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THESIS

NAVAL THEATER BALLISTIC MISSILE DEFENSE (TBMD)-DEVELOPMENT OF THE INFORMATION EXCHANGE REQUIREMENTS

by

Daniel M. Brintzinghoffer

June 1996

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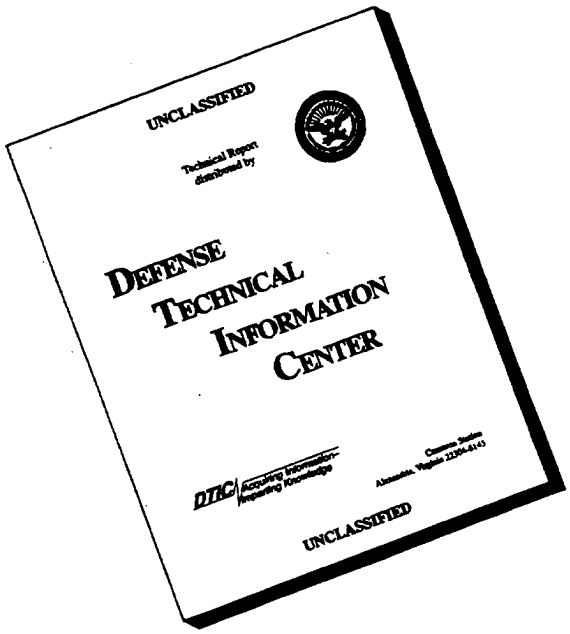

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As the United States moves into the next century one of the biggest threats facing her national interests is the proliferation of Theater Ballistic Missile (TBM) Systems, with their potential for carrying Weapons of Mass Destruction(WMD). In order for the United States to "project power", the Navy must play a large role in the protection of friendly assets from TBM attacks. Thus, the Navy is continuing to develop new systems and technologies as it attempts to migrate older weapons systems to fulfill this mission into its initial ballistic missile defense concept, Navy Area Defense (NAD). This thesis looks at the differences between the current "as is" physical/information architectures for the Anti-Air Warfare Commander and the future "to be" physical/information architectures for Theater Ballistic Missile Defense Commander.

The conventional anti-air warfare and TBM defense information requirements, on an Aegis, are developed using IDEF 0 Diagrams. These information requirement differences must be used as drivers for future system acquisition and development. Also, the potential problem areas associated with adding TBMD as an additional responsibility for the Air Warfare Commander (AWC) onboard and AEGIS platform, are covered.

The results of this thesis represent the initial plan (roadmap) for changes needed to support the evolving mission (Navy Area Defense) in the fleet.

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NAVAL THEATER BALLISTIC MISSILE DEFENSE (TBMD) - DEVELOPMENT OF THE INFORMATION EXCHANGE REQUIREMENTS

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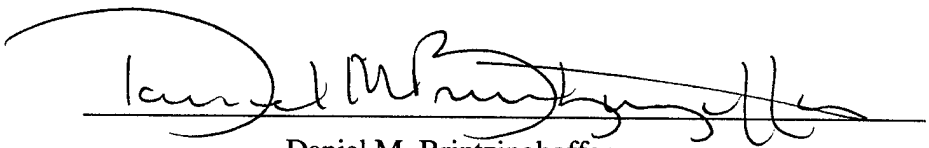
Author: 
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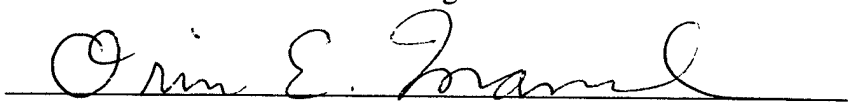
Approved by: 
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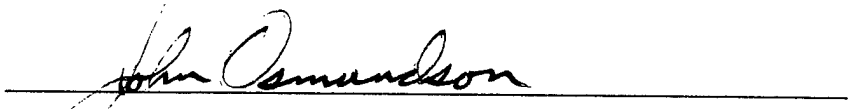
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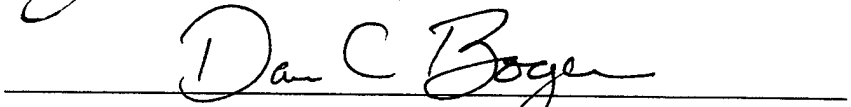
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ABSTRACT

. As the United States moves into the next century one of the biggest threats facing her national interests is the proliferation of Theater Ballistic Missile (TBM) Systems, with their potential for carrying Weapons of Mass Destruction(WMD). In order for the United States to "project power", the Navy must play a large role in the protection of friendly assets from TBM attacks. Thus, the Navy is continuing to develop new systems and technologies as it attempts to migrate older weapons systems to fulfill this mission into its initial ballistic missile defense concept, Navy Area Defense (NAD). This thesis looks at the differences between the current "as is" physical/information architectures for the Anti-Air Warfare Commander and the future "to be" physical/information architectures for Theater Ballistic Missile Defense Commander.

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EXECUTIVE SUMMARY

With the fall of the Soviet Union and the collective protection her alliances provided, more nations now feel vulnerable to the will of self-appointed regional hegemonies. As the world enters the new century there is one weapon system whose cost, availability, and range of power make it the obvious choice for regional hegemonies, the Theater Ballistic Missile (TBM). The resulting instability in turn creates a need for a weapon system that will ensure the vulnerable nations some strategic security and additional defensive capabilities. The proliferation of TBMs has quickly become a national security concern for the U.S. The fact that nations (who otherwise have disproportionate amounts of political, economic or military power) wish to engage in the acquisition of TBM systems is in itself a topic of many other studies. With the increasing availability of open source technical information their quest for more advanced offensive missile systems will only get easier.

As the United States moves into the next century one of the biggest threats facing her national interests is the proliferation of Theater Ballistic Missile (TBM) systems, with their potential for carrying Weapons of Mass Destruction (WMD). In order for the United States to "project power", the Navy must play a large role in the protection of friendly assets from TBM attacks. Thus, the Navy is developing new systems and technologies as it attempts to migrate older weapons systems into its initial ballistic missile defense concept, Navy Area Defense(NAD). The United States must respond to the TBM threat and that response will inevitably be joint. In order to get an accurate picture of the Navy's role in the TBMD mission one must first understand the overall concept for joint missile defense. The Joint Staff has broken down the notion of Theater Ballistic Missile Defense into four components:

1. Attack Operations
2. Passive Defense
3. Battle Management Command, Control, Communications, Computers and Intelligence (BMC^4I)
4. Active Defense.

The principal component discussed in this thesis is Active Defense, which is the primary role that the Aegis cruiser will play [while the Theater Ballistic Missile Defense Commander (TBMDC) is embarked.] This thesis looks at the differences between the current "as is" physical/information architectures for the Anti-Air Warfare Commander and the future "to be" physical/information architectures for Theater Ballistic Missile Defense Commander.

The conventional anti-air warfare and TBM defense information requirements, on an Aegis, are developed using IDEF 0 Diagrams. These information requirement differences must be used as drivers for future system acquisition and development. Also, the potential problem areas associated with adding TBMD as an additional responsibility for the Air Warfare Commander (AWC) onboard an AEGIS platform, is covered.

The results of this thesis represent the initial plan (roadmap) for changes needed to support the evolving mission (Navy Area Defense) of Aegis platforms in the fleet.

I. INTRODUCTION

A. THE THREAT

With the fall of the Soviet Union and the collective protection her alliances provided, more nations now feel vulnerable to the will of self-appointed regional hegemonies. The resulting instability in turn creates a need for a weapon system that will ensure the vulnerable nations some strategic security and additional defensive capabilities. As the world enters the new century there is one weapon system whose cost, availability, and range of power make it the obvious choice for regional hegemonies, the Theater Ballistic Missile (TBM). The proliferation of this weapon system has quickly become a national security concern for the U.S. The fact that nations (who otherwise have disproportionate amounts of political, economic or military power) wish to engage in the acquisition of such systems is in itself a topic of many other studies. For the purposes of this paper the assumption is made that these nation's acquisition strategies are succeeding. With the increasing availability of open source technical information, their quest for more advanced missile systems will only get easier.

