, an Edge Switch, Combat System Boundary Defense components, and a System Monitor Module.

- Core Switch - The core switches are the first tier of the network and they provide the data communications backbone, access to infrastructure for specific groups of hosts/subsystems, and essential connectivity to components that interface to the lower tier of the infrastructure. The Core

Switches provide the switching capability for the high-speed 40 GbE connections of the ALIS network, and connect to each of the edge switches on other cabinets in the ACI.

- Edge Switch - These high-performance, high-density, ultra-low-latency Ethernet switches provide network connectivity between the components within the MCE, and between the MCE components and the ALIS Core Switch.
- System Monitor -
  The Cabinet System Monitor accepts various cabinet status inputs and sends those status values to an external system monitor. The Cabinet System Monitor reports on the following values:
    - Temperature
    - Humidity
    - Breaker Status
    - Fan Power
    - Battleshort On
    - Battleshort Reset

- Combat System Boundary Defense - The CS Boundary Defense is the front door to the Combat System Secure Domain and is one of the first lines of defense in the overall ACS Defense-In-Depth (DiD) strategy. Its primary purpose is to provide capabilities to protect, detect, and react to threats via data entering and leaving the Secured Combat System. Each Combat System Element (CSE) will be required to communicate via the CS Boundary Defense with elements outside the Secured Combat System. The CS Boundary Defense is broken into five components: CS Firewall, CS Intrusion Detection System (IDS), CS Bulk Data Transfer Service, Cross Domain Solution and CS Data Dissemination and Transformation Service.
    - CS Firewall (CS FW): The CS FW is a traditional firewall used to permit or deny incoming and outgoing network traffic based upon a white list set of rules. The CS FW requirement is it shall filter all incoming and outgoing network traffic based on a predefined set of rules as constrained by the platform's security enclave.
    - CS Intrusion Detection System (CS IDS): The CS IDS is another traditional IA component monitors incoming and outgoing network traffic for defined policy violations. The requirements of the CS IDS are it shall monitor for and provide notification upon detection of unpermitted incoming network traffic.
    - CS Bulk Data Transfer Service (CS BDTS): The CS BDTS is a component used to validate data files entering or leaving the combat system. This is to detect malicious or accidental threats contained within a file and to block further distribution. The requirement of the CS BDTS is it shall examine bulk data files for data integrity prior to distributing valid data files within the Combat System.
    - CS External Cross Domain Solutions (CDS): The Combat System is classified as a secret domain yet it has to communicate with other systems that are in other classification domains (e.g. unclassified). Each of these connections are required to have an approved CDS to ensure only allowed traffic occurs. The requirement is the CS shall allow for secure data transfer between the CS and external systems operating at different security classification levels.

4.1.3.39.3.1.3 Tactical Console

The Common Display System (CDS) program provide Open Architecture hardware and technology utilization into a common configuration for multiple platforms Aegis Destroyers, Cruisers undergoing modernization, CVN, DDG-1000, and other platforms. CDS provides common human machine interface (Combat Information Center (CIC) consoles and remote displays) to the Aegis Baseline 9 computing environment and provide war fighter team situational awareness in support of the Aegis Modernization program.

ACI also provides Thin Client Displays (TCDs) used as remote displays. The TCDs provide reduced set of capabilities compared to the console. The thin client displays support situational awareness capabilities, including the display of the TACSIT and ASTABs, and very limited action capabilities (some special points

and bearings can be entered). The goal was that fewer resources would be necessary to run the reduced capability set to provide basic situational awareness at auxiliary locations.

4.1.3.39.3.1.4 DiVDS Hardware

The DiVDS capability provides shipboard operators with access to video data on multiple sources (e.g., consoles, camera locations, tactical applications, video wall), and enables display of Status Board (ASTAB) and TACSIT information on the Multi-Mission Display (video wall). The ability to share this information enhances situational awareness, decision making, and replay/archiving capabilities. The system promotes high level concepts of expandability and ease of use.

The DiVDS utilizes Commercial Off the Shelf (COTS) technologies and standards. The DiVDS equipment consists of the DiVDS Cabinet, Thin Client Displays, and the Multi-Mission Display. The Multi-Mission Display is composed of projectors, calibration sensors, and a single screen. The DiVDS Cabinet contains COTS equipment that provides the capabilities of video recording, video content and projector image processing, analog to digital IP encoding, and network switching. The DiVDS interfaces with and supports the tactical data processing capability of the weapons system it is integrated with as follows:

- Making video available, visible, and usable thereby enhancing shipboard safety and overall situational awareness.
- Providing the ability to view several video sources from multiple locations.
- Providing multi-user collaboration capability to Combat Information Center (CIC) operators using the Video Wall and multi-space collaboration capability to operators using remote displays.
- Providing access to video sources except when limited by security, policy or regulation.
- Providing an extendable, scalar design to meet the number of video sources and view locations for specific site application.

4.1.3.39.3.1.4.1 Mulit-Mission Display System

The Multi-Mission Display System is composed of Projectors, Calibration Sensors, and a Multi-Mission Display screen.

4.1.3.39.3.1.4.1.1 Projector

There are four Extreme Short Throw (EST) projectors used to project the image on the Multi-Mission Display Screens. The EST technology allows the projectors to fill large screens from very a short distance (approximately 22" for Aegis versus 100" for conventional projectors), using a unique combination of built-in mirrors/optics. This allows the displays to be mounted in front of and below the video wall screens versus on the ceiling, eliminating head-room issues and potential light interference.

4.1.3.39.3.1.4.1.2 Calibration Sensor

The calibration sensor is a video camera that provides the image of the video wall screen to the Projector Image Processing Server for use in image blending.

4.1.3.39.3.1.4.1.3 Mulit-Mission Display Screen

The Multi-Mission Display Screen is a screen assembly for the projection of the Multi-Mission Display image from the EST projectors. The assembly is mounted directly in front of the Command Console on the bulkhead.

4.1.3.39.3.1.4.2 DiVDS Cabinet

The DiVDS Cabinet houses the following subassemblies as shown in Figure 4.1-36: three (3) Servers; one (1) RAS; one(1) Switch chassis; six (6) Low Resolution Analog Encoders; ten (10) high resolution Analog Encoders, four (4) DVI to Fiber Media Converters. The DiVDS Cabinet is a Mission Critical Enclosure (MCE) in accordance with ADS-B1-1993 Appendix I.

The Cabinet also contains a System Monitor Board (Part of ORTS) used for readiness assessment and control.

4.1.3.39.3.1.4.2.1 Projector Image Processing Server

The Projector Image Processor Server is a 3U ruggedized server, which supports generation of DVI output to the Video Wall Projectors from the frame buffers from the Content Processing Server. Data received from the calibration sensors is used in support of the video output to the projectors.

4.1.3.39.3.1.4.2.2 Content Processing Server

The Content Processing Server is a 3U ruggedized server supports control of video wall, console, and thin-client video content. The server accepts video input from IP Camera Video sources and from the A/D Encoders, and distributes the input as required to the appropriate display surface (as determined by received controls from CDS consoles or remote displays).

4.1.3.39.3.1.4.2.3 Video Recording Server

The Video Recording Server is a ruggedized server that supports at least 3 simultaneous video streams, including storage of at least 100 hours of video, playback, and transfer to storage media when requested.

4.1.3.39.3.1.4.2.4 DiVDS Edge Switch

The DiVDS Edge Switch is a high-performance, high-density, ultra-low-latency Ethernet switch. There is one Edge Switch in the DiVDS Cabinet which provides configurable Ethernet ports. The switch receives IP Video from the A/D Encoders and directly from IP Video sources and provides IP Video to the Client Processing Server, Video Recording Server, and the Thin Client Displays.

4.1.3.39.3.1.4.2.5 A/D Encoder

The Analog to Digital (A/D) Encoders provide the capability to convert analog video input into IP streaming video. There are 10 High Resolution RGB encoders and 6 Standard Resolution NTSC encoder, allowing for a total of 10 high resolution and 24 standard resolution inputs. The current video inputs are:

<u>High Resolution Analog to Digital Video Encoder</u>

- Receives analog video in RGB Sync-on-Green format via BNC connectors.
- Supports resolutions up to 1280x1024 for analog video received in RGB format.

<u>Low Resolution Analog to Digital Video Encoder</u>

- Receives analog video in NTSC format via BNC connectors.
- Supports resolutions up to 720x480 for analog video received in NTSC format.

4.1.3.39.3.1.4.2.6 Remote Access Server

The DiVDS cabinet contains a Remote Access Server to support maintenance. The RAS provides network access to the RS-232 console interfaces on the Servers and network switches. The RAS has 32 RS-232 serial ports with single AC power supply.

4.1.3.39.3.1.5 Data Distribution System

The AN/SPQ-15(V) Data Distribution System (DDS) is an Advanced Sensor Distribution System (ASDS) developed as the latest generation of radar data distribution equipment providing distribution via fiber Ethernet LAN to the Data Display Group consoles, legacy displays and weapon systems. DDS uses enterprise network equipment for the distribution of digitized radar video data over a dedicated network.

4.1.3.39.3.1.5.1 Converter-Receiver Control

The Converter-Receiver Control (CRC), near the IFF Processor Controller, provides the analog-to-fiber Ethernet conversion for request of IFF challenges and IFF video signals in the system.

4.1.3.39.3.1.5.2 Radar Signal Distribution Switchboard

The Radar Signal Distribution Switchboard RSDS) provides distribution of radar via ALIS to Ethernet equipped displays in response to display commands. The RSDS processors host software that provides raster scan conversion of radar video data and IFF symbology received over Ethernet. The RSDS provides video display processing as requested by each connected tactical console to create video IP packets compatible with the displays software. The RSDS utilizes an IP Multicast capable Ethernet Switch to stream the requested video presentation as processed IP Packets to the tactical console.

4.1.3.39.3.1.5.2.1 Network Switch
The Network Switch provides distribution of video, navigation, and radar data, and controls.

4.1.3.39.3.1.5.2.2 Radar Scan Conversion Processor
The Radar Scan Conversion Processor (RSCP) converts a polar-sampled radar image into a Cartesian format, creating the necessary display pixels.

4.1.3.39.3.1.5.2.3 Human Machine Interface
The Human Machine Interface supports a Graphical User Interface (GUI) and Application Programming Interface (API) for diagnostics. It also provides for distribution of received NMEA 0183 formatted waypoint and route data from the Real Time Subsystem (RTS) of NAVSSI via the Data Multiplex System (DMS).

4.1.3.39.3.1.5.3 Signal Data Converter
The Signal Data Converters (SDCs) are used to convert analog and digital radar signals to Internet Protocol (IP) packets for output to associated RSDS. The SDC's function is to digitize the radar azimuth data and video, then place the data in IP packets that are sent to the RSDS using multicast. There are three SDCs in Aegis BL10, which convert data from SPS-73, AN/SRQ-4 (MH-60R Data), and AN/SPQ-9B.

4.1.3.39.3.1.5.4 Radar Video Converter
The Radar Video Converter (RVC), with one or two Display Interface Modules (DIM), is collocated with legacy displays to provide IP to analog translation. The DIM converts the radar video data packets back to analog radar display signals compatible with the AN/SPA-25H displays or Integrated Bridge & Navigation System (IBNS).

4.1.3.39.3.2 System Services
The System Service Reusable Components (SSRC) provides computational support for the tactical computer programs of the AWS. Services provided include Data Extraction and Recording (DXR), General Foundation Services (GFS), Intercomputer Relay Services (ICR), Inter-Process Communication (IPC), Resource Management Services (RMS), Operator Console Interface (OCI), Time Service (TS), Gyro Receiver Service (GRS), SM Application Management (AM), and SM Equipment Management (EM).

The SSRC also includes Component Framework services, providing Aegis platform-specific infrastructure support for enterprise components via a Navy standardized platform-independent Application Programming Interface (API). Services provided include Component Framework Data Recording Services (CFDRS), Component Framework Logging Services (CFLS), Component Framework Message Services (CFMS), and Component Framework Time Services (CFTS), Component Identification Service, Component Availability Management Service, Component Operational Mode Service, Component Navigation Ownship Position Service, Component Navigation Ownship Attitude Service, Component Navigation Ownship Environment Service.

4.1.3.39.3.2.1 Resource Mangement Services
RMS provides the Aegis system and element designers with a set of flexible resource management capabilities that can facilitate the construction of tactical software programs to meet the goals of distributed computing envisioned for Aegis COTS Refresh 3 (CR3) Baselines. Though general in their features, the RMS capabilities focus on supporting two types of resource management functions that are specified in pre CR1 tactical computer program CPRSs, namely, Local Resource Management (LRM) and Element Resource Management (ERM). LRM manages the resources of a particular computing node. Node resources include the various processes that comprise the tactical computer program load for the node and the various hardware resources (typically in the form of Input/Output (I/O) interface boards) that are particular to the node. ERM manages the resources that comprise a particular element. Element resources comprise the various computing nodes themselves and, conceivably, any other resource that can be shared among its nodes. RMS provides Process Management Services, Virtual Resource Services, Node Heart-Beat Services, and Configuration Definition Services.

4.1.3.39.3.2.2 SM Equipment Application Management

The EM component monitors the health of the ACI Equipment and network connections, and performs Fault Detection/Fault Isolation (FDIFI) on faulty equipment on the network. Any network attached equipment, which supports SNMP v1, v2c, or v3, may be managed by the Equipment Management via SNMP interface. Other equipment that supports Ethernet interface but doesn't support SNMP may be managed via ICMP-ping. For those equipment not supporting Ethernet interface, the status is reported by the elements via SAF-AIS_NTF Notification.

4.1.3.39.3.2.3 Component Framework Time Services

The CTFS provides the Aegis implementation the Time Services specified in the Surface Navy Combat System Time Service API. The CFTS component provides Time of Day services, maintains node synchronization and accuracy status, and provides a rich set of conversion utilities among the various time scales and formats to Surface Navy Product Line Components. It uses the System Services TS to implement much of the CFTS functionality via a wrapper layer, and implements the required functionality itself where the System Services TS does not provide the capability.

4.1.3.39.3.2.4 SM Application Management

The AM component provides the following services for monitoring and management of:

- Availability Management Framework (AMF) - This includes start/stop, monitor, recover and repair applications. It also provides interface for a management client to manage and control the applications.
- Status Tracking - This service publishes application availability status, and provides a mechanism for other applications to subscribe for the status updates.
- Alarm and State Change Notification - This service provides a mechanism to publish or subscribe a SAF-compliant Notification. It also provides the service to retrieve published Notification.

4.1.3.39.3.2.5 Component Framework Logging Services

The CFLS provides the Aegis implementation of the Logging Service Surface Navy Combat System Logging Service API. CFLS provides an API for Surface Navy Product Line components to log text messages to a file and/or a display. It provides an ability to set a logging level threshold such that only messages that have logging levels that are equal to or higher than this threshold will be logged, and allows a user to create multiple loggers, each with its own independent logging characteristics.