There are over 20 countries, not currently in the North Atlantic Treaty Organization (NATO), that have some ballistic missile capability, many of which are also in the process of acquiring some form of a weapon of mass destruction (WMD) which can be delivered by TBMs. "By the end of this decade, as many as 10 developing countries could have nuclear weapons, and 10 could possess a biological capability."[1]

In Third-World missile systems, relatively poor accuracy creates the need for a more powerful warhead. "While First World land attack cruise missiles gain their leverage through stealth and accuracy derived from a system of systems, Third World Theater Ballistic Missiles stand alone, and must rely on speed and brute force."[2] Taking that need for a more powerful

warhead one step further, many of these countries are aggressively pursuing chemical, biological, and nuclear payloads for their less accurate missiles. This natural progression becomes an immediate threat when one considers the destructive power of these WMD. Chemical and biological weapons are much easier to produce, but the complete destructive power of a nuclear warhead makes it the ultimate prize for an up-and-coming regional power. Some evidence suggests that the Iraqis came close to attaining some nuclear weapons capability in 1991, and the Iranian program is not far behind.

"The Iranian effort to acquire nuclear weapons technology mirrors the push by President Saddam Hussein to build a nuclear bomb in Iraq over the last 15 years. The Iranians use many of the old Iraqi smuggling routes and contacts..."[3] The Theater Ballistic Missile with weapons of mass destruction give them an additional ability to affect international politics.

There is little doubt that the Israeli government would have become an active participant in the Persian Gulf War had the conventional SCUDs fired at them by Iraq contained a WMD. Those missiles affected many decisions, political as well as military, during that war. The proliferation of the TBMs combined with WMD payloads has brought the Ballistic Missile Defense Organization (BMDO) and its effort to produce an effective defense against those systems into the spotlight. "In an era of reduced U.S. overseas presence, the first American Theater Ballistic Missile Defense capability on the scene of a developing crisis is likely to come from the sea--but it will be enabled, supported and eventually reinforced by the complementary capabilities of all branches, and possibly bolstered by the synergistic contributions of allies and coalition partners."[4]

This thesis will discuss some of the general concepts of Theater Ballistic Missile Defense (TBMD), focusing specifically on the physical and information architectures being developed

for the Navy's role in the Active Defense element of the TBMD solution. In addition a brief discussion of operational considerations and areas of potential improvement will be covered.

B. FOUR ELEMENTS OF THEATER BALLISTIC MISSILE DEFENSE

The United States must respond to the threat described above, and that response will inevitably be joint. In order to get an accurate picture of the Navy's role in the TBMD mission one must first understand the overall concept for joint missile defense. The Joint Staff has broken down the notion of Theater Ballistic Missile Defense into four components:

1. Attack Operations
2. Passive Defense
3. Battle Management Command, Control, Communications, Computers and Intelligence (BMC^4I)
4. Active Defense.

1. Attack Operations

Attack Operations are those whose primary mission is to destroy TBM launch platforms and their supporting elements, to include logistic infrastructure, BM C^3 nodes, and their targeting and surveillance systems. The key tenet of Attack Operations is that attacking forces attempt to destroy the missiles and any WMDs on the ground. If these operations are successful they are certainly the Joint Force Commander's (JFC's) preferred method of eliminating the TBM threat. This element also presents the greatest challenge to the TBMD planner. During a recent ROVING SANDS 95 Joint Tactical Air Operations Exercise, " even with special operations forces and a Pioneer unmanned aerial vehicle dedicated to locating [an] SS-21 battery, it successfully fired all missiles--many with [simulated] chemical warheads--against some 20 corps and division targets."[5] Some of the defining characteristics of TBMD Attack Operations are:

1. The inherent danger to attack aircraft while over enemy territory due to the additional proliferation of highly advanced Surface to Air Missiles.
2. The more restrictive ROE that will be applied to the operations taking place over foreign soil.
3. A data transfer system that will get the needed targeting data to the shooter in a timely manner.

2. Passive Defense

Passive Defense is any actions taken to lessen the effects of damage caused by an enemy's ballistic missile attack. Those actions include minimizing an enemy's ability to target friendly assets, reducing the vulnerability of those assets, and steps taken to improve survival of those assets. Those assets are not necessarily military equipment and personnel, civilian population centers are also included. The way in which the Joint Force Commander (JFC) responds to the need for protection of those allied population centers can greatly enhance his military coalition building efforts. The theater Commander in Chief will certainly include the major population center on his Defended Assets List (DAL). The J-36 CONOPS states, "It is critical to plan for and disseminate TM [Theater Missile] launch warning and impact area prediction to civil authorities, as well as coalition forces.... The theater CINC and his subordinates should consider assisting the host nation civil authorities in establishing passive defense measures for the civilian population."[6] Our national assets currently have the capability to detect a TBM launch, but getting that information to the population centers for distribution is the major challenge. One of the defining characteristics of TBMD Passive Defense is the importance of Intelligence and Early Warning. "The specific capabilities of the threat must be well understood in order to plan effective Passive Defense measures. *Implementation* of those measures in a timely manner (and with a minimum of false alerts)

requires effective Early Warning."[7] Political realities will force military commanders to defend the civilian population centers vice applying their full TBMD capabilities to protecting their own force .

3. Battle Management C^4I

Battle Management C^4I is not just another pillar on which the TBMD strategy rests, it is the base on which the three operational pillars get their foundation. BMC^4I is an operational system of systems that integrates the physical systems with the doctrinal concepts, organizational structures, and operational procedures in an attempt to develop a level of synergism that was previously unachievable. According to Joint Pub 3-01.5, "the threat cannot currently be countered by any single technical solution, nor will it likely be in the future. This threat can only be countered by the synergistic performance achieved by coordination and integrating all four operational elements into cohesive and coherent combat operations."[8] The BMC4I systems will provide the channel for the vital launch warning data dissemination, and will allow coordination of the TBMD battle. It will include Intelligence Preparation of the Battlespace (IPB), much of the joint planning information required to conduct TBMD operations, force orders, and interceptor kill assessment and Battle Damage Assessment of the DAL following TBM attack. While serving as the link among the other three elements, BMC^4I must help create a truly integrated system of systems and give the JFC the flexibility to respond to the threat.

4. Active Defense

Active Defense is any operation that attempts to destroy the cruise missile or the TBM itself while in flight. One major air threat to friendly forces in theater in the past has been the air

launched cruise missile (ALCM). Our principal tactic for defending against the ALCM is to attack the aircraft before it reaches its weapons release point, thus eliminating the easier of the two potential AAW targets. With the proliferation of the TBM there is no longer the opportunity for our air defense forces to shoot the "archer"; our TBMD assets must have the capability to shoot down the arrows. "Planning for TBMD Active Defense attempts to compensate for the challenging nature of the target by working to achieve defense in depth--early sensor cueing, followed by multiple shot opportunities for complementary interceptor systems throughout the course of an inbound missile's flight."[9] Responsibility for this mission will normally be assigned by the Joint Force Commander to an Area Air Defense Commander (AADC). They will set the priorities for defense and appropriation of the JFC's assets. Those assets may be transferred to the operational control of the AADC for defensive planning and will then operate under the Rules of Engagement for the Active Defense forces. Characteristics of active defense include:

1. The advanced notification of any information concerning the type of warhead on the TBM
2. The need for the earliest possible alert of TBM preparation and launch, to enable a rapid netted cueing of Active Defense sensors and systems
3. A highly organized coordination between the different element of the layered defense
4. The ability to select the correct weapon and establish strict fire discipline for a given threat, in order to save the TBMD assets.

This thesis will discuss Active Defense and Command and Control issues. The detection, tracking, and interception of Theater Ballistic Missiles in flight is the crux of the Navy's role in the Active Defense element of Theater Ballistic Missile Defense. Specifically, this thesis will define what information is needed to consummate an engagement and how that information will reach a given shooter in a joint environment. The Navy in 2005 plans to have a multi-tiered

TBMD system with Navy Area Defense (NAD) as the lower tier element and Navy Theater Wide defense (NTW) as the upper tier defense. The SM2 Block IV missile will be the interceptor for the NAD system and the NTW will rely on the SM2/LEAP variant. The use of these two systems will give the theater CINC flexible defensive coverage from a ground level point defense system to an extended range of over 100 km.

C. ASSUMPTIONS

The Naval Area Defense (NAD) and Navy Theater Wide Defense (TWD) will be the significant new capability that the Navy will bring into the joint arena in the future. This thesis will discuss only the first of the two systems to come on line, the NAD. This new system will have a significant political, as well as military, impact. For the purpose of this thesis it will be assumed that all of the developing Command and Control systems discussed will be operational and employed. The time frame for the thesis in the "to be" domain will be circa 2005. The second chapter will attempt to demonstrate the differences between the AAWC's current physical architecture and the Ballistic Missile Defense Commander's (BMDC's) future physical architecture. Both commanders will be embarked on an Aegis cruiser. The third chapter will attempt to describe the differences in information exchange requirements for the two commanders. The last chapter will combine and summarize the changes and will discuss some of the potential problem areas during this evolution. Because the Aegis cruiser is the only TBMD player that is truly multi-mission capable, i.e., AAW, USW, ASW, etc., there are problems that may occur with the systems that are seemingly not related to TBMD.

II. PHYSICAL ARCHITECTURES

This chapter will describe the differences between the current AAWC physical architecture and the "to be" physical architecture that will be used during the Navy's TBM active defense mission using NAD. The "as is" architecture will provide the bases on which the "to be" physical Information Architecture will be built. When performing AAW operations the Anti-Air Warfare Commander will reside on an Aegis cruiser or destroyer, therefore the architecture shown in Figures 1 and 2 represents a generic Aegis cruiser/destroyer.

A. "AS IS" PHYSICAL ARCHITECTURE

The key nodes providing Command and Control (C2) systems and communications services which comprise this "as is" architecture are described below in the numbered order shown on Figure 1.

1. Officer in Tactical Command Information Exchange system (OTCIXS)

OTCIXS interfaces with JMCIS and the AEGIS Weapon System (AWS) to provide a secure computer-to-computer tactical information network among surface combatants. The network operates on 1.2 or 2.4 KHz channels over UHF SATCOM using USMTF and OTH-T Gold message formats.

2. Operational Intelligence (OPINTEL)

The OPINTEL system provides data on one-way (shore-to-ship) FLTSATCOM channels that provides Sensitive Compartmented Information (SCI) to afloat units.

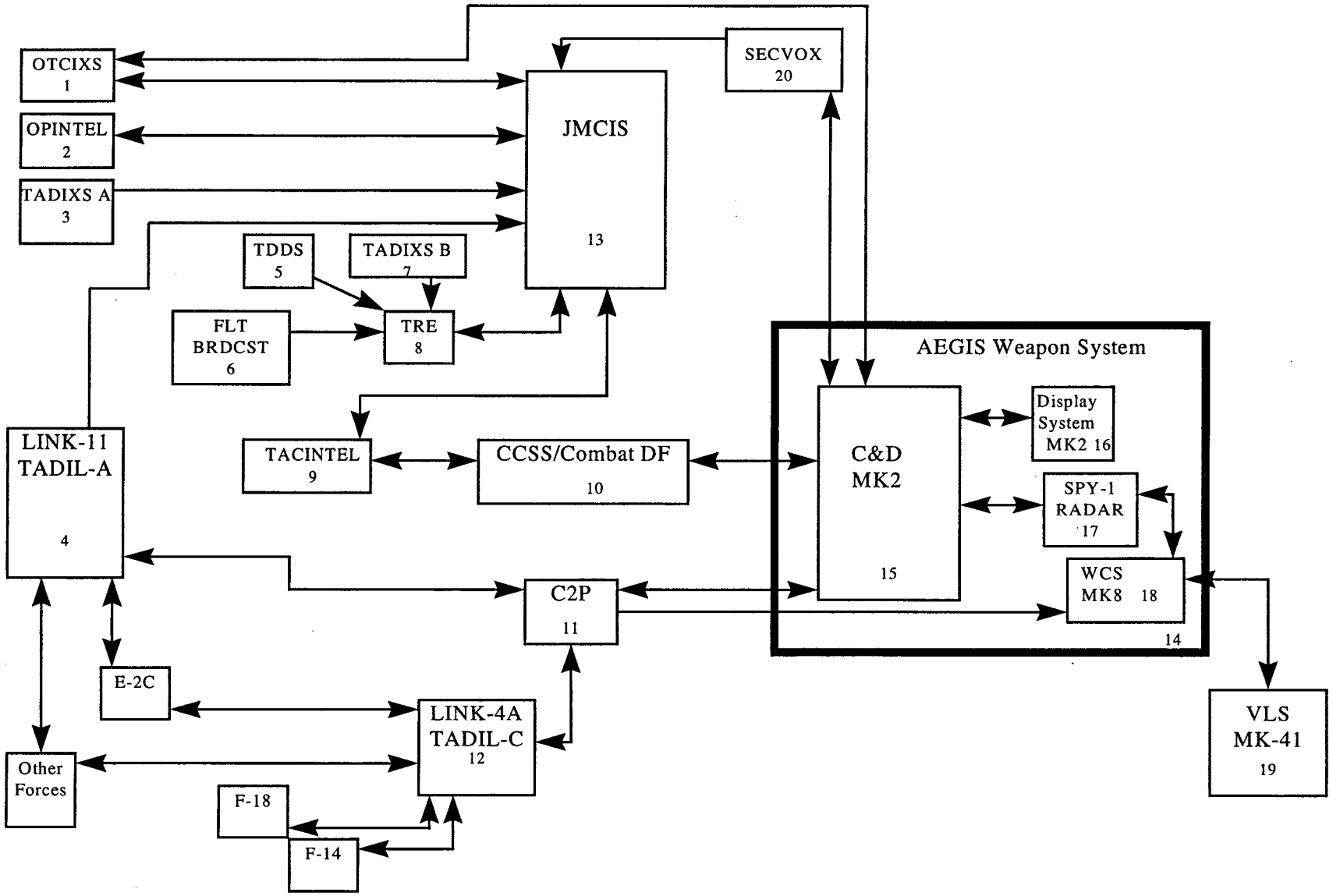
OTCIXS
1
OPINTEL
2
TADIXS A
3
JMCIS
13
SECVOX
20
TDDS
5
TADIXS B
7
FLT
BRDCST
6
TRE
8
AEGIS Weapon System
LINK-11
TADIL-A
4
TACINTEL
9
CCSS/Combat DF
10
C&D
MK2
15
Display
System
MK2 16
SPY-1
RADAR
17
WCS
MK8 18
14
C2P
11
E-2C
LINK-4A
TADIL-C
12
Other
Forces
F-18
F-14
VLS
MK-41
19

Figure 1

3. Tactical Data Information Exchange System A (TADIXS A)

TADIXS A is a satellite broadcast one-way, shore-to-ship communications link serving as a worldwide network for disseminating near real-time OTH-T data and the Ocean Surveillance Products (OSP) from designated shore sites to flag-capable and Tomahawk-equipped platforms, in OTH-T GOLD format. The TADIXS Gateway Processors at each NCTAMS provide both the shore hub of the TADIXS, and the NCTAMS transfers information between OTCIXS networks.

4. Link-11 (TADIL A)

Link-11 using TADIL A message formats is a secure, computer-to-computer network of digital links which allows ships, aircraft and ground stations to share tactical data, primarily track data. TADIL A messages currently are used by USMC and USAF systems and certain NATO allies in addition to the Navy to exchange surveillance data (air, surface, and subsurface); Electronic Warfare (EW) and intelligence, aircraft control and status; weapon control and status; command management; and training. The Navy will be modifying the standards and protocols over the next several years to support TMD.