4.1.3.39.3.2.6 Intercomputer Relay Services

The Intercomputer Relay CSCI supports full-duplex communication between local applications executing in advanced processors of CR3 Baselines and a remote computer (a remote computer is the computer on the other end of an NTDS link from ICR). The CR3 baselines introduce a new variant of ICR that did not exist in earlier baselines. In previous baselines which had fully redundant equipment suites, a single ICR daemon controlled a single channel, with two daemons running in two different computers making up the logical link (i.e. Dual Daemon ICR (DDICR). The new variant introduced into CR3 is for baselines which do not have a fully redundant equipment suite, but must still support both channels of a logical link (i.e. Multi-Channel ICR (MCICR)). In this configuration, a single ICR daemon can control up to three separate channels. Both variants are fully supported in CR3, however, the two variants are mutually exclusive. Applications use Inter-Process Communication (IPC) to send messages to ICR, which relays them to the remote computer on low-level serial Naval Tactical Data System Type-E (NTDS-E) links. Messages from the remote computer are relayed by ICR as ARC IPC messages to their final receivers.

4.1.3.39.3.2.7 Time Service

Time Services provides system time and clock synchronization capabilities to applications operating in a LAN-Based, distributed computing environment. System time is derived from Global Positioning System (GPS) Time received from NAVSSI, converted to Coordinated Universal Time (UTC), and distributed to the clients. A commercially available synchronization protocol is used to maintain synchronized time across the nodes. Previous baselines utilized Network Time Protocol (NTP) to perform this function. For CR3 baselines, the Precision Time Protocol (PTP) will be added as the primary synchronization mechanism. Support for NTP will continue for legacy systems.

4.1.3.39.3.2.8 General Foundation Services

The GFS provides three services to AWS elements: General Logging (GENLOG), the NTDS Device Driver (NDD) and Element Cleanup Utilities (ECU). GENLOG interfaces with an application to receive error and informational data. GENLOG directs error and informational data to UNIX standard error (stderr), an element-supplied Resource Manager (RM), and to the network (Multicast). The NDD provides the capability for users to control the operation of the NTDS interface cards. NDD also provides the capability of mapping and unmapping VME based memory. The NDD also manages the System Wide Shared Memory (SWSM) area in host memory to allow the User (host) to access SWSM areas from within their programs. This SWSM area can be used to communicate with other VME based devices, such as the NTDS Interface card. The ECU provides a common, cross platform method for terminating processes and cleaning up shared resources. It is responsible for cleaning up both tactical and non-tactical environment configurations.

4.1.3.39.3.2.9 Gyro Receiver Service

GRS provides an API by which client applications may screen incoming messages from the Gyro Data Processor (GDP) and interpolate/extrapolate ship attitude data. This data is used to calculate or predict a ship's attitude at a requested time. It receives system gyro data from the AN/WSN-7 and system time data from the Time Service, and distributes it to the gyro consumers upon request. It also asynchronously reports gyro status change to the gyro consumers.

4.1.3.39.3.2.10 Data Extraction and Recording

The DXR Component provides the capability for multiple application programs operating in a LAN-based, distributed computing environment to record data under centralized control. Recording may be directed to multiple local and remote recording devices. If the local recording device selected is native operating system files, DXR provides the option to record data using a compression algorithm. If remote recording is selected and compression is desired, DXR provides for the option to record data to removable media via a Remote Recording Compressor (RRC) which uses an open source data compression library. Remote devices include the Aegis Advanced Operator Control Device (AOCD).

DXR provides application programs with two types of services, a data extraction service and a data recording control service. Each service employs an Application Programming Interface (API) to provide application programs access to the service. The DXR Data Extraction (DE) API provides application programs with mechanisms to efficiently record selected data items for analysis purposes. The DXR Control Client (CC) API provides control client programs with mechanisms that enable or disable recording, control the local recording devices and query DXR for its current recording and device statuses.

4.1.3.39.3.2.11 Component Framework Pub/Sub Messaging Service

The CFMS provides the Aegis implementation of the Component Framework Publication/Subscription Messaging Service (CFPSMS) common infrastructure component used by Surface Navy Product Line Components. This component provides an asynchronous Pub/Sub Messaging capability that conforms to the Application Program Interface specified in the Surface Navy Combat System (SNCS) Pub/Sub Message Service API. It uses the Commercial Off-the-Shelf Publishing/Subscription middleware product RTI DDS 4.x to implement the Pub/Sub transport technology conforming to the Object Management Group (OMG) Data Distribution Service (DDS) 1.2 Specification.

4.1.3.39.3.2.12 Component Framework Data Recording Services

The CFDRS provides the Aegis implementation of the Logging Service Surface Navy Combat System Data Recording Service API. CFDRS provides an API for Surface Navy Product Line components to record data using the System Services DXR service to implement the needed functionalities.

4.1.3.39.3.2.13 Operator Console Interface

The purpose of OCI API is to provide the interface between the Tactical Elements (C&D, SPY, WCS, etc.) and instances of the OCI computer program running on the Advanced Operator Control Devices (AOCD). The OCI API uses Internet Protocol (IP) multicast to communicate bi-directionally with the OCI computer programs. The OCI API is the window through which tactical applications view the OCI functions running

within AOCD. A single Tactical Element may be composed of many application programs in several computers. Any of these applications may post a message to the OCI. The OCI API, using User Datagram Protocol (UDP/IP), sends the message to a network multicast group. The instances of the AOCD OCI computer program are members of that group. Each receives a copy of the message. Similarly an operator at any AOCD may command a request to be sent to a particular Tactical Element. The AOCD OCI computer program sends the message to a network multicast group whose members are the application programs of the designated Tactical Element.

4.1.3.39.3.2.14 Inter-Process Communiation

IPC provides classes of communications service that are not directly available from COTS products. The services are tailored to the specific needs of high-performance, real-time, computer programs that often require message latencies in the millisecond to 10 millisecond range and may need to send and receive hundreds of messages per second in a single processor. The utilization of computer resources by middleware must be restricted so that even under maximum message loads sufficient processing power is available to the tactical application. IPC is built on Internet Protocols in order to ensure compatibility with standard network switches and routers and portability to the largest number of platforms. User Datagram Protocol (UDP) unicast and multicast have been selected as the transport layer protocols because they give the IPC developer maximum control over the behavior of the communications system. UDP protocols are inherently unreliable. Reliability, in the form of acknowledgments and retries, is added when needed by IPC. IPC provides unicast and multicast service in COTS Refresh 3 (CR3) Baselines.

4.1.3.39.3.2.15 Cyber Services

ACI provides the following Cybersecurity Services: Firewall, Bulk Data Transfer Service, Boundary Proxy Service, Update Manager, Identity Management, Host Level Protection System, Cross Domain Solution, Security Information & Event Management Service, Certificate Management, Sandbox, and Network Asset Manager.

- Firewall – A network based application level firewall configured to allow only approved (whitelist) traffic to/from Combat System
- Bulk Data Transfer Service – A staging area used to examine & validate all bulk data (files) prior to their being downloaded into or exported out of the Secure Combat System Domain (SCSD)
- Boundary Proxy Service – Filter and validate traffic prior to entering or exiting the SCSD.
- Update Manager- provides the ability to update system files for elements of the SCSD.
- Identity Management – Centralized service for user and process identification and authentication
- Host Level Protection System – A centralized service to manage systems including file integrity checks and malware scaning
- Cross Domain Solution – A centralized solution to allow for data exchange between different security classification levels
- Security Information & Event Management Service – A centralized service for receiving, reviewing, and reporting on system events.
- Certificate Management – a centralized capability for managing certificates called Centralized Certificate Service (CCS) used within the SCSD
- Sandbox – A centralized managed area where applications considered to be high risk from a cybersecurity perspective may be executed with reduced risk to the other SCSD elements.
- Network Asset Manager – A centralized service managing network assets attached to the combat system.

4.1.3.39.4 Element Interfaces

Table 4.1-31 AWS Computing Infrastructure Interfaces

Element	Interface Description	IDS

Element	Interface Description	IDS
01 SPY-1	SPY-1 receives AEGIS Time-of-Day data via PTP	NA (Time)
01 SPY-2	This provides the physical interface for SPY connectivity for the SPY interface to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1
02 C&D-1	This provides the physical interface for C&D connectivity for the C&D interface to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1
02 C&D-2	This provides the interface to the VL/EDP processor within the AWS Computing Infrastructure (ACI). It consists of a network connection between NVF and the VL/EDP processor in the aft ACEG cabinet and is only applicable for ships not configured with NAVSSI	WS-21288/4
02 C&D-3	The C&D Computer Suite interfaces with ACI via ALIS to provide navigation data and system mode change data in support of the ACI instantiation of the objective architecture component framework.	WS-35724
02 C&D-4	The ACI provided instantiation of the IWS objective architecture component framework application programmers interface.	WS-35453
02 C&D-5	The C&D Computer Suite provides System track data to the ACI for provision through the CS DDTS to CSSE.	IWS-OBJARCH-CDM
02 C&D-6	Provides ownship local and remote datalink track and engagement status information to C&D via ALIS.	CDE(IDS)84-19 Rev 11/Chg3
02 C&D/VCMT	The Tactical Consoles interfaces with the Secure Voice System in Command and Decision to provide secure voice communication to operators.	NA (Voice)
03 WCS-1	This provides the physical interface for WCS connectivity for the WCS interface to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1
03 WCS-2	The Conversion Equipment Cabinets provides WDRC with resets. WCS also interfaces with the Remote Launch Enable panels in 32 VLS and the Vent Closure Control circuits 23 CSSE via the Vertical Launch Processor (VLP) in ACEG. All ACI interfaces are routed via ALIS.	WS-21288/4

Element	Interface Description	IDS
04 FCS-1	This provides the physical interface for FCS connectivity for the FCS interface to other CS elements via NTDS. This interface also provides system services to AWS Elements.	ANCD-9586/1
04 FCS-2	The four WCS/FCS IOPs receive Net Time Protocol time data from the FWD and AFT ACEG cabinets via ALIS. The source of the time data for the FWD and AFT ACEG cabinets is the IRIG-B time code from the FWD and AFT NAVSSI RTS.	WS-21288/4
04 FCS/DCC	Provides communications switching between WCS/FCS I/O normal and alternate channels.	ANCD-9586/1
07 ORTS-1	ORTS interfaces with the DAP in the ACEG cabinets to receive readiness/assessment data. ACEG DAP also provides NTDS-E interfaces to the SPY1-D(V) Transmitter Driver cabinets for status and BITE results reporting.	WS-21288/4
07 ORTS-2	This provides the physical interface for ORTS connectivity for the ORTS interface to other CS elements via ALIS. This interface also provides system services to AWS Elements. The System Monitor Module interfaces with ORTS via the ORTS Bus.	ANCD-9586/1
07 ORTS-3	ORTS initiates a display with the CS Boundary Defense components to support configuration (e.g.policy, filters, rules) through a GUI. In addition, ORTS will manage the CSBD software components (CS GW and CS DC) through AM.	NA (Remote Desktop)
07 ORTS-4	ADS provides DiVDS video and TCDs to the ORTS system via ALIS.	WS-35435
07 ORTS-5	ORTS has the ability to print to the ACI provided printers.	NA (Printer Data)
09 SSRS/SPA-25H	The AN/SPA-25H interfaces with the AN/SPQ-15(V) to receive analog video for display on the SPA-25H or IBNS.	WS-35436
09 SSRS/SPS-73	The AN/SPQ-15(V) interfaces with AN/SPS-73 to receive radar video and true bearing.	FES 455011
10 IFF-1	This provides the physical interface for the IFF connectivity for IFF interface to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1

Element	Interface Description	IDS
10 IFF-2	The AN/SPQ-15(V) interfaces with the AN/UPX-24 of the IFF system to receive IFF video and data, and to request specific video. There is one physical connection which provides 14 virtual channels.	FES 455011
11 EWS-1	This provides the physical interface for EWS connectivity for the EWS interface to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1
11 EWS-2	The ACI provided instantiation of the IWS objective architecture component framework application programmers interface. The interface is used by SLQ-32(V)6.	WS-35453
12 US&CS	This provides the physical interface for the AN/SQQ-89A(V)15 interface to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1
13 HSE/ SRQ-4-1	DiVDS interfaces with HSE to receive three analog camera video feeds from the MH-60R: Forward Looking Infrared (FLIR), VCR video, and Inverse Synthetic Aperture Radar (ISAR) Video. This video is displayed on consoles throughout the combat information center and the bridge.	WS-35435
13 HSE/SRQ-4-2	The AN/SRQ-4 sends analog helicopter radar video and radar video sync signals to the SPQ-15 video Data Distribution System (DDS). This video is displayed on consoles throughout the combat information center.	FES455011
14 NAV/CADRT	DiVDS interfaces with CADRT to receive analog camera video.	WS-35435
14 NAV/INS	To support the display of radar video, the SPQ-15 DDS receives ownship heading and speed synchro data from the RLGNs via ICOM	WS-35436
14 NAV/NAVSSI-1	The ATP receives synchronized time information from the GPS via an Inter-Range Instrumentation Group (IRIG) Type-B interface from the FWD and AFT Navigation Sensor System Interface (NAVSSI).	WS-21288/4
14 NAV/NAVSSI-2	The SPQ-15 receives RS-422 NMEA-183 from the forward and aft RTS via DMS. The NMEA-183 message is used to fill the DDS interface with navigation data (ownship heading and speed, and position data), which is then sent to the AN/SPA-25H Indicator Group (part of SSRS, located in the CIC).	FES 455011

Element	Interface Description	IDS
14 NAV/RLGN	The Gyro Data Processor (GDP) of each ACEG cabinet receives an OD1 Navigational Data Periodic Message directly from one of the WSN-7(V) RLGNs via an NTDS-D interface. The OD1 message contains time, position data (LAT/LONG), attitude data (heading, roll, pitch) and velocity data. The GDP converts and reformats the OD1 data into the GDR message and transmits that data to AEGIS Weapon System element processors.	WS-21288/4
14 NAV/WSN-7	The GDP receives the ship's attitude (roll,pitch, and heading) data from the Ring Laser Gyro, smoothes and formats the data into a single output message for distribution to the SPY, WCS/FCS I/O processors, GWS and SPQ-9B via ALIS.	ANCD-9586/1
15 EXCOM	This provides the physical interface for the EXCOM connectivity for EXCOM interface to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1
17 TWS	This provides the physical interface for the TWS connectivity for TWS interface to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1
18 PWS	DiVDS interfaces with CIWS to receive analog camera video from each of the CIWS Mount via the PWS Remote Control Station.	WS-35435
21 ICOM	ACI provides the Battleshort Relay Closure to ICOM.	NA (Battleshort Relay Closure)
23 CSSE	This interface provides RAS IP Video to DiVDS via ALIS.	ANCD-9586/1
23 CSSE/CSBD	The C2 DDTS within CSSE interfaces with the ACI CS DDTS to facilitate secured data exchanges from the Combat System Secured domain to external systems. The Bulk Data Transfer Services (BDTS) will interface with CSSE CANES to push or pull data files into the Combat System Secured Domain.	WS-35792-CSSE/ACI
23 CSSE/EXTRON	DiVDS interfaces with EXTRON to receive analog PC video.	WS-35435