5. The Tactical Related Application (TRAP) Data Dissemination System (TDDS)

A principal means of disseminating TBM launch alert and cueing information to users is the TDDS. The Defense Support Program (DSP) sensors downlink the unprocessed sensor data to the Tactical Event System (TES) which develops the target information and distributes it by TDDS.

TDDS is composed of a worldwide network of ground sites which interface with sensor systems and satellite transponders via a UHF network and a Terrestrial Communications

Network (TCN). Over the UHF network, single sites transmit and receive from one satellite. Dual sites transmit and receive from two satellites. The dual sites store and forward data from one satellite to the other. Over the TCN, high speed communications circuits are used for interground site communications. Among the messages which TDDS processes are generic tactical contact reports in USMTF-SENSOREP format as described in Joint PUB 6-04. TDDS transforms them into message type 7 (generic on-the-air format) for transmission via the satellite.

6. Fleet Satellite Broadcast System (FSBS)

The Fleet Satellite Broadcast System transmits 15 sub-channels of encrypted message traffic at an input data rate of 75 bps per channel. These sub-channels are time-division multiplexed in a one-way RF transmission at 1200 bps. The shore-based terminal transmits these data on a direct sequence spread-spectrum SHF signal to UHF satellites, where the signal is translated to UHF and down-linked. Message traffic is queued and/or channel selected prior to transmission by two processor-controlled message switching systems:

1. The Naval Communications Processing and Routing System (NAVCOMPARS) for general-service message traffic.
2. STREAMLINER for special-intelligence message traffic.

General service message traffic can be read into the NAVCOMPARS processor from facilities at the NCTAMS/NCTS or can automatically be read from an Automatic Digital Information Network (AUTODIN) switching center. In general, the same process is applicable for entering special-intelligence messages via STREAMLINER.

The High Speed Fleet Broadcast (HSFB) Program will upgrade the Fleet Broadcast System (FBS) transmission subsystem by improving broadcast transmission speed, information throughput, and resource flexibility. The HSFB upgrade offers the capability to reallocate

available information throughput capacity among users in response to changing tactical environments and the ability to handle traffic quantity and quality demands imposed by high speed automated subsystems. Identical reconfigurable time division multiplexers (TDMs) replace satellite broadcast multiplexers ashore and afloat. The AN/SSR-1A satellite broadcast receiver (modified) accommodates coded data rates up to 19.2K bps.

7. Tactical Data Information Exchange System (TADIXS B)

TADIXS B is a UHF broadcast designed to deliver targeting quality contact data to tactical users of all services. Contact data consists of contact type, identification, location, time and amplifying data of selected air, sea and land contacts. It supports the I&W, surveillance, and targeting data requirements of operational decision makers and targeteers in all warfare areas.

8. Tactical Receive Equipment (TRE)

Tactical Receive Equipment receives, decodes, processes and distributes on a FIFO basis TDDS and TADIX B transmissions at various world wide fixed and mobile receiving sites and provides an automated interface for users' Tactical Data Processors in several information formats as shown below. After screening for duplicates, messages are filtered, formatted and transferred based on parameters specified by users' data processors (e.g., JMCIS).

9. Tactical Intelligence (TACINTEL)

TACINTEL is a computer-based message processing system providing automatic receipt and transmission of Special Intelligence (SI) for shore and afloat users. TACINTEL subscribers may participate in up to six RF nets with automatic message routing, on a priority basis, among

nets. Transmission control is achieved using a computerized polling scheme. A net control function specifies to each subscriber a sequence order list which gives the order and time allocation for a transmission. Subscribers access the net during a random access time slot at the end of each net transmission cycle. A portion of a DAMA 25 kHz channel has been allocated to TACINTEL, and baseband interfaces can be configured automatically for using different communication media, including UHF LOS, UHF SATCOM, SHF SATCOM, EHF SATCOM and HF.

10. Combat Cryptologic Support System (CCSS) and Combat Direction Finding (DF) System

CCSS is a cryptologic sensor management, coordination and tasking system installed aboard AEGIS cruisers and functioning as a passive surveillance sensor and as an extension of the C2 system. CCSS provides continuous all weather, day-and-night, near-real time response to command. It provides target acquisition, combat surveillance, early warning, threat warning and special intelligence information. It supplements and complements existing ship's sensors. It is primarily designed to support the AAWC.

Combat DF is an automated electronic warfare system installed aboard DDG-51 class ships which provides tactical cryptologic support through the exploitation of hostile communications. Combat DF automatically intercepts and localizes communication signals, and uses cryptologic techniques to locate, identify and track targets over the horizon. It disseminates tactical cryptologic data and target information to:

1. own ship decision makers
2. force combat and command support systems
3. shore support sites.

11. Command and Control Processor (C^2P)

The C^2P provides translation interfaces between incompatible information processing systems, such as TADILs A, C, and J. It accepts data from other platform systems, formats it in accordance with the Joint Interoperability of Tactical Command and Control Systems (JINTACCS) message standards for the designated link, and sends it to communication devices for transmission to the user. On AEGIS ships the C^2P provides for data exchange between Link 11, Link 4A and AEGIS C&D.

12. Link-4A

The Link-4A system provides digital data link communications between controlled aircraft and a controlling Combat Direction System (CDS) station. The application of Link-4A to AAW is in its ability to transmit target detection, identification and track data from airborne, ship-based or ground-based sensors to the appropriate weapons control systems, and to provide a means of relaying such data among a community of users. The system is capable of one or two way communication in the UHF frequency band. It provides an omni-directional asynchronous signal, unencrypted, with a + or - 20 kHz FSK modulation. A time division multiplex, discrete address system sequentially directs messages to individually addressed subscribers.

13. Joint Maritime Command Information System (JMCIS)

JMCIS supports ships, commands, and navy command centers ashore, including specific segments for FLEET CINC and JFC/AADC (Afloat). Its primary functions include:

1. collaborative mission planning
2. force coordination
3. developing, maintaining and disseminating a near real time common tactical picture including TMD launch alerts and missile engagements.

14. AEGIS Weapon System (AWS)

The AEGIS Weapon System provides a fully integrated multi-mission system capability comprised of sensors, displays and weapon fire control. The AWS elements are further described in the following sub-sections.

15. AEGIS Command and Decision (C&D) MK 2

C&D is a computer and display system designed to manage and direct non-weapon systems functions for the combat systems aboard AEGIS cruisers and AEGIS destroyers. C & D consists of equipment, computer software and personnel. It is the central facility for monitoring the overall air, surface and subsurface tactical environment and serves as the repository for tracks. Organic and nonorganic tracks are correlated and decorrelated as well as purged. In addition, tracks are sent to ownship weapons systems and sensors.

C&D supports the dissemination of force and ownship sensor data including appropriate alerts and orders. C&D is designed to facilitate efficient use of force and ownship weapons systems. C&D allows operator entry of doctrine statements which control the combat system mission. In general, C&D provides for operator entry, review, modification, activation, deactivation and/or deletion of doctrine statements and information.

16. AEGIS Display System (ADS) MK 2

ADS is a manned, computer-driven display system that provides support to both high-level shipboard decision making (by ownship personnel with force-level warfare area command responsibilities) and by an embarked commander. ADS provides decision support and decision

execution support. ADS receives its data from C&D and displays the information on the following:

1. large screen displays
2. automated status boards that provide summaries of readiness, status and tactical data
3. interactive stations that provide geographic and alphanumeric displays for the commanders, their TAOs, and console operators.

ADS supports the dissemination or orders resulting from the decision process.

C&D information transfers to ADS include the system and force track files, status information on systems and operations, and the AEGIS system doctrine that is currently in effect.

17. SPY-1 Radar

The SPY-1 radar provides the AEGIS Weapon System (AWS) with an integrated shipboard three dimensional S-band sensor system supporting both the Command and Decision and the Weapons Control functions of AWS.

18. Weapons Control System (WCS) MK-8

The WCS MK-8 translates weapon engagement orders and related assignments from C&D into commands for the control and management of Standard Missiles (SM-2) and other combat systems weapons. The WCS provides interference coordination between Phalanx, SM-2, ASROC, Tomahawk, Harpoon and the five inch gun mount. The WCS:

1. computes threat engagability for weapon assignment and schedules,
2. controls and monitors engagements
3. carries out kill assessments
4. provides timing data for the combat system.

Using the SPY-1 target and missile track data the WCS:

1. generates SM-2 missile initialization data

2. controls missile firing via the VLS
3. generates midcourse guidance commands and forwards them via the SPY-1.

At the appropriate time, WCS assigns a fire control director to illuminate the target during the missile terminal homing phase. The WCS also has a significant air control capability through the Link-4A interface.

19. Vertical Launch System (VLS) MK-41

The VLS MK-41 provides the housing and the launch mechanism for the repertoire of missiles carried aboard AEGIS cruisers and destroyers.

20. Secure Voice (SECVOX)

The Navy has SECVOX capabilities to support TBMD C2 encrypted communications between and within echelons of the TBMD command structure. The Advance Narrowband Digital Voice Terminal provides a common (Air Force, Army, Navy and Marine Corps) protocol for 3 kHz half duplex transmit/receive encrypted voice communications among tactical air, surface and shore units via:

1. line of site UHF
2. beyond line-of-site HF or UHF aircraft relay channels
3. WSC-3 Fleet SATCOM UHF channels.

Netted secure voice capability via UHF SATCOM will be available with the introduction of the TD-1271 B/U and USC-42(V)3 DAMA multiplexers. The Navy also uses the 16 kbps TRI-TAC digital secure voice mode, providing interoperability with the other services.

B. "TO BE" PHYSICAL ARCHITECTURE

This "To Be" AAWC Physical Information Architecture aboard AEGIS ships in the 2000-2002 time period supports the Navy's Area Defense (NAD). Key Command and Control (C2) systems and communications services which comprise this architecture are described below in the numbered order shown on Figure 2.

1. Officer in Tactical Command Information Exchange system (OTCIXS)

OTCIXS interfaces with JMCIS and the AEGIS Weapon System (AWS) to provide a secure computer-to-computer tactical information network among surface combatants. The network operates on 1.2 or 2.4 KHz channels over UHF SATCOM using USMTF and OTH-T Gold message formats.

2. Operational Intelligence (OPINTEL)

The OPINTEL system provides data on one-way (shore-to-ship) FLTSATCOM channels that provides Sensitive Compartmented Information (SCI) to afloat units.

3. Tactical Data Information Exchange System A (TADIXS A)

TADIXS A is a satellite broadcast one-way, shore-to-ship communications link serving as a world wide network for disseminating near real-time OTH-T data and the Ocean Surveillance Products (OSP) from designated shore sites to flag-capable and Tomahawk-equipped platforms, in OTH-T GOLD format. The TADIXS Gateway Processors at each NCTAMS provide both the shore hub of the TADIXS, and the NCTAMS transfers information between OTCIXS networks.

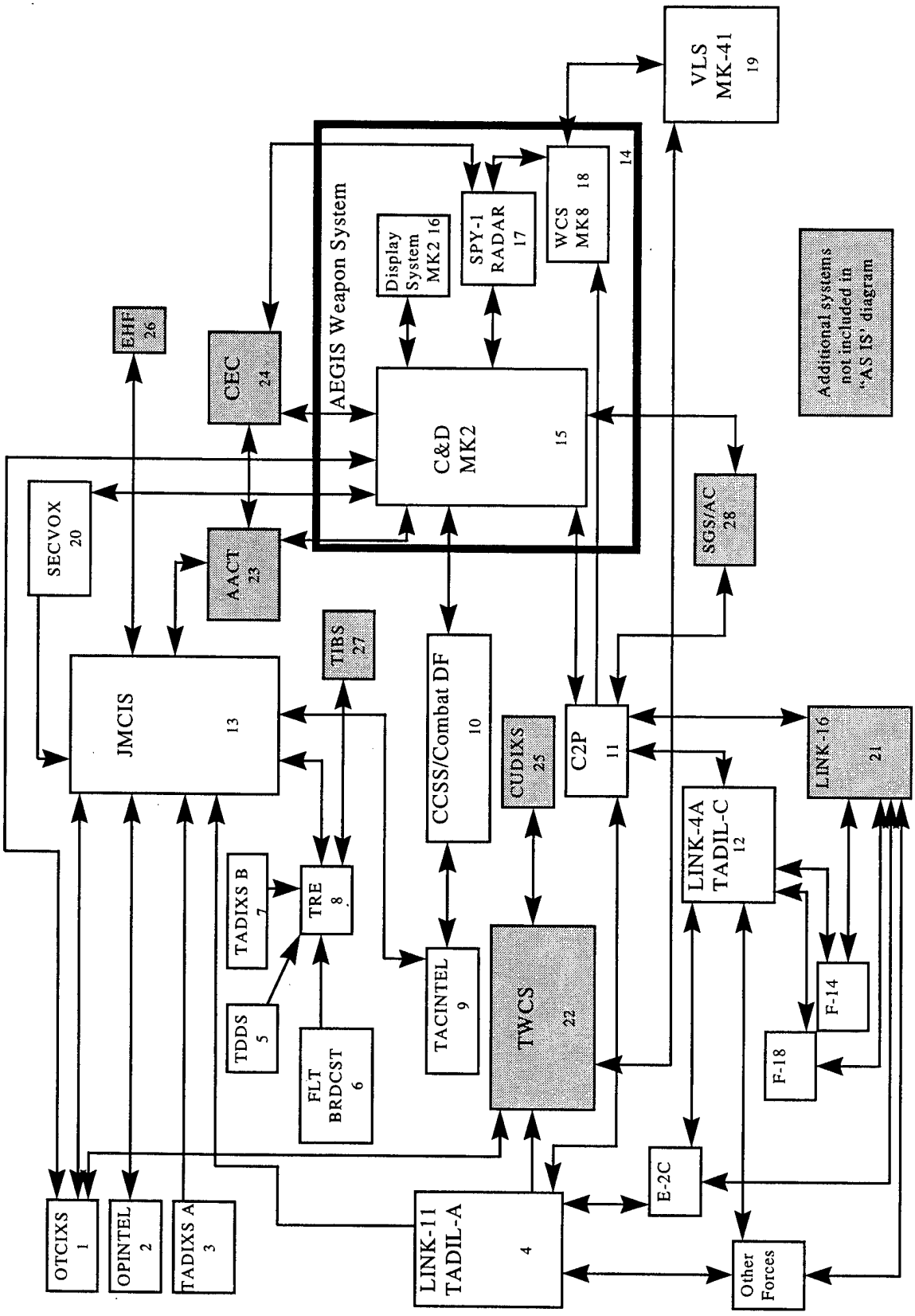
OTCIXS 1
OPINTEL 2
TADIXS A 3
LINK-11 TADIL-A 4
TDDS 5
FLT BRDCST 6
TADIXS B 7
TRE 8
TACINTEL 9
CCSS/Combat DF 10
C2P 11
LINK-4A TADIL-C 12
JMCIS 13
AEGIS Weapon System
14
C&D MK2 15
Display System MK2 16
SPY-1 RADAR 17
WCS MK8 18
VLS MK-41 19
SECVOX 20
LINK-16 21
TWCS 22
AACT 23
CEC 24
CUDIXS 25
EHF 26
TIBS 27
SGS/AC 28
E-2C
F-14
F-18
Other Forces
Additional systems not included in "AS IS" diagram

Figure 2

4. Link-11 (TADIL A)

Link-11 using TADIL A message formats is a secure, computer-to-computer network of digital links which allows ships, aircraft and ground stations to share tactical data, primarily track data. TADIL A messages currently are used by USMC and USAF systems and certain NATO allies in addition to the Navy to exchange surveillance data (air, surface, and subsurface); Electronic Warfare (EW) and intelligence, aircraft control and status; weapon control and status; command management; and training. The Navy will be modifying the standards and protocols over the next several years to support TMD.