Element	Interface Description	IDS
23 CSSE/RAVE & CKT	DiVDS interfaces with CSSE to receive five analog camera video feeds: 1) Radar Alignment Verification Equipment (RAVE) camera, used to verify FCS illuminator alignment 2) The forward and aft VLS cameras 3) The port and starboard Bridge AN/KAS-1A Cameras, useful in low-visibility (fog or night) pilotage and area surveillance	WS-35435
23 CSSE/VLP	The WCS VLP (p/o ACEG) interfaces with the Vent Closure Panels to control the ship's intake vents to prevent the ingestion of toxic gases from missile firings.	WS-21288/4
25 GWS-1	The GCSC(s) receives system time using the Precision Time Protocol via ALIS. The GWS receives redundant ownship's attitude data (heading, roll and pitch) via ALIS from both the forward and aft GDP.	WS-21288/4
25 GWS/GWS Console	The GWS Console receives a direct AN/SPQ-9B radar video feed via the AN/SPQ-15(V) Data Distribution System (DDS). The DDS provides various radar videos to gun consoles GFCS and GECO No. 1.	WS-35436
25 GWS/IEU	The MK 34 GWS EOSS DIS and TIS video is provided to ALIS via the Distributed Video System (DiVDS). The MK 38 Mod 2 Gun Video is integrated with DiVDS.	WS-35435
28 CEC	(FOUO) This provides the physical interface for the CEC connectivity for CEC interface to other CS elements via ALIS. This interface also provides system services to AWS Elements. Classified as FOUO by CEC SCG [OPNAVINST S5513.3B-(119.10)]	ANCD-9586/1
29 GCCS-M -1	DiVDS interfaces with GCCS-M to receive analog camera video.	WS-35435
29 GCCS-M -2	This provides the physical interface for the GCCS-M connectivity for GCCS-M interface to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1
30 SGS	This provides the physical interface for SGS connectivity for the SGS interface to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1
32 VLS-1	The LCUs connect to printers in ACI via an ALIS Ethernet connection.	NA (Printer Data)

Element	Interface Description	IDS
32 VLS-2	This provides the physical interface for the VLS connectivity for VLS interface to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1
33 ADS	This provides the physical interface for the ADS connectivity to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1
34 ATD-1	This provides the physical interface for the ATD connectivity for ATD interface to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1
34 ATD-2	DiVDS receives analog (RGB) Training Display video from the BFTT component of the Advanced Training Domain.	WS-35435
37 HSRS-1	This provides the physical interface for the HSRS connectivity for HSRS interface to other CS elements via ALIS. This interface also provides system services to AWS Elements.	ANCD-9586/1
37 HSRS-2	Time of Day—The Radar is modified with adding two VME modules in the Video Processor Unit to accept Forward and Aft IRIG-B Time Sync from MCE 1 and MCE 2 cabinets respectively.	WS-21288/4
37 HSRS/SPQ-9B	The AN/SPQ-15(V) interfaces with the SPQ-9B to receive radar video and relative corrected ACP.	FES 455011
38 NFS	DiVDS receives the Command Summary Display video.	WS-35435
41 VCD-1	The ACI provided instantiation of the IWS objective architecture component framework application programmers interface.	WS-35453
41 VCD-2	The VCD Computer Suite interfaces with the ACI via network interfaces to ALIS. Digital helo radar and camera video may be received from VCD in lieu of the data available directly from HSE	IWS-OBJARCH-CDM
91 SB&BS/IBS	DiVDS interfaces with the IBS of SC&BS to receive analog camera video.	WS-35435
EXT/Battle Short Alarms	The VLP interfaces with Battle Short Alarms to provide warning to the ship's crew when Battle Short is enabled.	

4.1.3.39.5 Design Approach/Rationale/Constraints

Changes are identified in Aegis BL10 due to SPY-6 integration, CIWS sensor integration, and cybersecurity.

SPY-6 integration impacts ACI for new hardware interfaces on the ALIS network. Additional impacts include network access controls for message transfer.

CIWS sensor integration impacts ACI for a new ethernet interface connection into the combat system. This interface has additional cybersecurity impacts as well.

Cybersecurity upgrades primarily impact ACI has ACI controls hardware of the combat system. ACI implements the cybersecurity protections for hosted combat system elements.

4.1.3.40 Mission Planner (40)

4.1.3.40.1 Purpose

The Mission Planner (MP) provides pre-mission planning and ship positioning, plan evaluation/verification and action management/assessment capabilities for the Aegis Combat System (ACS). MP includes decision support capabilities to facilitate coordination of ownship sensors and weapon systems, and to support commanders in assignment of responsibility.

Inputs to the MP include but are not limited to ship's mission, launch areas, hostile air space, defended areas, defended assets (including guarded units), water depth, min & max search elevation, plan tasking (with mission priorities), and weapon doctrine firing policies. Outputs include Ship Operating Area (SOA) maneuver areas, Defendable Area Footprint and Launch Area Denied (LAD) (for BMD only), Estimated Collateral Damage Area (ECDA), Radar Tasking for organic detection, Cued Acquisition Doctrine for remote detection, Weapons Doctrine, estimated radar resource consumption, related alerts (e.g. Estimated Collateral Damage Area) and tutorials along with performance metrics aligned with the ship's mission.

4.1.3.40.2 Requirements Satisfied

The MP Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 2, Section 3.2.11.

4.1.3.40.3 Description

MP provides ownship personnel and embarked commanders with capabilities to execute tasking to Aegis equipped ships. The MP assesses the need to update organic radar tasking and Cued Acquisition Doctrine as ownship and the defended asset transit to different locations. To verify ACS performance, MP computes Dynamic Test Targets (DTTs) and Enhanced Dynamic Test Targets (EDTTs) for each plan and provides the capability to modify DTT/EDTT parameters for use in the ACS. MP also computes Training Target Data (TTD) to support crew training.

MP performs the following key functionality for BMD:
- Computes radar search doctrine for SPY BMD autonomous search
- Develops cued acquisition doctrine for BMD engagement tasking in C&D
- Develops deployment regions wherein the ship can meet its assigned BMD tasking
- Interfaces with the bulk data transfer system (BDTS) to support collaborative planning networks

MP performs the following key functionality for AAW:
- Computes radar organic and remote doctrine for SPY AAW search
- Develops deployment regions wherein the ship can meet its assigned AAW tasking

MP performs the following key functionality for IAMD:
- Computes optimized radar organic and remote tasking for coverage of AAW & BMD missions
- Develops deployment regions wherein the ship can meet its assigned AAW & BMD tasking

The Mission Planner is depicted in Figure 4.1-38.

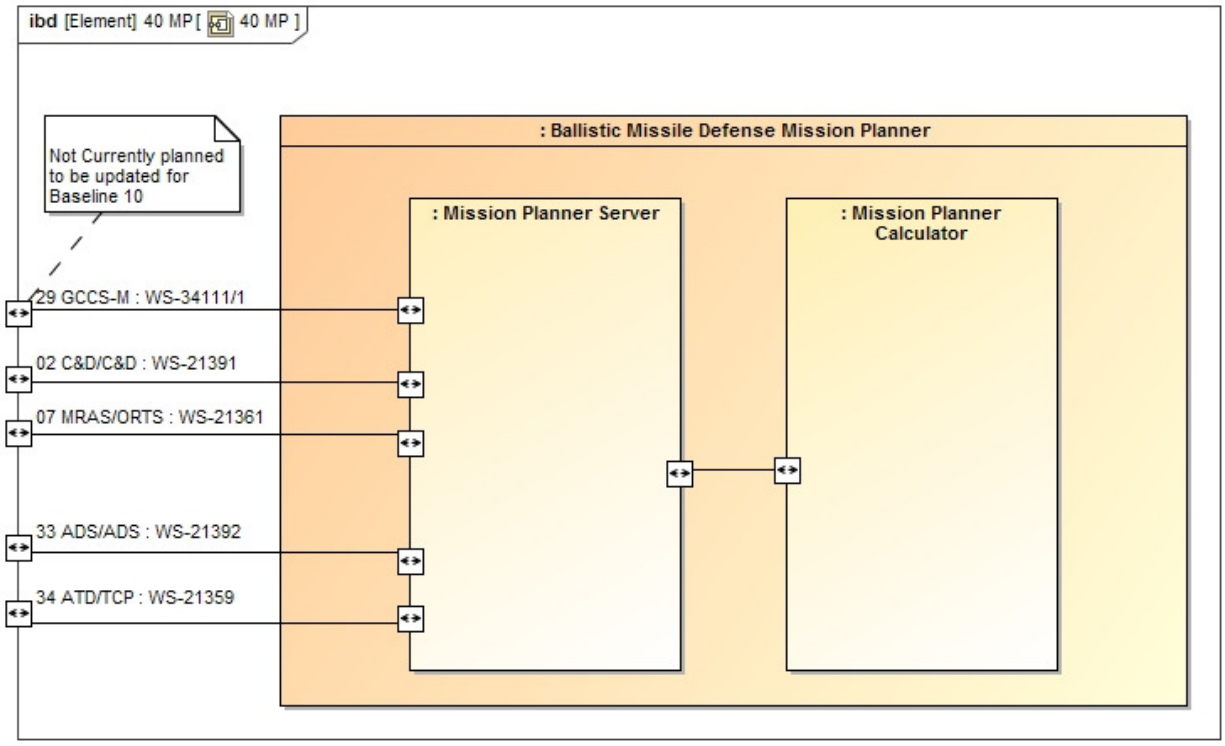

Figure 4.1-38 40 MP

4.1.3.40.3.1 Mission Planner Architecture

BMD MP consists of two software subsystems, MP Server and MP Calculator. Communication between MP Calculator and the MP Server via a Common Object Request Broker Architecture (CORBA) interface.

4.1.3.40.3.1.1 Mission Planner Server

The MP Server is responsible for maintaining the overall status of the MP element. MP Server handles arbitration of incoming and outgoing message processing to/from the external systems and interfaces with the MP Calculator to perform plan calculation and assessment functions. MP Server also provides operational status to ORTS, sends target data to the ATD component of the Advanced Training Domain during training scenarios. Additionally, MP Server provides a relational database and ensures plan data persistence and recoverability.

4.1.3.40.3.1.2 Mission Planner Calculator

The MP Calculator provides the following services to the MP Server:

Plan Calculation - The MP Calculator provides the functionality responsible for generation of plan results. This functionality includes organic and remote radar search tasking computations, and determination as to whether ownship can perform the plan based upon requests for the MP Server. The message contains plan inputs which are defined by the ship's primary mission. The MP Calculator then computes the plan and returns one or more types of results based on the task type, along with any tutorials that are generated. These outputs are Plan Generated Doctrines (PGD), either organic radar search tasking or remote radar search tasking based on the task type, Estimated Collateral Damage Area (ECDA), Launch Area Denied (LAD) for BMD only, Hostile Air for AAW only, Defended Area Footprint (DAF) for BMD only, Ship Operation Area (SOA), Dynamic Test Targets (DTT), and Enhanced Dynamic Test Targets (EDTTs) and Training Target Data (TTD).

Tactical Action Management - The MP Calculator provides plan computations during execution of a plan within the weapon system. New radar tasking and cued acquisition doctrine and DTT/EDTTs are

automatically generated based on ship movement and upon request with modified warfighter parameters including but not limited to radar resources and mission posture.

Engageability Service - The MP Calculator provides the functionality responsible for computing engageability for individual trajectories used in the computation of the plan.

DTED Service - The DTED Service SU provides the functionality responsible for determining if doctrines are impeded by geographical terrain obstructions.

MPM Service - The MPM Service provides the interface functionality between the Mission Planner and the Mission Planning Module for plan computations and action management.

4.1.3.40.4 Element Interfaces

Table 4.1-32 Mission Planner Interfaces

Element	Interface Description	IDS
02 C&D	This interface allows MP to send plans to C&D that include Radar, Weapon and Cued Acquisition doctrine parameters and Defended Asset parameters. C&D also provides ownship and guarded unit navigation data to MP. MP and C&D communicate using a connectionless publish-subscribe communications protocol over the Data Distribution Service (DDS) network messaging middleware.	WS-21391
07 ORTS/MRAS	This interface provides a means for ORTS to verify MP availability for fault isolation. It consists of two-way primary and alternate TCP/IP connections over the ALIS network between MP Server and ORTS.	WS-21361
29 MTC2	This interface allows the MP to exchange data with a higher echelon mission planner via MTC2 . It consists of two-way primary and alternate TCP/IP connections over the ALIS network using a HTTPS web service protocol between MP Server and MTC2 . *While there is an interface in existence for MP and GCCSM, program of record for ACB20 is not to update the interface.*	WS-34111/1
33 ADS/ADS	This interface allows operators to create, modify, and review all watchstander entered planning parameters including but not limited to AOI's, Launch Areas, Defended Areas, special assets, and plans. It also allows operators to start and stop plan calculations and adjust action management criteria. MP and ADS communicate using a connectionless publish-subscribe communications protocol over the DDS network messaging middleware.	WS-21392

Element	Interface Description	IDS
34 ATD	This interface allows MP to send training Launch and Impact point position data to the TCP component of the Advanced Training Domain after a training scenario has been initiated. This interface consists of two-way TCP/IP connection over the ALIS network between the active MP Server and TCP.	WS-21359

4.1.3.40.5 Design Approach/Rationale/Constraints

Changes are identified for Aegis BL10 for SPY-6 integration.

Mission planner upgrades include supporting IAMD, AAW, and BMD capabilities. Mission planner provides plans for C&D so that C&D can task sensors to execute the plan.

4.1.3.41 Vehicle Control Domain (41)

4.1.3.41.1 Purpose

The Vehicle Control Domain (VCD) element will ultimately be the focal point for the management of off-board vehicles within the combat system. VCD will perform control and integration functions for off-board vehicles, as well as their sensors, weapons, and communication systems. The ship's personnel will be provided the capability for monitoring and controlling the sensors, weapons, and communications systems on the vehicle as separate segments from the vehicle itself to effectively coordinate tasking of those sensors and weapons with tasking of organic shipboard sensors and weapons in support of the ship missions.

The MH-60R capability is distributed across the VCD, HSE, ADS, C&D, EWS, and SQQ-89. For BL9.C2, VCD will support processing necessary to control the MH-60R helicopter. All other air legacy air control functions will remain within WCS and C&D. The following capabilities will be supported by VCD for BL9.C2:

- Control of the MH-60R helo (including handover, route management, fly-to-points, and waypoints)
- Initialization of helo communication and synchronization with the ACS
- Distributing helo track data to ACS source and system track managers (e.g., acoustic tracks/sonobuoys to SQQ-89, ESM tracks to EWS).
- Helo sensor segment control (Acoustics, MMR/IFF, ESM)
- Provision of shipboard datalink status

4.1.3.41.2 Requirements Satisfied

The VCD Element satisfies the requirements found in WS-21200/20, Aegis BL 9.C2 System Specification, Volume 2, Section 3.2.12.

4.1.3.41.3 Description

The VCD Element is composed of the Vehicle Control Computer Program. The VC Computer Program coordinates, manages, controls and supports the off-board vehicles of the Combat System. The following paragraphs describe VCD.

The Vehicle Control Domain element is depicted in Figure 4.1-39.

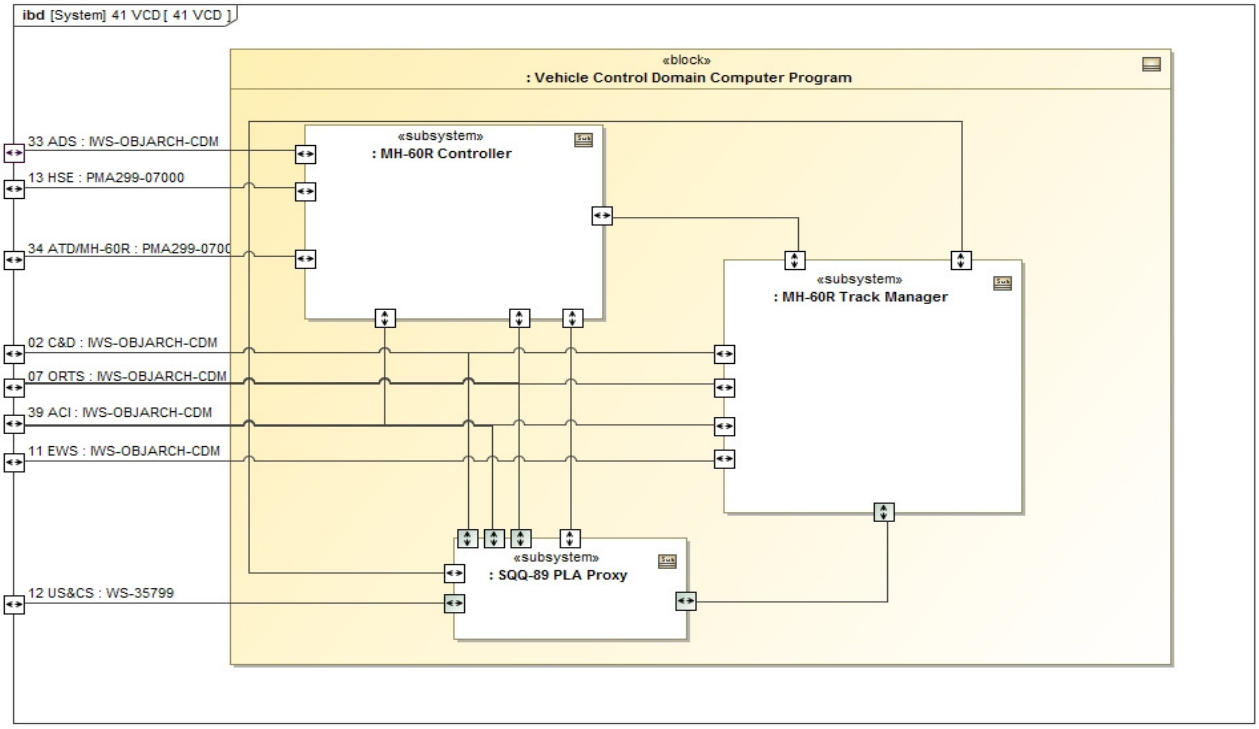

Figure 4.1-39 41 VCD

4.1.3.41.3.1 Vehicle Control Computer Program

The VC computer program is made up of the following:

- MH-60R Controller
- MH-60R Track Manager
- Common Datalink (CDL) Controller

4.1.3.41.3.1.1 MH-60R Controller

The MH-60R Controller handles helo tasking from the Combat System. It maintains health and status information on the vehicle, its communication link, and its sensor/weapon payload. The MH-60R Controller also maintains configuration data and synchronizes reference data exchanged between the combat system and MH-60R helicopter.

The MH-60R Controller receives and provides specific messages to and from the helicopter, via HSE, in accordance with the PMA299-07000 interface. It translates PMA299-07000 to/from PLA messages and manages vehicle payloads and health/status reporting.

4.1.3.41.3.1.2 MH-60R Track Manager

The MH-60R Track Manager is responsible for managing and distributing track data downlinked from and uplinked to the MH-60R helicopter. This includes publishing messages on the combat system LAN for surface and subsurface tracks, EW data, and acoustic data for use by C&D, EWS and US&CS.

4.1.3.41.3.1.3 Common Datalink (CDL) Controller

The Common Datalink (CDL) Controller is responsible for providing status of the shipboard datalink equipment and for providing a means for an operator to control the datalink settings.

4.1.3.41.4 Element Interfaces

Table 4.1-33 Vehicle Control Interfaces

Element	Interface Description	IDS
02 C&D	C&D interfaces with VCD via DDS Pub/Sub over ALIS. VCD sends C&D non-ASW MH-60R source track data via the Track Server and information on the health and status of the helicopter (including control status) and its equipment for C&D status reporting. For ships equipped with AN/SLQ-32 (V)2 or 3, C&D receives and forwards MH-60R ALQ-210 status and EW emitters to SLQ-32. C&D manages and provides system track data to VCD for track association/correlation.	IWS-OBJARCH-CDM
07 ORTS	VCD interfaces with ORTS to provide status of VCD, helo equipment, and shipboard datalink equipment. ORTS will also perform remote loading of VCD.	IWS-OBJARCH-CDM
11 EWS	For ships with SEWIP Block 2, the EWS interfaces with VCD via ALIS to synchronize and integrate EW Source Tracks. VCD provides EWS with MH-60R ESM segment control.	IWS-OBJARCH-CDM
12 US&CS	The VCD Computer Suite system interfaces with SQQ-89 via ALIS. The VCD Computer Suite sends helo health and status, MH60R tracks, bearings and points, and sonobuoy information to the US&CS to support sonobuoy processing and synchronization of data bases. The VCD Computer Suite receives segment control commands and sonobuoy data from US&CS via the interface.	IWS-OBJARCH-CDM
13 HSE	Digital communications between VCD and the MH-60R helicopter are facilitated by the Helo Shipboard Equipment element. The VCD sends and receives all digital communications exterior to the ship via the Common Data Link (CDL).	PMA299-07000
33 ADS	The VCD Computer Suite interfaces with the ADS via network interfaces to ALIS. Tactical situation data, status data and operational readiness data are sent from VCD to ADS. In support of the ASTAC submode, ADS provides VCD helo segment controls and status, and sends engagement task orders, and handover requests to VCD	IWS-OBJARCH-CDM
34 ATD	The VCD Computer Suite interfaces with the ATD via ALIS. The VCD receives PMA299-07000 interface simulation for MH-60R from MH-60R SIM.	PMA299-07000
39 ACI	The ACI provided instantiation of the IWS objective architecture component framework application programmers	IWS-OBJARCH-CDM

Element	Interface Description	IDS
	interface.	

4.1.3.41.5 Design Approach/Rationale/Constraints

No changes are identified for Aegis BL10. However, any changes determined to be needed during detailed design will be included in a future version of the SSDD.

4.1.4 Element Configuration Table

Table 4.1-34**Error! Reference source not found.** identifies the BL 10 system configuration for each Combat System Element of the Aegis Combat System.

Table 4.1-34 BL 10 Element Configuration Table

Element	System Configuration
01 SPY	• AN/SPY-6
02 C&D	• AWS BL10 w/ BMD 6 (C&D) • SVS ON-740(V)1/U Secure Voice
03 WCS	• KAS • AWS BL10 w/ BMD 6 (WCS)
04 FCS	• Mk 99
07 ORTS	• AWS BL10 w/ BMD 6 (ORTS)
09 SSRS	• SSR/NAV RDR SPS-73 TR FC13 sw v12.02 [AMOD] or Sperry BME [SCN] • SPA-25
10 IFF	• IFF AN/UPX-29 (V) AIMS MARK XIIA with Mode 5/S; UPX-24(V) sw 3.0 • IFF Sim
11 EWS	• AN/SLQ-32(V)6 SEWIP Block 2 with SKC Bld 1 and Decoy System • SEWTT
12 US&CS	• ASW AN/SQQ-89A(V)15 ACB 15/TI14 • SAST • ASW Controller • ASW Track Manager • USW-DSS, AN/UYQ-100 • USW-DSS SIM
13 HSE	• MH-60R AN/SRQ-4 Ku Band sw V1.4
14 NAV	• NAVSSI AN/SSN-6F 4.2.2
15 EXCOM	• CDLMS UYQ-86(V)5 sw v 4.X TR • JTT-M USQ-151 Blk 6 R1 sw6.1.1 rel 3.3 • ADNS INC III (w/Service Pack 3) • • TDL Sim
17 TWS	• Tomahawk TTWCS SWG-5(V)3 5.4.0.2
18 PWS	• CIWS MK 26 (single mt) BLK 1B BL2 B213 sw vB213 (Next Gen interface)
19 UCS	• AN/SLQ-25A
20 UWS	• OTST Mk 32 • VLA missile (Mk 46, Mk 54) • Mk 46 torpedo • Mk 54 torpedo
21 ICOM	• Moriah 1.3 or 1.5 • IVCS AN/STC-3(V)2 IVCS • SVS ON740(V)I/U Secure Voice • GEDMS (MG & DSMC Obsolescence)

22 LSS	• N/A
23 CSSE	• CANES AN/USQ-208A(V)1 SW v2
24 TSS	• AN/SQR-20
25 GWS	• GWS Mk34 Mod X sw v(tbd); GCS Mk 160 Mod X[SCN]/Gun Mt Mk 45 Mod 4/MK 37 Mod 4 GMCP/EOSS Mk 20 Mod 0 • EO/IR Sim
26 CCSS	• SSEE AN/SSQ-130(V) INC F
28 CEC	• CEC USG-2B SDP-S 2.1.10 PAAA/ CAB-S antenna • CEC Enhanced Trainer
29 GCCS-M	• GCCS-M 4.1.0.1 GL
30 SGS	• SGS/AC re-host/NTDS Elim sw v7.0.0
32 VLS	• VLS MK 41 MOD 15 B/L VII MK 41 Mod 15 w/BMD 5.1-6 Ordalt
33 ADS	• TI 16 (CDS) • AWS BL10 w/ BMD 6 (ADS)
34 ATD	• BFTT USQ-T46D(V)3 hw build 4.2 / sw capability build 5 • AWS BL10 w/ BMD 6 (TCP) • MH-60R Sim • TTC
37 HSRS	• SPQ-9B PDD 6.03.00 (w/o secondary IFF)
38 NFS	• NFS is contained with GWS (Gun Computer System Fires Planner)
39 ACI	• TI 16 (Core Computing System, ALIS) • DiVDS, SLQ-15 • Tactical Console
40 MP	• AWS BL10 w/ BMD 6 (MP)
41 VCD	• MH-60R Controller • MH-60R Track Manager • CDL Controller

4.2 Concept of Execution

This section describes the Combat System concept of execution among the system elements as identified in Section 4.1.3. This section models interactions for a specified set of use cases related to the Baseline 10 program. It includes diagrams and descriptions showing the dynamic relationship of the components, that is, how they will interact to achieve the mission.

The system concept of execution shows how the ACS Elements and Operators dynamically interact to provide system capability. Mission Scenarios are operational scenarios that show how the Navy expects to use the system capability to meet its mission objectives. The concept of execution identifies the key mission scenarios that drive, constrain and provide context for the BL10 capabilities. The development of the concept of execution involves allocating behavior and interfaces to elements and operators while investigating system capability threads. The concept of execution is represented using system use cases and activity diagrams. The activity diagrams show the following on a per scenario basis:

- Identify behaviors allocated to elements and personnel for specific system capability threads
- Reveal how the elements and personnel collaborate to accomplish the system capability threads
- Identify inter-element messages required
- Identify impacts to the operator in terms of HSI

The complete concept of execution for each capability is described in three levels of detail. Appendix D describes how the system interacts with its environment and how system elements collaborate to provide system behavior. Post-SFR Appendix D is updated to describe how the components which compose the AWS elements collaborate to provide system behavior (this was previously provided under Appendix E).

4.3 Interface Design

External and internal combat system interfaces are described below. The interface design for each capability is described in two levels of detail. Appendix D describes the interface design for elements that collaborate to provide each capability.

4.3.1 External Interfaces to the Combat System

External interfaces to the combat system are depicted in Figure 4.3-1 and summarized in Table 4.3-1**Error! Reference source not found.**.