5. The Tactical Related Application (TRAP) Data Dissemination System (TDDS)

A principal means of disseminating TBM launch alert and cueing information to users is the TDDS. The Defense Support Program (DSP) sensors downlink the unprocessed sensor data to the Tactical Event System (TES) which develops the target information and distributes it by TDDS.

TDDS is composed of a worldwide network of ground sites which interface with sensor systems and satellite transponders via a UHF network and a Terrestrial Communications Network (TCN). Over the UHF network, single sites transmit and receive from one satellite. Dual sites transmit and receive from two satellites. The dual sites store and forward data from one satellite to the other. Over the TCN, high speed communications circuits are used for interground site communications. Among the messages which TDDS processes are generic tactical contact reports in USMTF-SENSOREP format as described in Joint PUB 6-04. TDDS transforms them into message type 7 (generic on-the-air format) for transmission via the satellite.

6. Fleet Satellite Broadcast System (FSBS)

The Fleet Satellite Broadcast System transmits 15 sub-channels of encrypted message traffic at an input data rate of 75 bps per channel. These sub-channels are time-division multiplexed in a one-way RF transmission at 1200 bps. The shore-based terminal transmits these data on a direct sequence spread-spectrum SHF signal to UHF satellites, where the signal is translated to UHF and down-linked. Message traffic is queued and/or channel selected prior to transmission by two processor-controlled message switching systems:

1. The Naval Communications Processing and Routing System (NAVCOMPARS) for general-service message traffic
2. STREAMLINER for special-intelligence message traffic.

General service message traffic can be read into the NAVCOMPARS processor from facilities at the NCTAMS/NCTS or can automatically be read from an Automatic Digital Information Network (AUTODIN) switching center. In general, the same process is applicable for entering special-intelligence messages via STREAMLINER.

The High Speed Fleet Broadcast (HSFB) Program will upgrade the Fleet Broadcast System (FBS) transmission subsystem by improving broadcast transmission speed, information throughput, and resource flexibility. The HSFB upgrade offers the capability reallocate available information throughput capacity among users in response to changing tactical environments and the ability to handle traffic quantity and quality demands imposed by high speed automated subsystems. Identical reconfigurable time division multiplexers (TDMs) replace satellite broadcast multiplexers ashore and afloat. The AN/SSR-1A satellite broadcast receiver (modified) accommodates coded data rates up to 19.2Kbps.

7. Tactical Data Information Exchange System (TADIXS B)

TADIXS B is a UHF broadcast designed to deliver targeting quality contact data to tactical users of all services. Contact data consists of contact type, identification, location, time and amplifying data of selected air, sea and land contacts. It supports the I&W, surveillance, and targeting data requirements of operational decision makers and targeteers in all warfare areas.

8. Tactical Receive Equipment (TRE)

Tactical Receive Equipment receives, decodes, processes and distributes on an FIFO basis TDDS and TADIX B transmissions at various worldwide fixed and mobile receiving sites and provides an automated interface for users' Tactical Data Processors in several information formats as shown below. After screening for duplicates, messages are filtered, formatted and transferred based on parameters specified by users' data processors (e.g., JMCIS).

9. Tactical Intelligence (TACINTEL)

TACINTEL is a computer-based message processing system providing automatic receipt and transmission of Special Intelligence (SI) for shore and afloat users. TACINTEL subscribers may participate in up to six RF nets with automatic message routing, on a priority basis, among nets. Transmission control is achieved using a computerized polling scheme. A net control function specifies to each subscriber a sequence order list which gives the order and time allocation for a transmission. Subscribers access the net during a random access time slot at the end of each net transmission cycle. A portion of a DAMA 25 kHz channel has been allocated to TACINTEL, and baseband interfaces can be configured automatically for using different

communication media, including UHF LOS, UHF SATCOM, SHF SATCOM, EHF SATCOM and HF.

10. Combat Cryptologic Support System (CCSS) and Combat Direction Finding (DF) System

CCSS is a cryptologic sensor management, coordination and tasking system installed aboard AEGIS cruisers and functioning as a passive surveillance sensor and as an extension of the C2 system. CCSS provides continuous all weather, day-and-night, near-real time response to command. It provides target acquisition, combat surveillance, early warning, threat warning and special intelligence information. It supplements and complements existing ship's sensors. It is primarily designed to support the AAWC.

Combat DF is an automated electronic warfare system installed aboard DDG-51 class ships which provides tactical cryptologic support through the exploitation of hostile communications. Combat DF automatically intercepts and localizes communication signals, and uses cryptologic techniques to locate, identify and track targets over the horizon. It disseminates tactical cryptologic data and target information to:

1. own ship decision makers
2. force combat and command support systems
3. shore support sites.

11. Command and Control Processor (C^2P)

The C^2P provides translation interfaces between incompatible current and planned information processing systems, such as TADILs A, C, and J. It accepts data from other platform systems, formats it in accordance with the Joint Interoperability of Tactical Command and Control Systems (JINTACCS) message standards for the designated link, and sends it to

communication devices for transmission to the designated recipients. C^2P accepts incoming data link messages, determines the platform systems that are to receive the data, reformats it to the formats expected by the receiving systems, and routes it. On AEGIS ships the C^2P provides for data exchange between Link 11 and the AEGIS C&D suite.

12. Link-4A

The Link-4A system provides digital data link communications between controlled aircraft and a controlling Combat Direction System (CDS) station. The application of Link-4A to AAW is in its ability to transmit target detection, identification and track data from airborne, ship-based or ground-based sensors to the appropriate weapons control systems, and to provide a means of relaying such data among a community of users. The system is capable of one or two way communication in the UHF frequency band. It provides an omni-directional asynchronous signal, unencrypted, with a + or - 20 kHz FSK modulation. A time division multiplex, discrete address system sequentially directs messages to individually addressed subscribers.

13. Joint Maritime Command Information System (JMCIS)

JMCIS supports ships, commands, and navy command centers ashore, including specific segments for FLEET CINC and JFC/AADC (Afloat). Its primary functions include:

1. collaborative mission planning
2. force coordination
3. developing, maintaining and disseminating a near real time common tactical picture including TMD launch alerts and missile engagements.

14. AEGIS Weapon System (AWS)

The AEGIS Weapon System provides a fully integrated multi-mission system capability comprised of sensors, displays and weapon fire control. The AWS elements are further described in the following sub-sections.

15. AEGIS Command and Decision (C&D) MK 2

C&D is a computer and display system designed to manage and direct non-weapon systems functions for the combat systems aboard AEGIS cruisers and AEGIS destroyers. C & D consists of equipment, computer software and personnel. It is the central facility for monitoring the overall air, surface and subsurface tactical environment and serves as the repository for tracks. Organic and nonorganic tracks are correlated and decorrelated as well as purged. In addition, tracks are sent to ownship weapons systems and sensors.

C&D supports the dissemination of force and ownship sensor data including appropriate alerts and orders. C&D is designed to facilitate efficient use of force and ownship weapons systems. C&D allows operator entry of doctrine statements which control the combat system mission. In general, C&D provides for operator entry, review, modification, activation, deactivation and/or deletion of doctrine statements and information.

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21. Link-16 - New

Link-16 will become an important netted data link between most TMD platforms, other forces and allies by 2002. Link 16 provides increased throughput, security, jam resistance, location accuracy and interoperability. Link-16 is the U.S. Naval/North Atlantic Treaty Organization (NATO) designation for netted links which allow the exchange of tactical information among ships and aircraft using digital formats, protocols, and standards set forth in

Navy Operational Specification 516, and NATO STANAG 5516. In joint service terminology, Link-16 is synonymous with TADIL J.

Link-16/TADIL J is part of a joint service system known as the JTIDS. JTIDS is interoperable with USN, USAF, USA, United Kingdom , France and NATO terminals. NATO and certain aircraft will use what is known as the MIDS terminal, the Multi-Functional Information Distribution System, functionally identical to the U.S. JTIDS Class 2 terminal.