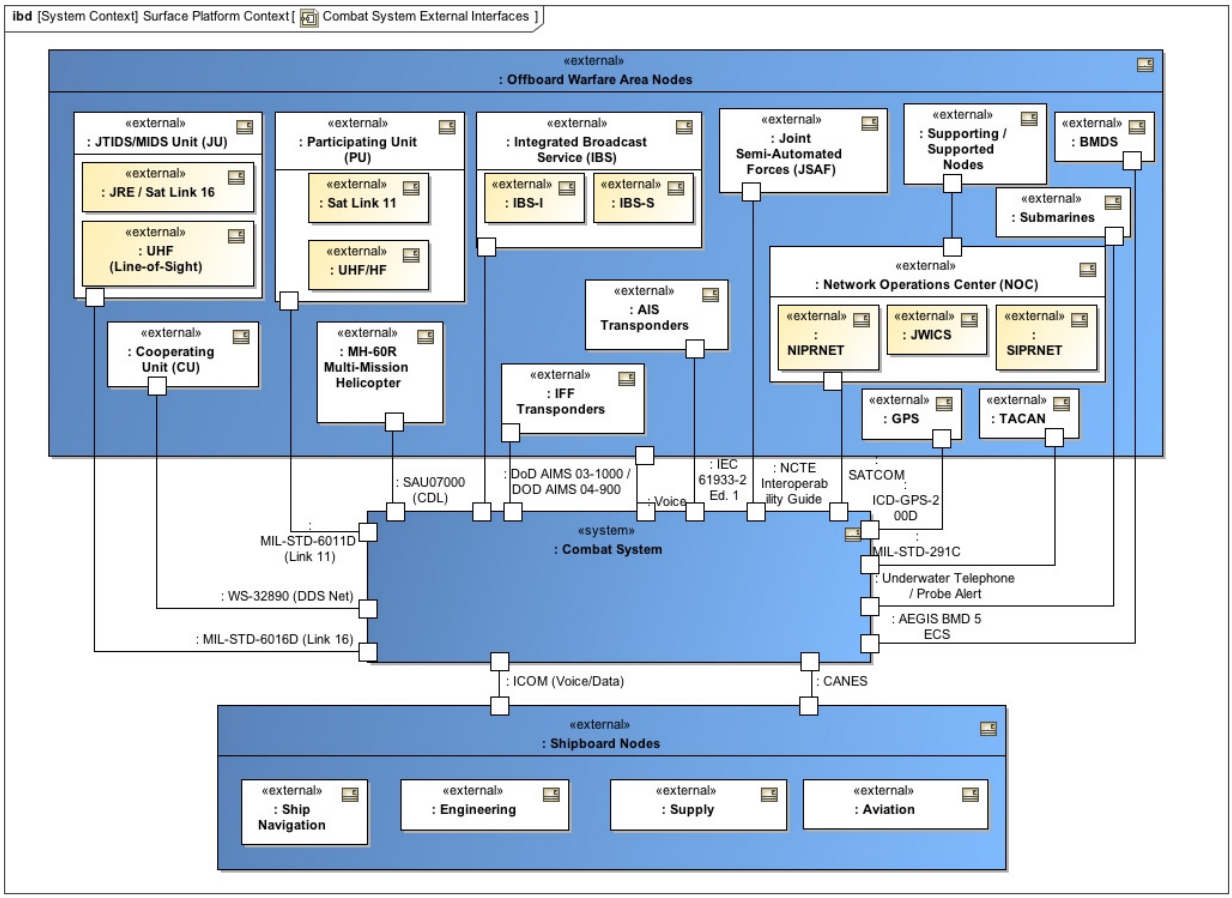

Figure 4.3-1: Combat System External Interfaces

Table 4.3-1 Combat System External Interfaces

External Interface to	Description
Shipboard Nodes (Data / Voice)	The combat system interfaces with shipboard nodes via ICOM and the CANES. Shipboard nodes include Ship Navigation, Engineering, Supply, and Aviation.
Ballistic Missile Defense Systems (BMDS)	The combat system provides communication paths for the BMD IERs IAW the Aegis BMD 6 ES.
Submarines	The combat system communicates with submarines via Underwater Telephone and Probe Alerts.
Cooperating Units (CUs)	The combat system interfaces with Cooperating Units (CUs) via the Data Distribution System (DDS) Network in accordance with WS-32901-1.
Offboard Warfare Area Nodes (Voice)	The combat system interfaces with offboard warfare area nodes via secure and non-secure voice systems including high frequency (HF), very high frequency (VHF), and ultra-high frequency (UHF).
Network Operations Center (NOC)	The combat system interfaces with Supporting and Supported Warfare Area Nodes via NOC Satellite Communications (SATCOM). Using SATCOM, the combat system can communicate using Secret Internet Protocol Router Network (SIPRNET) and the Unclassified but Sensitive Internet Protocol Router Network (NIPRNET). SATCOM also provides for communications using the Joint Worldwide Intelligence Communications Systems (JWICS).
Integrated Broadcast Service (IBS) Nodes	The combat system communicates with external warfare area nodes via Integrated Broadcast Service – Simplex (IBS-S) and Integrated Broadcast Service – Interactive (IBS-I).
Automatic Identification System (AIS) Transponders	The combat system interfaces with external nodes via the Automatic Identification system in accordance with IEC 61993-2.
TACAN Transponders	The combat system transmits and receives TACAN signals to support aircraft position determination relative to ownship.
Identification Friend or Foe (IFF) Transponders	The combat system interfaces with external nodes via IFF in accordance with DoD AIMS 03-1000 and DoD AIMS 04-900. The combat system interrogates, transmit, and receive IFF modes 1, 2, 3, C, 4, and 5. Additionally, the combat system can interrogate and receive IFF mode S.
Global Positioning System (GPS)	The combat system receives GPS data in accordance with ICD-GPS-200D.
Ownship Controlled Multi-Mission Helicopters (MH-60R)	The combat system communicates with MH-60R Multi-Mission Helicopters via the Common Data Link (CDL) for voice and data. Communications will be in accordance with the PMA299-07000 Rev 1 Change 4.
Link 11 Participating Units (PUs)	The combat system communicates with Link 11 PUs via Satellite Link 11, HF, and UHF. The combat system interfaces with Link 11 PUs in accordance with MIL-STD-6011.
Link 16 JTIDS/MIDS Units (JUs)	The combat system communicates with Link 16 JUs via UHF line-of-sight and Satellite Link 16. The combat system shall interfaces with Link 16 JU in accordance with MIL-STD-6016. The combat system also communicates with Joint Range Extension (JRE) nodes via UHF, Super High Frequency (SHF), and Extremely High Frequency (EHF) SATCOM in accordance with MIL-STD-3011.

External Interface to	Description
Navy Continuous Training Environment (NCTE) Interoperability Guide	The combat system communicates with participants in a Fleet Synthetic Training (FST) event. Using the NCTE, the combat system receives synthetic data from Joint Semi-Automated Forces (JSAF) which is distributed on the Training LAN within the combat system.

4.3.2 Internal Interfaces to the Combat System

Table 4.3-2 lists all the interfaces identified in this document that have formally defined interface specifications (e.g. PEO IWS weapon specifications). Interfaces without a formal interface document are also identified with an indication of IDS not applicable (NA) within the table.

Table 4.3-2 Internal Combat System Interfaces

Interface Specification Number	Interface Description/Title
ANCD-9586/1	Title: Tactical Configuration Directive IP Address, Hostname and Network Configuration Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12) Interface between ACI and ACS
CDE(IDS)84-19 Rev 10	Title: Advanced Combat Direction System Block 1 Command and Control Processor to Combat Direction System Model 5 Interface Design Specification (IDS) dated 12 May 2005. Interface between CDS and C2P
ICD-GPS-200D	Title: Navstar GPS Space Segment / Navigation User Interfaces
IWS-OBJARCH-CDM	Title: IWS Common Data Model, Track Data Model. Defines source and system track classes, and track data messages. Provides the track data interface between ADS and C&D, and other elements of the Combat System
PMA-280-1233	Interface between GCCS-M and TTWCS via ALIS
NA (ADNS)	Interface between ADNS and NFS
NA (AIS Comms)	The AIS transponder operates in two modes; transmit/receive and receive only. The ship's crew can choose the operational mode. In receive only mode, the AIS transponder receives one-way serial data transmitted from another ship. The data the AIS transponder receives includes the other ship's Marine Mobile Service Identity, Navigation Status, Speed Over Ground, Position Accuracy, Lat/Long, True heading, Course Over Ground, Time Stamp, IMO Vessel Number, Call Sign, Name of Ship, Type of Ship/Cargo, Dimensions of Ship, Reference Point for Position Reports, Type of Position Fixing Device, Draft of Ship and Destination, and the AIS transponder forwards that received data to the terminal box for distribution. Users may connect to the terminal box to obtain the received AIS data. In the transmit/receive mode, the transponder not only receives broadcasts from other ships but also transmits the same type of AIS data about itself to every ship within VHF coverage range.
NA (Attitude Data)	Ship heading, roll, and pitch data from the Ring Laser Gyro Navigator (RLGN) system.
NA (Blanking)	Blanking pulses are sent to the SLA-10D Blanker Video Mixer to inhibit the EWS receiver when ownship sensors are radiating.
NA (CDL Data)	External Ku-Band Common Data Link (CDL) communications with ownship controlled helicopters.

Interface Specification Number	Interface Description/Title
NA (Display Data)	Data for display on console and keyboard/trackball inputs.
NA (Ephemeris Data)	Parameters that can be used to accurately calculate the location of astronomical objects in the sky at a given time or times. It describes the path that the object is following as it orbits Earth.
NA (EW Coordination)	IP based data used for the coordination of EW operations.
NA (FD/FI)	Fault Detection and Fault Isolation Data.
NA (GCCS-M Client)	Web-based common operational picture (COP) communications with a GCCS-M server.
NA (IBS)	Integrated Broadcast Service (IBS) communication.
NA (Illumination)	X-band emission from shipboard illuminators to support SM and ESSM terminal homing.
NA (Intel Coordination)	IP based intelligence data exchange to support EW/IO.
NA (IR)	Infrared emissions.
NA (IRIG-B Data)	Inter-range instrumentation group time code B use for time synchronization. Time code B has a time frame of 1 second with an index count of 10 milliseconds and contains time-of-year and year information in a binary coded decimal format, and seconds-of-day in straight binary seconds.
NA (CANES Comms)	Communications between ADNS to CANES for users of IP based satellite communications with system that are not part of the combat system.
NA (Link 11 HF/UHF)	Communications with Link 11 PUs via HF and UHF.
NA (Link 16 UHF)	Communications with Link 16 JTIDS/MIDS Units (JUs) via UHF.
NA (Mission Readiness Data)	Mission readiness data between the shipboard integrated survivability management system and ORTS.
NA (Moriah Wind Data)	Wind Data from the Moriah Wind System.
NA (Nav Data)	Integrated navigation data from shipboard sensors. It may include ownship position as latitude and longitude, component velocity vectors (north and east), Greenwich Mean Time (GMT), almanac data, ownship speed over ground, ships attitude, inertial velocity north and east, ship's dead reckoned position, calculated ocean current, wind speed and direction, and ownship speed over water.
NA (OperatorActions)	Operator inputs into the system. Typically via a console.
NA (Position Data)	FCS position data to support alignment and verification using Radar Alignment Verification Equipment (RAVE).
NA (Position Errors)	WCS data to support alignment and verification using Radar Alignment Verification Equipment (RAVE).
NA (Power/Control)	Power and control interface for the towed array.
NA (Printer Data)	Data to infrastructure printers.
NA (RF)	The FCS Radar Transmitters interface with the CSSE CWI Monitors via a Waveguide Switch Assembly to receive RF samples of X Band CWI transmitter energy for purposes of AM/FM noise measurements.
NA (SATCOM)	Communications with satellites.
NA (Sonobuoy)	Live sonobuoy acoustic information is received from RF data links with sonobuoys.
NA (SSEE System Monitor)	Signal exploitation system status via a coaxial interface with the CANES control panel.
NA (Synchro IFF Radar Returns)	Radars provides true antenna azimuth and Ro trigger to synchronize IFF returns with the radar.

Interface Specification Number	Interface Description/Title
NA (TACAN Comms)	Communications with TACAN enabled aircraft. Helicopters equipped with TACAN avionics can use this system for en-route navigation as well as non-precision approaches to ships.
NA (Tactical Data)	Tactical data from C4I systems to GCCS-M via CANES.
NA (Test Request/Response)	ORTS test requests and responses to support fault detection and isolation, and mission readiness assessment.
NA (Towed Sonar Data)	Sonar data from the towed sonar systems.
NA (TSN Data)	Data exchanged between TWS and the Tomahawk Strike Network.
NA (Voice)	Voice communications.
NA (Warning Alarm)	Communications to set off warning alarms.
NA (CS DDTS)	Allows for the modification of CS DDTS configuration (e.g. policy, filters, rules) and maintenance (e.g. start, stop, status) through a GUI.
NAVSEA 7454930/B	Title: NAVSEA Interface Control Drawing (ICD) 7454930, Standard Missile-6 Block I Initialization Message Requirement, Revision B Interface between VLS and SM-6
NAVSEA 7454931/B	Title: NAVSEA Interface Control Drawing (ICD) 7454931, Standard Missile-6 Block I External RF Communications Link Interfaces, Revision B Interface between SPY and SM-6 (RF Link)
PMA299-07000	Title: *MH-60R/SCS IDS* *Interface between MH-60R Simulator and VCD*
SEWTT-V4-BFTT-TI1207-IDD	Title: Interface Design Description (IDD) for the Surface Electronic Warfare Team Trainer (SEWTT) Version 4 / Battle Force Tactical Training (BFTT)
T23-30-159	Interface between SGS and EXCOM (TIPOFF)
T8901-XX-IRS/IDD 010 BFTT Rev 6	Title: Interface Requirements Specification/Interface Design Document for Battle Force Tactical Training (BFTT) System AN/USQ-T46(V), AN/USQ-T46A(V) and AN/USQ-T46B(V) Interface between ACS (AWS) and ACTS (BFTT)
WS-19644/15	Title: Interface Design Specification for Operational Readiness Test System (ORTS) Mark 10 Mod 6 and Weapons control System (WCS) Mark 9 Mod 5 and 6 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB 12) Interface between ORTS and WCS
WS-19670 Rev B	Title: Aegis Standard Missile/Vertical Launching System Mk 41 Mod () Interface Design Specification Interface between SM and VLS
WS-19682/19	Title: Interface Design Specification for Aegis Combat Trainer System (ACTS) Mark 51 Mod 4 and 5 and Weapons Control System (WCS) Mark 9 Mod 5 and 6 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB 12) Interface between ACTS and WCS
WS-19721/11	Title: Interface Design Specification for Weapons Control System (WCS) Mark 9 Mod 5 and 6 and Fire Control System (FCS) Mark 99 Mod 11 and 14 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB 12) Interface between WCS and FCS
WS-20931/4	Interface between VLS (B/L IV and up) and TWS
WS-20932/2	Interface between VLS and TWS
WS-20934/6	Interface between SQQ-89A(V)15 and VLS (B/L VI/VII)

Interface Specification Number	Interface Description/Title
WS-20935	Interface between UWS and VLS
WS-21264/10	Title: Interface Design Specification for Aegis Display System (ADS) Mark 8 Mod 1 and 2 and Weapons Control System (WCS) Mark 9 Mod 5 and 6 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB 12) Interface between ADS and WCS
WS-21267/9	Title: Interface Design Specification for Aegis Display System (ADS) Mark 8 Mod 1 and 2 and Operational Readiness Test System (ORTS) Mark 10 Mod 6 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB 12) Interface between ADS and ORTS
WS-21272/11	Title: Interface Design Specification for Aegis Display System (ADS) Mark 8 Mod 1 and 2 and Command and Decision System (C&D) Mark 3 Mod 5 and 6 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB 12) Interface between ADS and C&D
WS-21278/7	Title: Interface Design Specification for Aegis Combat Trainer System (ACTS) Mark 51 Mod 4 and 5 and Operational Readiness Test System (ORTS) Mark 10 Mod 6 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB 12) Interface between ACTS and ORTS
WS-21286/7	Title: Interface Design Specification for Aegis Display System (ADS) Mark 8 Mod 1 and 2 and Aegis Combat Trainer System (ACTS) Mark 51 Mod 4 and 5 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12) Interface between ADS and ACTS
WS-21288/4	Title: Interface Design Specification for the Aegis Conversion Equipment Group (ACEG) and Advanced Processors (AP) for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12) Provided in 5 parts: Part 1: Aegis Time Processor (ATP) Part 2: Binary Millisecond Processor (BMP) Part 3: Gyro Data Processor (GDP) Part 4: Data Acquisition Processor (DAP) Part 5: Vertical Launch Processor (VLP)
WS-21288/4 Part 1	Title: Interface Design Specification for the Aegis Conversion Equipment Group (ACEG) and Advanced Processors (AP) for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12) Part 1: Aegis Time Processor (ATP)
WS-21288/4 Part 3	Title: Interface Design Specification for the Aegis Conversion Equipment Group (ACEG) and Advanced Processors (AP) for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12) Part 3: Gyro Data Processor (GDP)
WS-21328/14	Title: Interface Design Specification for Command and Decision System (C&D) Mark 3 Mod 5 and 6 and Weapons Control System (WCS) Mark 9 Mod 5 and 6 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12) Interface between C&D and WCS

Interface Specification Number	Interface Description/Title
WS-21329/12	Title: Interface Design Specification for Command and Decision System (C&D) Mark 3 Mod 5 and 6 and Operational Readiness Test System (ORTS) Mark 10 Mod 6 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB 12) Interface between C&D and ORTS
WS-21338/14	Title: Interface Design Specification for Aegis Combat Trainer System (ACTS) Mark 51 Mod 4 and 5 and Command and Decision System (C&D) Mark 3 Mod 5 and 6 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12) Interface between ACTS and C&D
WS-21359	Title: Interface Design Specification for Mission Planner Computer and Aegis Combat Trainer System (ACTS) Mark 51 Mod 4 and 5 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12) Interface between MP and ACTS
WS-21361	Title: Interface Design Specification for Mission Planner Computer and Operational Readiness Test System (ORTS) Mark 10 Mod 6 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12) Interface between MP and ORTS
WS-21391	Title: Interface Design Specification for Mission Planner Computer and Command and Decision System (C&D) Mark 3 Mod 5 and 6 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12) Interface between MP and C&D
WS-21392	Title: Interface Design Specification for Mission Planner Aegis Display System (ADS) Mark 8 Mod 1 and 2 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12) Interface between MP and ADS
WS-32901-1 Rev E	Interface between BFTT and CEC
WS-33365 Rev B	Title: Vertical Launching System Mk 41 Mod () & Evolved Seasparrow Missile (ESSM) Interface Design Specification dated 01 December 2001. Interface between VLS and ESSM
WS-33448/1	Interface between US&CS and UWS
WS-33479	Interface between GWS and NFS
WS-33498	Interface between ICOM (DMS) and US&CS (SQQ-89)
WS-33551	Title: Interface Design Document for the Sensor Integration System Interface of Radar Set AN/SPQ-9B Interface between CEC and HSRS (AN/SPQ-9B)
WS-33576	Interface used by NFS to communicate with AFATDS
WS-33581	Interface used by NFS to communicate with TLDHS
WS-33611	Interface between HSRS (SPQ-9B) and GWS
WS-33740	Title: Vertical Launching System MK 41 Mod 0/2/15 Standard Missile-3 Block I/IA/IB/IIA GPS Hot Start Interface Design Specification Interface between VLS and SM
WS-33852	Title: Interface Design Specification for the AN/SQQ-89A(V)15, AN/SQQ-89A(V)15 with EC200/204 Surface Ship USW Combat Systems, AN/SSQ-121 Computer Aided Dead Reckoning Tracer and the AN/USQ-172(V)4 Global Command and Control System-Maritime dated 11 September 2007. Interface between SQQ-89A and GCCS-M

Interface Specification Number	Interface Description/Title
WS-34015	Title: Standard Missile-3 Block 4 Capability RF Link Interface Requirements Specification Between the Aegis Weapons System (AWS) and the Standard Missile-3 dated 30 November 2004. Interface between AWS (WCS and SPY) and SM-3 (RF Link)
WS-34111/1	Title: Interface Design Specification for Global Command and Control System - Maritime (GCCS-M) and Mission Planner (MP) for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12) Interface between GCCS-M and MP
WS-34112/1	Title: Interface Design Specification for Global Command and Control System - Maritime (GCCS-M) and Operational Readiness Test System (ORTS) Mark 10 Mod 6 for Aegis Modernization (AMOD) Advanced Capability Build 12 (ACB12) Interface between ORTS and GCCS-M
WS-35159	Interface used by NFS to communicate to PFED
WS-35407	Title: Interface Voice Communications System Intercommunications Interconnecting Group Interface Design Specification (IVCS - C&D) Interface between ICOM (IVCS) and C&D (SVS)
WS-35408	Title: Aegis Weapon System Mk 7 / Standard Missile-2 Blocks III, IIIA, IIIB Communications Link Interface Design Specification dated 01 February 2010. Interface between AWS (SPY) and SM (BLK III, IIIA, IIIB)
WS-35409	Title: Aegis Weapon System Mk 7 / Standard Missile-2 Block IV Communications Link Interface Design Specification dated 01 February 2010. Interface between AWS (SPY) and SM-2 BLK IV
WS-35411	Title: Global Command and Control System - Maritime / Aegis Weapon System Interface Design Specification dated 01 July 2009. Interface between GCCS-M and AWS (ADS, ACTS, C&D)
WS-35412	Title: Cooperative Engagement Processor / Aegis Display System Interface Design Specification dated 01 October 2009. Interface between CEC (CEP) and ADS
WS-35416	Title: Aegis Weapons Control System Mk 8 Mod () Vertical Launching System Mk 41 Mod () (Baseline IV/V/VI/VII) Interface Design Specification Interface between WCS and VLS
WS-35417	Title: Aegis Weapons Control System Mk 9 / Close - In Weapon System Mk 15 Interface Design Specification dated 01 October 2009. Interface between WCS and CIWS
WS-35418	Title: NSPO Aegis Weapon System Mk 7 / Evolved Seasparrow Missile Communications Link Interface Design Specification Interface between AWS (SPY) and ESSM
WS-35419	Title: Aegis Display System / Common Data Link Management System Interface Design Specification dated 01 December 2008. Interface between ADS and CDLMS
WS-35420	Title: Command and Decision (C&D) System Mk 3 Mod 5 / Cooperative Engagement Processor Interface Design Specification dated 01 June 2013 Interface between C&D and CEP

Interface Specification Number	Interface Description/Title
WS-35424	Title: Aegis Command and Decision System/Electronic Warfare System AN/SLQ-32 Interface Design Specification Interface between C&D and EWS AN/SLQ-32(V)2/3
WS-35426	Title: Operational Readiness Test System Mk 10 Mod 3 and 6 / Common Data Link Management System Interface Design Specification Interface between ORTS and CDLMS
WS-35429	Title: Aegis Weapon System (AWS) / Radar Set AN/SPQ-9B (SPQ-9B) Interface Design Specification dated 01 November 2009. Interface between AWS (C&D, ADS, ACTS, ORTS) and HSRS (SPQ-9B)
WS-35430	Title: Navigation Sensor System Interface (NAVSSI) AN/SSN-6(V) to Ship's Network Interface Design Specification (Aegis Modernization Advanced Capability Build 12) dated 01 October 2009. Interface between NAV (NAVSSI) and AWS (ALIS)
WS-35431	Title: Aegis Local Area Network Interconnect System (ALIS) to Gun Weapon System (GWS) (MK 34 MODS 2 and 4) Interface Design Specification dated 01 February 2009. Interface between C&D (GWS via ALIS) and GWS
WS-35432	Interface between C&D (ALIS) and EXCOM (JTT)
WS-35434	Title: Aegis Weapon System (AWS) / Gun Weapon System MK 34 Mod 4 Interface Design Specification dated 01 October 2009. Interface between AWS (SPY, C&D, ORTS) and GWS
WS-35435	Title: Distributed Video System (DiVDS) / Common Display System (CDS) Interface Design Specification Interface between DiVDS and Video Sources, and DiVDS and Displays
WS-35436	Title: Interface Design Description (IDD) for Data Distribution System (DDS) and Common Display System (CDS) for Aegis Advanced Capability Build 12 (ACB12) Interface between ADS (SPQ-15) and ACS
WS-35437	Title: Cooperative Engagement Capability (CEC) AMOD CR3 to Aegis LAN Interconnect System (ALIS) Interface Design Specification for Navigation Information dated 01 September 2009. Interface between CEC and ACI (ALIS)
WS-35453	Component Framework Computer Program Requirements Specification.
WS-35563	Title: Vertical Launching System Mk 41 Mod () & Standard Missile-3 Block IIA Interface Design Specification Interface between VLS and SM
WS-35536	Title: Interface Requirements Specification for the Battle Force Tactical Training (BFTT) AN/USQ-T46D(V) and AN/SQQ-89A(V)15 w/EC-219 (ACB-13) for SAST.
WS-35548	Title: Aegis Display System MK 7 Mod 1 / Computer-Aided Submode Training Lesson Authoring System Interface Design Specification Interface between ADS and COAST

Interface Specification Number	Interface Description/Title
WS-35555-2	Title: Interface Requirements Specification for the Battle Force Tactical Training (BFTT) AN/USQ-T46X(V) and Navy Continuous Training Environment (NCTE)
WS-35575	Title: Aegis LAN Interconnect System (ALIS) for Remote Display Connection/PMW160 Tactical Networks Interface Design Specification Interface between EXCOM/GCCS-M/JTT-M/CANES and ADS for Remote Desktop Protocol connections
WS-35581	Title: Interface Design Description between the AN/SLQ-32(V) Electronic Warfare System and the Combat System Product Line Components Interface between EWS and C&D, WCS, ORTS, and ADS.
WS-35588	Title: Aegis Weapon System MK 7/Standard Missile-3 Block IIA/Kill Assessment (KAS) Interface Design Specification Interface between WCS (KAS) and SM
WS-35598	Title: RF Communications Link Interface Design Specification Between theAN/SPY-1 Radar System with Multi-Mission Signal Processor (MMSP) and the Standard Missile-3 Block IIA Interface between SPY and SM
WS-35603	Title: Combat System to Interrogator System AN/UPX-29(V) With Mark XIIA/Mode S Ethernet Interface Design Specification Interface between IFF and CEC, and IFF and C&D (Draft).
WS-35607	Title: BFTT System, AN/USQ-T46x, Shipboard Training Federation. For BFTT to training simulators other than SAST.
WS-35682	Draft C&D to SGS/AC interface specification for NTDS elimination.
WS-35724	ACI – C&D Interface Description Document
WS-35772	Title: Aegis Weapon System Mk 7 Mod 24 (ACB-16) / AN/SQQ-89A(V)15 (ACB-15) Surface Ship Undersea Warfare Combat System Interface Design Specification. Interface between AWS and US&CS (SQQ-89)
WS-35792	Interface to support communications between ACI and CSSE in support of DDTS/BDTS exchanges.
AMDR External IRS	**Interface between the SPY-6 (AMDR) radar and other combat system elements.**

5 Requirements Traceability

The allocation of requirements to ACS elements and to ACS element requirements and the traceability from each ACS element to the system requirements and from each system requirement to the ACS element is maintained in the Aegis Common Source Library DOORS database.

6 Notes

6.1 Acronyms

AADC	Area Air Defense Commander
AASDS	Aegis Advanced Sensor Distribution System
AAW	Anti Air Warfare
AAWC	Anti-Air Warfare Coordinator
AC	Alternating Current
ACB	Advanced Capability Build
ACB12	Advanced Capability Build 12
ACB16	Advanced Capability Build 16
ACB20	Advanced Capability Build 20
ACEG	Aegis Conversion Equipment Group
ACEG I/O	Aegis Conversion Equipment Group and Input/Output
ACF	Air Control Function
ACI	AWS Computing Infrastructure
ACNT	Aegis Computer Network Tech.
ACO	Acoustic Console Operator
ACP	Air Charging Panel
ACS	Aegis Combat System
ACTS	Aegis Combat Training System
ADD	Architecture Description Document
ADNS	Automated Digital Network System
ADS	Aegis Display System
ADSU	Above Deck Sensor Unit
AECU	Antenna Environmental Control Unit
AEW&C	Airborne Early Warning and Control
AFATDS	Advanced Field Artillery Tactical Data System
AHD	Acoustic Hailing Device
AIC	Air Intercept Controller
AICS	Air Intercept Control Supervisor
AIS	Automated Identification System
AKA	Also Known As
ALFS	Airborne Low Frequency Sonar
ALIS	Aegis LAN Interconnect System
AM	Application Management
AMD	Air and Missile Defense
AMF	Availability Management Framework
AMOD	Aegis Modernization
AMRAAM	Advanced Medium- Range Air-to-Air Missile
AMS	Application Management Services
AMW	Amphibious Warfare
AO	Acoustic Operator
AO	Aviation Officer
AOCD	Advanced Operator Control Device
AP	Advanced Processors
API	Application Program Interface
APS	Advance Processing Services
ARP	Azimuth Change Pulse
ARPA	Automatic Radar Plotting Aid
ASAC	Anti-Submarine Air Controller
ASCM	Anti-ship Cruise Missile
ASDS	Advanced Sensor Distribution System
ASF	Alert Support Function
ASF	Anti-Submarine Warfare Function

ASFS	Acoustic Sensor Functional Segment
ASM	Anti-Ship Missile
ASMD	ASM Defense
ASN(RDA)	Office of the Assistant Secretary of the Navy (Research, Development and Acquisition)
ASROC	Anti-Submarine Rocket
ASRS	Air Search Radar System
ASST	Anti-Ship Surveillance and Targeting
ASTAB	Automated Status Board
ASTAC	ASW/SUW Tactical Air Controller
ASU	Anti-surface Warfare
ASUW	Anti Surface Warfare
ASUWC	Anti-Surface Warfare Coordinator
ASW	Anti-Submarine Warfare
ASWCS	Anti-Submarine Warfare Control System
ASWCSO	ASWCS Operator
AT	Antiterrorism
ATAC	Air Tasking Attribute Correlator
AT/FP	Anti-Terrorism Force Protection
ATD	Automatic Target Detection
ATD	Advanced Training Domain
ATDC	Advanced Tactical Display Center
ATFP	Anti-Terrorism Force Protection
ATO	Afloat Training Organization
ATOD	Aegis Time-of-Day
ATP	Aegis Time-of-Day Processor
ATS	Acoustic Track Supervisor
ATTWO	Antiterrorism Tactical Watch Officer
AUR	All-Up-Rounds
AV	Anti-Virus
AVM	Anti-Virus Management
A-V	Audio-Visual
AW	Air Warfare
AWS	Aegis Weapon System
AWSC	Above Water Sensor Coordinator
BB	Black Box
BBD	Bright Bridge Display
BBDO	Bright Bridge Display Operator
BCD	Binary Coded Decimal
BDC	Boundary Defense Capability
BDI	Battle Damage Indication
BDII	BDI Imagery
BEWT	BFTT Electronic Warfare Trainer
BFTT	Battle Force Tactical Trainer
BIT	Built-In-Testing
BITE	Built-In-Test Equipment
BLOS	Beyond Line-of-Sight
BM	Ballistic Missile
BMCS	Bulkhead Mounted Computer System
BMD	Ballistic Missile Defense
BMDS	Ballistic Missile Defense System
BMF	Space Track Management Function
BMJB	Bi-Module Junction Box
BMP	Binary Millisecond Processor
BMS	Binary Millisecond
BOL	Bearing Only Launch

BOM	Base Object Model
BOPC	BFTT Operator Processor Console
BRM	Button Resource Manager
BSC	Beam Steering Controller
BT	Bathythermograph
BTR	Beacon Track Report
BTSE	BFTT Training Software EW
BW	Beam Width
C&D	Command and Decision
C2	Command and Control
C2P	Command and Control Processor
C4I	Command, Control, Communications, Computers, and Intelligence
CAD	Cued Acquisition Doctrine
CADRT	Computer Aided DRT
CAL	Common Asset Library
CANES	Consolidated Afloat Network and Enterprise Services
CANTCO	Cannot Comply
CAP	Combat Air Patrol
CAP	Channel Access Protocol
CAS	Consolidated Antenna System
CAST	Computer-Aided Sub-mode Training
CAUSS	Common Airborne USW Sensor System
CBR	Chemical, Biological, or Radiological
CC	Combat Control
CC	Control Client
CCD	Charge-Coupled Device
CCS	Core Computing System
CCSS	Cryptologic Combat Support System
CD	Compact Disk
CDADS	Common Display Architecture Display Subsystem
CDL	Common Data Link
CDLMS	Common Data Link Management System
CDS	Cross Domain Solution
CDS	Common Display System
CDU	Control Display Unit
CEB	Combined Effects Bomblet
CEC	Cooperative Engagement Capability
CEF	CEC Interface Manager
CEF	Cooperative Engagement Function
CEIU	Communications Equipment Interface Unit
CEM	Common Enclosure Module
CEP	Cooperative Engagement Processor
CEPN	CEP Track Number
CEPX	CEP Index
CET	CEC Enhanced Trainer
CFA	Crossed-Field Amplifier
CFDRS	Component Framework Data Recording Services
CFF	Call for Fire
CFLS	Component Framework Logging Services
CFMS	Component Framework Message Services
CFPSMS	Component Framework Publication/Subscription Messaging Service
CFTS	Component Framework Time Services
CGM	Guided Missile Cruiser
CHENG	Chief Systems Engineer
CIC	Combat Information Center
CICSUP	Combat Information Center Superviser