JTIDS is a time division multiple access, jam-resistant digital data and voice communications system operating in the 960-1215 Mhz frequency range. Messages on JTIDS can be broadcast or addressed to a specific location. Users listen to all broadcast time slots and select what is of interest. A series of time slots is used as virtual circuits between specific users. There are three modes by which users can access a net:

1. Dedicated (preassigned)
2. Contention
3. Time Slot Reallocation (TSR).

There are also two relaying modes:

1. Paired Slot
2. Repromulgation.

The TSR mode allows rapid access to JTIDS nets users. In this mode, there is a pool of time slots available which are available without a predetermined, preassigned plan. Subscribers use TADIL J "announcement" messages to enter a net. Entry can occur for each subscriber as rapidly as every 6 seconds.

22. Tomahawk Weapon Control System (TWCS)

TWCS is an element of the Tomahawk Weapons System. TWCS provides shipboard computer-assisted processing and control of targeting, engagement planning and launch control of the Tomahawk missile. To accomplish this, TWCS correlates and tracks surface and air contact reports received from several interfacing systems.

The theater ocean surveillance data base maintained by TWCS provides targeting information for Tomahawk weapon employment. TWCS targets may be received from either on-board or off-board command systems. TWCS can maintain a common force-level track data base, disseminate the force track data base, and issue ASUW engagement orders to designated TWCS platforms via OTCIXS. Tomahawk land attack missions (TLAM) may also be received via TADIXS A and processed by TWCS.

23. Advanced AAW Correlator Tracker (AACT) - New

As part of the AEGIS Weapon System (AWS), the AACT performs:

1. AAW over-the-horizon (OTH) tracking
2. real time tracking
3. track serving for combat displays (a geoserver for map displays)
4. an archiving and playback server.
5. sends real time track information to JMCIS
6. receives OTH tracks and supporting data base information
7. receives and processes tracks from the CEC and from the C&D suite
8. sends command orders
9. sends OTH tracks and track association data to the C&D
10. provides the track and command display track picture to the Combat Display system.

24. Cooperative Engagement Capability (CEC) - New

The Cooperative Engagement Capability (CEC) provides a way of merging local/remote sensors and weapons from different anti-air warfare ships, thus allowing multiple ships to act as a single distributed anti-air warfare unit. The CEC consists of three components on each ship:

1. a new ship-to-ship communication system called the Data Distribution System (DDS)
2. a new Cooperative Engagement Processor (CEP)
3. the necessary modifications to the ships' existing combat systems.

The CEP is an embedded real-time system that communicates directly with the ship's combat system from which it obtains local radar plots. These plots are shared with the other CEPs via the DDS. Each CEP uses its own plot as well as those received from the other CEPs to form identical composite-track databases. CEC depends on the timeliness and concurrence of these track databases. The composite track picture overcomes jamming, multipath, and the radar horizon limitations on individual ships by forming a single continuous track from all of the distributed sensors available. Where no data is available for short periods, CEC projects tracks retaining the assigned track number when good data resumes.

The Cooperative Engagement Decision function will provide for operation of Battle Force AAW assets as a single distributed AAW system under adaptive control. Cooperative Engagement Prosecutor will allow use of special engagement techniques requiring coordination of activities between units, such as "Remote Launch" or "Forward Pass", in response to specific tactical situations.

A major element of the CEC, the Data Distribution System, or DDS, encodes and distributes ownship sensor and engagement data to other units and receives and decodes the remote data. DDS characteristics include high data capacity, fast response, spread spectrum,

distributed network control, adaptive automatic relay capability and a directive phased array antenna.

The DDS consists of special-purpose hardware and computer programs that establish and control the jamming-resistant directional data flow between ships equipped with the CEC. The computer programs:

1. manage and monitor the data transfer
2. track the positions of other units relative to the ownship unit
3. compute the pairwise communications global schedule governing when each unit transmits data to other units
4. distribute the tactical cooperative engagement data to other units.

25. Common User Digital Information Exchange Subsystem (CUDIXS)/Naval Modular Automated Communications Subsystem (NAVMACS)

This system provides high volume users with a global, two-way satellite ship-shore information exchange capability. It is divided into two major elements: the Common User Digital Information Exchange Subsystem (CUDIXS) and the Naval Modular Automated Communications Subsystem (NAVMACS). CUDIXS is a shore-based control system that provides RF link control of the network and processing of message traffic. NAVMACS uses the CUDIXS link-control protocol and processes message traffic at subscriber terminals.

All UHF satellites have 25-kHz wide channels allocated for CUDIXS/NAVMACS transmissions. Each channel is operated as a half-duplex UHF of 2400 bps. Each area CUDIXS/NAVMACS network has a dedicated RF channel (DAMA time slot) on its area UHF satellite.

Control of message traffic transmissions on CUDIXS/NAVMACS channels is achieved by a polling, controlled-access protocol. Link control is maintained by the CUDIXS processor software through a Sequence Order List (SOL). This list specifies for each subscriber the order

in which to transmit and the length of that transmission. The transmission portion of the net cycle is independent of message length, therefore one message may require several net cycles for a complete transmission. Prior to transmission, the subscriber processor queues messages by precedence and restructures each message into data blocks. Header information in the data blocks is used subsequently by the link-control processor to establish traffic precedence level, sequence of transmission and the number of data blocks to be transmitted. Even though the time for a given net cycle is variable, the average cycle time for the SOL and the subscriber transmission is one minute.

26. EHF/Information Exchange System (EHF/IXS) - New

By FY 1999 all CGs and DDG 51s will be equipped with AN/USC-38 EHF satellite terminals. Beginning in FY96 the Navy will begin installing limited production models of the Navy EHF Communications Controller (NECC) which will provide the fleet with data network communication services via the AN/USC-38. With NECC, the Navy will have an EHF/IXS allowing automated, netted tactical data exchange over jam-resistant EHF satellite links. Ship-shore-ship and ship-ship tactical data nets will be formed by tactical commanders, as required.

27. Tactical Information Broadcast Service (TIBS) - New

TIBS is a multi-source, multi-sensor theater broadcast dissemination service provided by an adaptive configuration of producers, communications networks, and users. The network provides a continuous secure broadcast of data among sources and data subscribers who are interconnected by a common channel in the UHF band. In-theater data providers transmit directly to local users via UHF satellite or via UHF line-of-site transmission. Out-of-theater data

producers can enter data into the theater TIBS network by direct uplink to a TIBS satellite link or through land-line connection to a TIBS network node. A maximum of ten data producers and up to 250 receive-only users can be on any one TIBS theater network at one time. TIBS uses a 70-bit TADIL-J-like format for broadcasting messages. Changes have been made to the TIBS message set to accommodate TBM data from TES.

28. Shipboard Gridlock System/Auto-correlator (SGS/AC)

SGS/AC provides continuous automatic gridlock between two data-linked units operating with three-dimensional radars in an open ocean environment. To allow gridlock, SGS performs real-time estimation and correction of shipboard radar coordinate frame systematic misalignment errors during intership Link 11 track data exchanges between two ships at sea. The objective of this gridlock process is to allow the registration of radar tracks from one ship or aircraft in the coordinate system of another ship or aircraft, thereby enabling dependable agreement on mutually-held tracks for coordinating defensive decision making and weapons action.

III. INFORMATION ARCHITECTURES

The purpose of this chapter is to capture the changes in the information flow between the "as is" Anti-Air Warfare Commander (AAWC) model and the "to be" Theater Ballistic Missile Defense Commander (TBMDC) model. The AAWC and the TBMDC will be located on an Aegis cruiser. Sections A and B (and the Appendix) were completed by NRAD personnel and form the basis for Section C which was completed by the author with assistance from NRAD personnel.

A. INTRODUCTION TO ACTIVITY MODELING

This introduction is an excerpt that was taken from the final report that accompanied the Appendix.[10]

1. Context Diagram

A context diagram consists of a single process box and its related Inputs, Controls, Outputs, and Mechanisms (ICOMs). The process box could be the A0 node, or any node below it. An ICOM represents a type of information, data, or object that is used by, involved in performing, or produced by the process or sub-process node.