CICWO	Combat Information Center Watch Officer
CID	Combat Identification
CIOC	CEP Input/Output Converter
CIS	Common Services Interface
CIWS	Close-in Weapon System
CLM	Composite Layer Manager
CMASS	Cryptologic Management Analysis and Support Segment
CMS	COMSEC Management System
CMS	Control Management Subsystem
CMT	Console Multi-Channel Terminal
CND	Computer Network Defense
CND	Command and Decision System
CO	Commanding Officer
COAST	CAST Open Architecture Suite
COMOPTEVFOR	Commander Operational Test and Evaluation Force
COMSEC	Communications Security
CONOPS	Concept of Operations
COP	Common Operational Picture
CORBA	Common Object Request Broker Architecture
COTS	Commercial Off The Shelf
CP	Control Processor
CPC	Central Processing and Control
CPG	Control Processor Group
CPS	Common Processing System
CR2	COTS Refresh 2
CR3	COTS Refresh 3
CRC	Converter-Receiver Control
CRCU	Communications Remote Control Unit
CRL	Critical Resource List
CRT	Cathode Ray Tube
CRYPTO	Cryptologic
CS	Combat System
CS ISE	Combat System Interface Support Equipment
CSBD	Combat System Boundary Defense
CS BDTS	Combat System Bulk Data Transfer Service
CS DDTS	Combat System Data Dissemination and Transformation Service
CS FW	Combat System Firewall
CS IDS	Combat System Intrusion Detection System
CSC	Combat System Coordinator
CSCI	Combat System Computing Infrastructure
CSDTS	Common Shipboard Data Terminal Set
CSEA	Combat Systems Engineering Agents
CSEL	Combat System Equipment List
CSL	Common Source Library
CSO	Chief Security Officer
CSOOW	Combat Systems Officer of the Watch
CSP	Commander Safety Panel
CSS	Common Systems Services
CSSE	Combat System Support Equipment
CSSFS	Common System Services Functional Segment
CSTS	Combat System Trainer System
CSTT	Combat System Training Team
CTP	Common Tactical Picture
CTSL	Central Track Stores Locator
CTT3	Commander's Tactical Terminal 3
CU	Cooperating Unit

CVD	Control, Video Device
CW	Continuous Wave
CWC	Composite Warfare Commander
CWI	Continuous Wave Illumination
D/PD	Driver/Pre-Driver
DAC	Data Acquisition Converter
DACE	Data Acquisition and Control Electronics
DAF	Decision Aids Function
DAF	Defendable Area Footprint
DAP	Data Acquisition Processor
DBM	Data Base Manager Console
DCC	Display and Control Console
DCF	Doctrine Comparer Function
DCM	Data Collection Module
DCS	Data Channel Set
DCS	Display Control Subsystem
DCS	Digital Computer System
DDC	Data Converter Cabinet
DDF	Non-Track Data Distribution Management Function
DDG	Guided Missile Destroyer
DDICR	Dual Daemon ICR
DDM	Data Distribution Management
DDP	Digital Data Processor
DDS	Dual Display Station
DDS	Data Distribution System
DE	Data Extraction
DF	Direction Finding
DFCI	Digital Fire Control Interface
DFS	Display Framework Services
DHYSL	Digital Hybrid Speed Log
DIAS	Digital Integrated Announcing System
DiD	Defense in Depth
DIM	Display Interface Modules
DIO	Discrete Input/Output
DIP	Special Point Management Function
DIS	Distributed Interactive Stimulation
DISN	Defense Information Systems Network
DiVDS	Digital Video Distribution System
DLS	Decoy Launching System
DMF	Doctrine Management Function
DMS	Data Multiplexing System
DMSC	DMS Controller
DNC	Digital Nautical Chart
DoD	Department of Defense
DoDAF	DoD Architecture Framework
DP	Digital Processor
DPG	Data Processor Group
DRAM	Dynamic Random Access Memory
DRT	Dead Reckoning Tracer
DSF	Display Support Function
DSMAC	Digital Scene Matching Area Correlator
DTED	Digital Terrain and Elevation Data
DTT	Dynamic Test Target
DVDs	Digital Versatile Disc
DVR	Digital Video Recorder
DXR	Data Extraction and Recording Service

EA	Electronic Attack
EC	Embarked Commander
ECCM	Electronic Counter Countermeasures
ECDA	Embarked Commander Display
ECDA	Estimated Collateral Damage Area
ECDC	Embarked Commander Display Controller
ECM	Electronic Counter Measures
ECO	Engagement Control Officer
ECT	Element Conducted Test
ECU	Element Cleanup Utilities
EDP	Environmental Data Processor
EER	Electrical Equipment Racks
EHF	Extremely High Frequency
EIP	Embedded INFOSEC Product
EKMS	Electronic Key Management System
ELRF	Eye-Safe Laser Range Finder
ELX	Electronics Enclosure Assembly
EM	Equipment Management
EMCON	Emissions Control
EMF	Engagement Management Function
EMI	Electromagnetic Interference
Endo	Endo-Atmospheric
EO	Electro-Optical
EO	Engagement Order
EOD	Electro-Optic Director
EOM	Extended Operating Environment
EOS	Electro Optic Systems
EOSS	Electro-Optic Sensor System
EP	Electronic Protection
EPF	Engagement Plans Function
EPS	Engagement Planning Supervisor
ERF	Event Reconstruction Function
ERM	Element Resource Manager
ES	Environment Services
ES	Electronic Surveillance
ES	Electronic Support
ESA	Electronically Steered Array
ESM	Electronic Surveillance/Support Measure
ESO	Extended Surveillance Operator
ESP	Electronic Strike Package
ESSM	Evolved Sea Sparrow Missile
EST	Extreme Short Throw
ETC	Echo Tracker Classifier
ETC2	Exercise Tactical Command and Control
EW	Electronic Warfare
EWCO	Electronic Warfare Console Operator
EWF	Electronic Warfare Function
EWS	Electronic Warfare System
EWSUP	Electronic Warfare Supervisor
EXC	External Controller
EXCOM	Exterior Communications System
EXCOM	Exterior Communications
EXO	Exo-Atmospheric
F2D2	Functional Flow Diagrams and Descriptions
FAA	Federal Aviation Administration
FACS	Fully Automatic Computer Subsystem

FC	Fire Control
FCN	FPGA Computer Nodes
FCO	Fire Control Operator
FCS	Fire Control System
FD	Fault Detection
FD/FI	Fault Detection/Fault Isolation
FDDI	Fiber Distributed Data Interface
FDDIC	FDDI Controller
FI	Fault Isolation
FIS	Firing Inhibit Switch
FJUA	Forwarding JTIDS Unit TDL-A
FL	Fault Location
FLIR	Forward Looking Infrared
FM	Fault Management
FMS	Foreign Military Sales
FOAL	Fiber Optic Antenna Link
FODB	Fiber Optic Distribution Box
FODMS	Fiber Optic Data Multiplex System
FOICB	Fiber Optic Interconnection Box
FOM	Federated Object Model
FOM	Figure of Merit
FOT	Follow-On Terminal
FP	Force Protection
FPA	Final Power Amplifier
FPD	Flat Panel Display
FPGA	Field Programmer Gate Array
FSU	Free Standing Unit
FST	Fleet Synthetic Training
FWD	Forward
GCCS	Global Command and Control System
GCCS-M	Global Command and Control System - Maritime
GCS	Gun Computing System
GCSC	Gun Computer System Cabinet
GDP	Gyro Data Processor
GDS	Graphic Display System
GEC	Gigabit Ethernet Controller
GECO	Gun Engagement Console Operator
GEDMS	Gigabit Ethernet Data Multiplex System
GENLOG	General Logging
GFCP	Generic Front-End Communications Processor
GFCS	Gunfire Control Supervisor
GFS	General Foundation Services
GMCP	Gun Mount Control Panel
GMLS	Guided Missile Launching System
GMT	Greenwich Mean Time
GOT	Guidance Object Track
GOTS	Government off the Shelf
gpm	Gallons Per Minute
GPS	Global Positioning System
GRP	Grid Reference Point
GRS	Gyro Receiver Service
GRU	Gridlock Reference Unit
GSA	Generator-Synchronizer-Analyzer
GTF	GWS Track Manager Function
GU	Guarded Unit
GUI	Graphical User Interface

GVRC	GPS VME Receiver Card
GWOT	Global War on Terrorism
GWS	Gun Weapon System
HBA	Host Bus Adapter
HCI	Human Computer Interface
HCU	Hand Controller Unit
HDR	High Data Rate
HED	High End Displays
HF	High Frequency
HGHS	High Gain / High Sensitivity
HLPS	Host Level Protection Service
HM&E	Hull, Mechanical and Electrical
HMI	Human/Machine Interface
HOLC	High Order Language Computer
HPAG	High Power Amplifier Group
HRB	Hull Receiver Beamformer
HSE	Helicopter Shipboard Equipment
HSI	Human System Integration
HSRS	Horizon Search Radar System
HSS	Hull Sonar System
HT	Hand-held Transceiver
IA	Information Assurance
IADS	Integrated Audio Distribution System
IAMD	Integrated Air and Missile Defense
IAMD	Integrated Air and Missile Defense Mission Planner
IAF	IFF Association Function
ibd	internal block diagrams
IBDV	Improved BFTT Digital Voice
IBNS	Integrated Bridge & Navigation System
IBS	Integrated Bridge System
IBS	Intelligence Broadcast Service
IBS-I	Integrated Broadcast Service Interactive
IBS-S	Integrated Broadcast Service Simplex
IC	Illuminator Component
ICE	Independent Cost Estimate
ICOM	Interior Communications
ICOP	Integrated Common Operational Picture
ICP	Interface Control Processing
ICR	Intercomputer Relay Services
ICWG	Interface Control Working Group
IDA	ID Assignment & Resolution Function
IDD	Interface Design Document
IDM	Identity Management System
IDS	Identification Supervisor
IDS	Interface Design Specification
IDS	Identification System
IDS	Intrusion Detection System
IETM	Integrated Electronics Technical Manual
IEU	Interface Electronics Unit
IF	Intermediate Frequency
IFF	Identification Friend or Foe
IFM/CFR	Instantaneous Frequency Measurement Course Frequency Receiver
IIS	Integrated Weapon System Interface Services
IIU	IFF Interface Unit
IMO	International Maritime Organization
IMU	Inertial Measurement Unit

INFOSEC	Information Security
INM	Integrated Network Management
INS	Inertial Navigation System
IOM	Input-Output Module
IOP	Input/Output Processor
IOU	Input-Output Unit
IP	Impact Point
IP	Internet Protocol
IPC	Inter-Process Communication
IPCP	Interface Processing Computer Program
IPP	Impact Point Prediction
IR	Infrared
IRIG	Inter-Range Instrumentation Group
IRU	Inertial Reference Unit
ISAR	Inverse Synthetic Aperture Radar
ISETS	Integrated Sub-Element Test System
ISF	Identification Support Function
ISLS	Interrogator Sidelobe Suppression
ISMS	Integrated Survivability Management System
CANES	Integrated Ship Network System
ISP	Information Support Plans
ITP	Integrated Terminal Program
IU	Interface Unit
IVCS	Interior Voice Communications System
IWS	Integrated Weapon System
JBOD	Just a Bunch of Disks
JDN	Joint Data Network
JMCIS	Joint Maritime Command Information System
JPN	Joint Planning Network
JRE	Joint Range Extension
JSAF	Joint Semi-Automated Forces
JTF	JTT Management Function
JTIDS	Joint Tactical Information Distribution System
JTT	Joint Tactical Terminal
JTT-M	Joint Tactical Terminal - Maritime
JU	JTIDS/MIDS Unit
JWICS	Joint Worldwide Intelligence Communications Systems
KA	Kill Assessment
KAS	Kill Assessment System
KMS	Knowledge Management System
KVM	Keyboard/Video/Mouse
KW	Kinetic Warhead
LAD	Launch Area Denied
LAMPS	Light Airborne Multi-Purpose System
LAN	Local Area Network
LAN-IT	Local Area Network Information Technology
LAT	Latitude
LAU	LAN Access Unit
LCD	Liquid Crystal Display
LCO	Launch Control Operator
LCS	Local Control Station
LCU	Launch Control Unit
LE	Launch Event
LEAP	Lightweight Exo-Atmospheric Projectile
LED	Low End Displays
LFOTC	Littoral Fiber Optic Tow Cables

LHD	Local Harmonic Distribution
LIC	Line Input Converter
LIF	Link Management Function
LLS	Low Level Serial
LMS	Link Monitoring System
LO	Local Oscillator
LOC	Line Output Converter
LONG	Longitude
LOS	Line-of-Sight
LP	Launch Point
LPE	Launch Point Estimate
LPMP	Launch Platform Mission Planning
LR	Long Range
LRF	Laser Range Finding
LRM	Local Resource Manager
LRU	Line Replaceable Unit
LSEQ	Launch Sequencer
LSF	Link Support Function
LSL	Launch Schedule List
LSS	Logistics Support System
LSU	Launcher Switching Unit
LTO	Linear Tape Open
LTR	Local Track Report
MATT	Multi-Mission Advanced Tactical Terminal
MCE	Mission Critical Enclosure
MCICR	Multi-Channel ICR
MCP	Motor Control Panel
MCT	Master Clock Time
MD	Main Display
MDU	Mission Data Update
MDX	Mission Data Exchange
MFD	Multi-Function Display
MFL	Multi-Frequency Link 11
MFTA	Multi-Function Towed Array
MG	Maintenance Group
MIDS	Multi-function Information Distribution System
MIO	Maritime Interdiction Operations
MLM	Missile Launcher Modules
MLS	Multiple Level Secure
MMD	Multi-Mission Display
MMI	Man-Machine Interface
MMSI	Maritime Mobile Service Identity
MMSP	Multi-Mission Signal Processor
MODAS	Modular Ocean Data Assimilation System (
MOS	MIDS On Ships
MOSA	Modular Open System Approach
MOTW	Missions Other Than War
MP	Mission Planner
MPF	Mission Planner Function
MPM	Major Program Managers
MPU	Master Processor Unit
MRAS	Mission Readiness & Assessment System
MSF	Missile Supervisor Support Function
MSF	Mission Planner Support Function
MSS	Missile System Supervisor
MTBF	Mean Time Between Failures

MTC	Maintenance Trainer Console
MTF	Manual Track Management Function
MTI	Moving Target Indicator
MUX	Multiplexer
MWS	Moriah Wind System
NAS	Network Attached Storage
NATO	North Atlantic Treaty Organization
NAV	Navigation
NAVMACS	Naval Modular Automated Communications System
NAVSIM	Navigation Simulator
NAVSSI	Navigation Sensor System
NCD	Naval Capabilities Document
NCTE	Navy Continuous Training Environment
NCTR	Non-Cooperative Target Recognition
NDD	NTDS Device Driver
NDI	Non-Developmental Items
NECC	Navy EHF Communications Controller
NERF	Navy Emitter Reference File
NES	Network Encryption System
NFS	Naval Fires System
NGC2P	Next Generation Command and Control Processor
NGFS	Naval Gunfire Support
NGMG	Next Generation Maintenance Group
NGP	Next Generation Peripheral
NID	Naval Intelligence Database
NILE	NATO Improved Link Eleven
NIMA	National Imagery Mapping Agency
NIPRNET	Non-classified Internet Protocol Router Network
nmi	Nautical Mile
NOC	Network Operations Center
NRS	NAVSSI Remote Station
NSFS	Naval Surface Fire Support
NTCSS	Navy Tactical Command Support System
NTDS	Naval Tactical Data System
NTSP	Navy Training System Plan
NU	NILE Unit
NVF	Navigation Function
NVR	Network Video Recorder
OA	Open Architecture
OACE	Open Architecture Computing Environment
OASM	Open Architecture System Management
OBT	On-Board Trainer
OCI	Operator Console Interface
OCT	ORTS Conducted Tests
OGB	Optimized Gun Barrels
OMG	Object Management Group
OOD	Officer of the Deck
OPNAV	Office of the Chief of Naval Operations
OPSPEC	Operational Specification
OPTASK	Operational Tasking
ORF	Ownship Readiness Function
ORTS	Operational Readiness Test System
OS	Operating System
OSATD	Operational Sequence and Timing Diagram
OSDA	Ownship Display Assistant

OSDC	Ownship Display Controller
OSF	Operator Support Function
OSGA	Operator Support Global Alerts
OSH	Ownship Heading
OSS	Ownship Speed
OTCIXS	Officer in Tactical Command Information Exchange Subsystem
OTH	Over-the-Horizon
OTSTS	Over-the-Side Torpedo System
OVF	Overlay Support Function
PA	Public Address
PAAA	Planer Array Antenna Assembly
PAF	Performance Assessment Function
PAFS	Passive Acoustic Functional Segment
PAO	Polyalphaolefin
PARM	Participating Acquisition Resource Manager
PASS	Parameter Analysis and Storage System
PBB	Passive Broadband
PCMDS	Personal Computer Mission Distribution System
PDA	Periscope Depth Attack
PDU	Power Distribution Unit
PEO	Program Executive Office
PEO IWS	Program Executive Office Integrated Warfare Systems
PEO SHIPS	Program Executive Office Ships
PFED	Pocket-sized Forward Entry device
PGD	Plan Generated Doctrine
PIM	Position and Intended Movement
PLA	Product Line Architecture
PM	Performance Management
PMC	PCI Mezzanine Card
PMD	Portable Maintenance Device
POE	Projected Operational Environment
POTS	Plain Old Telephone Service
PPI	Plan Position Indicator
PPS	Pulse-Per-Second
PRF	Pulse Repetition Frequency
PRI	Pulse Repetition Interval
PSMD	Preliminary Ship Manning Document
PSP	Phalanx Support Processor
PSTN	Public Switched Telephone Network
PSuM	Phalanx Surface Mode
PTACSIT	Performance TACSIT
PTP	Precision Time Protocol
PTT	Permission To Train
PTTI	Precision Time and Time Interval
PTU	Precision Time Unit
PU	Participating Unit
PW	Pulse Width
PWS	Phalanx Weapon System
QBF	Radar Set AN/SPQ-9B Function
QoS	Quality of Service
R&D	Research and Development
R&S	Routing and Switching
R/T	Receiver/Transmitter
RAID	Redundant Array of Independent Disks
RAM	Radar Module Assembly
RAS	Remote Access Server

RAVE	Radar Alignment Verification Equipment
RBC	Rack-Based Console
RCC	Radar Control Computer
RCE	Radar Cued Engagement
RCP	Radar Control Program
RCS	Remote Control Station
REMAS	Remote Monitor Assessment System
RF	Radio Frequency
RHI	Radar Height Indicator
RIM	Radar Interface Manager
RIM	Receiver Inject Matrix
RLEP	Remote Launch Enable Panel
RLGN	Ring Laser Gyro Navigator
RM	Radio Monitor
RMS	Resource Management Services
RMT	Remote Multi-Channel Terminal
ROC	Required Operational Capabilities
RP	Radar Processor
RPS	Remote Power Supply
RRC	Remote Recording Compressor
RRM	Radar Resource Manager
RSC	Radar System Controller
RSC	Radar Set Controller
RSCP	Radar Scan Conversion Processor
RSD	Radar Search Doctrine
RSDB	Radar Signal Distribution Box
RSDS	Radar Signal Distribution Switchbox
RSF	Radar Support Function
RSM	Radar Signal Modulation
RSS	Radar Servo Structure
RSS	Radar Signal Simulator
RT	Real Time
RTDS	Radar Track Discriminator System
RTOS	Real-Time Operating System
RTP	Real-Time Processor
RTPG	Real Time Processor Group
RTS	Real Time Subsystem
RVC	Radar Video Converter
RVCA	Radar Video Control Amplifier
RVM	Radar Video Manager
RVPDU	Radar Video Processing Distribution Unit
S&T	Science and Technology
S&T	Search and Track
SA	System Administrator
SA/ASM	Selective Availability/Anti-Spoofing Module
SAC	Single Action Calling
SAD	System Architecture Document
SAFENET	Survivable Adaptable Fiber Optic Embedded Network
SAN	Storage Area Network
SAOI	Ship Area of Interest
SAOP	Stand Alone Operator Position
SAP	Surface Attack Permit
SARTIS	Ship Advanced Radar Target Identification System
SAST	Surface Ship Anti-Submarine Warfare Synthetic Trainer
SATCOM	Satellite Communication
SATNAV	Satellite Navigation

SAU	Shipboard Aviation Upgrade
SB	Straight Binary
SBC	Single Board Computer
SCC	System Coordinate Center
SCF	System Control Function
SCFS	Surface CAUSS Functional Segment
SCI	Sensitive Compartmented Information
SCP	System Control Panel
SCR	Sonar Control Room
SCS	Scheduling and Control Services
SCSD	Secured Combat System Domain
SCSI	Small Computer Serial Interface
SCUS	System Calibration Using Satellites
SDC	Signal Data Converter
SDP	Signal Data Processor
SDR	Signal Data Reproducers
SDR	Simplified Driver
SDT	Surface Detector Tracker
SE CONOPS	Systems Engineering Concept of Operations
SEI	Specific Emitter ID
SES	Supportability Environment System
SEWIP	Surface Electronic Warfare Improvement Program
SEWTT	SEWIP EW Tactical Trainer
SF	Search Manager
SFR	System Functional Review
SGS/AC	Shipboard Gridlock System with Automatic Correlation
SH	Status Handler
SHF	Super High Frequency
SICP	Subscriber Interface Computer Program
SIEM	Security Information and Event Management
SIF	Selective Identification Feature
SIMPLE	Standard Interface for Multiple Platform Link Evaluation
SIPRNET	Secret Internet Protocol Router Network
SITREP	Situational Report
SIWCS	Shipwide Interior Wireless Communication System
SKC	Softkill Coordinator
SLR	System Level Recorder
SM	Standard Missile
SM	System Management
SMD	Ship Manning Document
SMF	System Management Function
SMP	Symmetric Multi- Processors
SNAP	Shipboard Non-Tactical Automated Data Processing Program
SNCS	Surface Navy Combat System
SO	Sonar Operator
SO	Supply Officer
SO	Security Officer
SOA	Service-Oriented Architecture
SOA	Ship Operation Area
SOAP	Simple Object Access Protocol
SORTS	Status of Operational Readiness and Training System
SoS	System of Systems
SOS	Sonar Supervisor
SPF	Special Points Function
SPF	SPY Track Manager Function
SPPFS – STDA	Sensor Performance Prediction Functional Segment – Sonar Tactical Decision

SPS	Ship Protection System
SPU	Slave Processor Unit
SPYCP	SPY Computer Program
SPZ	Ship Protect Zone
SRB	Sensor Resource Broker
SRC	Surface Radar Controller
SRF	Surface Radar Support
SRM	System Resource Manager
SRO	Surface Radar Operator
SRR	System Requirements Review
SS	Simulation Services
SSB	Single-Sideband
SSWC	Surface/Subsurface Warfare Coordinator
SSDD	System/Subsystem Design Description
SSEE-E	Ships Signal Exploitation Equipment increment E
SSESM	Small Ship Electronic Support Measures
SSF	Submode Support Function
SSFC	Solid State Frequency Converter
SSN	Ship, Submersible, Nuclear
SSR	Surface Search Radar
SSRC	System Service Reusable Components
SSRS	Surface Search Radar System
SSWC	Surface/Subsurface Warfare Coordinator
SSWS	Surface / Subsurface Warfare Supervisor
stderr	Standard Error
S-TDL-J	Satellite TDL-J
STM	System Track Manager
STO	Systems Test Officer
STOW	Synthetic Theater of War
STS	Status Tracking Service
STW	Strike Warfare
SUCAP	Surface Warfare Combat Air PatrolSUW Surface Warfare System
SVP	Sound Velocity Profile
SVS	Secure Voice System
SVTT	Surface Vessel Torpedo Tubes
SWICS	Shipwide Interior Wireless Communications System
SWS	Surface Warfare Supervisor
SWSM	System Wide Shared Memory
SYSCOM	Systems Command
SysML	System Modeling Language
TAC-4	Tactical Advanced Computer
TACAN	Tactical Air Navigation
TACLANE	Tactical FASTLANE ®
TACSIT	Tactical Situation
TACTAS	Tactical Towed Array System
TAD	Theater Air Defense
TAM	Tactical Action Manager
TAO	Tactical Action Officer
TAPS	Towed Array Power Supply
TBI	True Bearing Indicator
TCC	Tactical Computer Console
TCD	Thin-Client Display
TCD	Technician Control Device
TCG	Tactical Computer Group
TCIP	Tomahawk Comms Interface Processor
TCOMMS	Tomahawk Communications System

TCP	Training Control Program
TCP/IP	Transmission Control Protocol/Internet Protocol
TCSS	Training Communications Subsystem
TCU	Trunk Coupling Unit
TDACS	Throttling Divert and Attitude Control System
TDL	Tactical Digital Link
TDLHS	Target Location Designation Handoff System
TDL-J	TDL J Series (aka Link 16)
TDMA	Time Division Multiple Access
TDPA	Time Division Pairwise Access
TDSS	Tactical Decision Support Subsystem
TE	Terminating Equipment
TEC	Tomahawk Equipment Cabinet
TER	Tomahawk Equipment Room
TERCOM	Terrain Contour Matching
TETA	Threat Evaluation and Tactical Advice
TF	Test Function
TFOM	Time Figure-Of-Merit
TIC	Tactical Information Coordinator
TIPOFF	Tactical Information Processor and On-Line Fusion Facility
TIS	Thermal Imaging Sensor
TKRS	Talkers
TLAM	Tomahawk Land Attack Missile
TMA	Target Motion Analysis
TMCode	Time Mark Code
TMF	Track Management Function
TMS	Training Management System
TNGA	Training Supervisor Assistant
TNGS	Training Supervisor
TNS	Track Number Services
TOD	Time-of-Day
TOM	Target Object Map
TRAFS	Torpedo Recognition and Alert Functional Segment
TRF	Track Function
TRM	Technical Review Manual
TRU	Time Reference Unit
TS	Time Service
TS	Track Server
TS	Trade Study
TSF	Training Support Function
TSN	Tomahawk Strike Network
TSOPs	Third Stage Operations
TSP	Torpedo Setting Panel
TSRM	Third Stage Rocket Motor
TSS	Towed Sonar System
TSTC	Total Ship Training Capability
TTCT	Tactical Team Coordination Training
TTP	Tactics, Techniques, and Procedures
TTPV	Tactical Tomahawk Penetrator Variant
TTWCS	Tactical Tomahawk Weapon Control System
TTY	Teletype or Teletypewriter
TVC	Thrust Vector Control
TWP	Tomahawk Workstation Printer
TWS	Tomahawk Weapon System
TWT	Traveling Wave Tube
UBS	Underwater Battery Supervisor

UCFS	Undersea Warfare Control Functional Segment (
UCS	Underwater Countermeasures System
UDP	User Datagram Protocol
UHF	Ultra High Frequency
UPS	Uninterruptible Power Supply
US&CS	Underwater Surveillance and Communications System
USB	Universal Serial Bus
USW	Undersea Warfare
USWC	USW Coordinator
USWCO	USW Console Operator
UTC	Coordinated Universal Time
UTO	Underwater Telephone Operator
UWD	Unambiguous Warning Device
UWS	Underwater Weapon System
VAB	Variable Action Button
VCCC	Vent Closure Control Circuit
VCD	Vehicle Control Domain
VCMT	Virtual Console Multi-Channel Terminal
VGI	VLS/GPS Integrator
VHF	Very High Frequency
VID	Visual Identification
VLA	Vertically Launched ASROC
VLAN	Virtual Local Area Network
VLP	Vertical Launch System Processor
VLS	Vertical Launch System
VME	Versa Module Eurocard
VPN	Virtual Private Network
VSC	Video Services Component
VT	Video Tracker
WAN	Wide Area Network
WB	Whitebox
WCC	Weapon Control Console
WCIP	Weapon Control Indicator Panel
WCS	Weapons Control System
WDRC	Warhead Data Receiver Cabinet
WFG	Waveform Generator
WMF	Weapons Management Function
WPU	Wind Processor Unit
WSID	Warfare System Interface Description
XBT	Expendable Bathythermograph
XML	Extensible Markup Language
XSV	Expendable Sound Velocimeter
ZOD	Zone of Acceptable Detection

Appendix A Aegis BL10 Combat System Use Case Report

(Provided under separate cover)

Appendix B Aegis BL10 Combat System Functional Architecture

(Provided under separate cover)

Appendix C Mapping of Aegis Functions to Combat System Elements

(Provided under separate cover)

Appendix D Capability Designs

(Provided under separate cover)

Appendix E AWS Component Level Capability Designs

(Merged into Appendix D will be provided for Delta SFR)

Appendix F (Not Used)

(No Longer Used)

Appendix G SV-7 (MOPs, KPPs, TPMs)

(Provided under separate cover)


PROGRAM EXECUTIVE OFFICE
PEO
IWS
INTEGRATED WARFARE SYSTEMS