IDEF 0 Activity Modeling

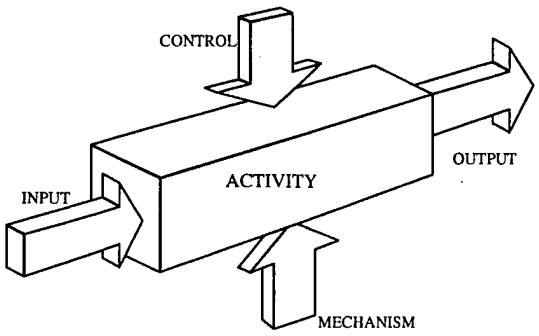

Figure 3

An ICOM has four possible roles relative to a node:

1. Input. Information or materials which are transformed or consumed in the production of the output to a node. (Arrows entering the left side of the node box.)
2. Control. Information or materials that govern or constrain the operation of a node. A control regulates the transformation of inputs to outputs. (Arrows entering the top of the node box.)
3. Output. Information or materials that are produced by a node, or result from a node. (Arrows leaving the right side of the node box.)
4. Mechanism. Usually people, machines, resources, or existing systems that perform (enable) a node, or provide energy to a node. (Arrows entering the bottom of the node box.)

2. Decomposition Diagram

A decomposition diagram describes the components of a process, the relationship of components of a process, and the relationship of sub-processes (tasks) to one another. During decomposition, the modelers read down a process by determining its sub-processes, and the flow of ICOMs among them. The ICOMs that interact with other activities or processes outside the decomposition diagram are also depicted, to document activity associations.

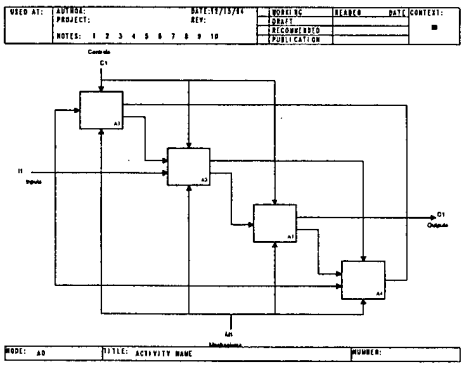

Figure 4

Unlike a node tree, which can show several levels of sub-processes at once, a decomposition diagram shows on each page only one level below the parent process that is being decomposed. The modelers must check to ensure that the process views are consistent from one level to the next. This breakdown of activities is repeated for each activity as long as the breakdown enhances the users understanding of the process and the entity's point of view is maintained.

3. IDEF0 Review Guidelines

An IDEF0 model should be read in a global manner rather than concentrating on one area of the model. The process and the information flows must be understood in relation to the rest of the model. The following steps provide guidance in reviewing a model in its entirety:

1. Scan the process (boxes) within the model to understand the subject area.
2. Review the context diagram and study the information flows. Identify the primary information flows (arrows).
3. Identify the primary information flows of the decomposition diagrams. Attempt to form a thread of major information flows among the processes.
4. Use this thread of information flows to walk through the series of processes.
5. Review the main story being told.
6. Review all supporting documents: FOE diagrams, process narratives, information flow (ICOM) definitions and any notes.

B. THE "AS IS" INFORMATION ARCHITECTURE

The "as is" architecture will be defined in a IDEF0 model located in Appendix A. This model was created by NRAD for the Ballistic Missile Defense Organization. It has been approved by the Director of Theater Air Defense (TAD) as the model that best describes the functions performed by the AAWC in an air-warfare environment on an Aegis cruiser. The "as is" architecture is included in this thesis to help demonstrate the changes, both necessary and inevitable, to the information exchange requirements when including ballistic missile defense as an additional role for the Aegis cruiser. "The purpose of the "Navy AAWC Process Model" is to capture the activities and information flow from the Navy AAW Warfare Area Commander and the organic (carrier battle group) and non-organic (joint forces not assigned to the carrier battle group) assets that contribute to the AAW defensive mission."

C. THE "TO-BE" INFORMATION ARCHITECTURE

1. Context Diagram Definitions

(A0) PERFORM TBMD OPERATIONS

TBMD operations from the viewpoint of the TBMD commander are defined in "Concepts for Integrated (Naval component) Battle Organization, 15 October 1995". The TBMD Commander is responsible for the defense from TBMs of the battle group as well as those assets assigned to him by the CJTF.

Centralized planning and decentralized execution is the premise on which active defense is based. This requires the surveillance of a wide area (with emphasis on likely launch areas) and the integration of active defense TBMD forces (into a theater air defense BMC4I system) in order to exchange track, intelligence, and I&W information between forces. The command and control

plan (available to support this dynamic, time-critical effort) must be supported by an effective naval as well as a joint organization architecture with information flow requirements carefully orchestrated.

(A0.1) PLAN TBMD OPERATIONS

Planning for active defense will focus on the capabilities to achieve a hard kill against most TBMs which are launched against the defended area. Theater-wide active defense systems include AEGIS ships, the HAWK missile system, the PATRIOT system, and THAAD/GBR. Coordination of active defense relies upon the flexibility and responsiveness of the BMC4I architecture to realize its full effectiveness. TBMD requires clear, flexible rules of engagement (ROE) from the Unified Commander so that decision makers can act quickly and decisively. Active defense exploits early warning and cueing to gain the best possible tracking and targeting coverage. Active defense requires the determination of whether a potential target meets engagement criteria and coordination among many elements. In an optimal situation, the plan will offer multiple engagement opportunities against each target by the TBMD forces. As importantly, the active defense system requires accurate kill assessment for every engagement.

The types of TBM warheads which threaten the DAL are as important to the AADC's planning as the launch areas and targets. The positioning of the units conducting the active defense provide cueing and tracking coverage critically effects the engagement strategy for every attack.

Active defense planning builds upon the available forces and identifies any additional forces which are required. Planning for active defense includes coordination with firing units having other mission assignments and detection/tracking systems in order to define which forces

are dedicated to TBMD active defense as a primary mission, and what forces can rapidly be reassigned for TBMD active defense from other missions.

Command, control, and coordination for active defense is based upon the operational assessment of TBMD scenarios. Planners will tailor the CRI system for effective TBMD response within the projected AOR and timelines. Command roles and functions will be assigned to the best-suited commanders, aligning supporting elements in a horizontal and vertical integration. Active defense plans provide:

1. guidance to units establishing the doctrinal statements
2. location and coverage assignment
3. the integration of CEC-capable and non-CEC-capable forces.

The result is command and control that ensures the most-rapid, reliable paths are established for TBMD warning and cueing information.

The TBMD commander must coordinate closely with USSPACECOM to make use of the space-based warning system.

(A1.1) ASSESS TBMD CAPABILITIES

Assessment of friendly forces' capabilities is an evaluation of how well they can perform against the threat's intentions. The accuracy of the assessment is crucial to the overall performance of the TBMD mission and is based on the accuracy of intelligence and other information. Assessment includes:

1. friendly and enemy order of battle
2. demonstrated proficiency
3. training level
4. pattern of operation
5. assets to be defended
6. any indications and warnings.

(A1.1.1) ASSESS ENEMY OFFENSIVE TBM CAPABILITY

The assessing of enemy offensive TBM capabilities is an evaluation of the threat and the perceived threat's intentions. The accuracy of this assessment is crucial to the overall:

1. tactical decisions
2. performance of the mission
3. execution of the plan.

(A1.1.2) ASSESS OWN FORCE TBMD CAPABILITIES

The assessing of own force TBMD capabilities/available weapons is an evaluation of how well own forces can perform against the threat's intentions. The accuracy of this assessment is crucial to the overall:

1. tactical decisions
2. performance of the mission
3. the execution of the plan.

(A1.1.3) PERFORM INTEGRATION OF ASSESSMENT

The TBMD commander produces an overall assessment of all hostile TBM capabilities and all friendly TBMD capabilities in the theater of operations.

(A1.2) DEVELOP DRAFT TBMD PLAN

Using the experience of his staff, the TBMD Commander creates a draft plan to defend all assets under his protection in the most efficient manner possible

(A1.2.1) CREATE PLAN

Given the boundaries of the controls, members of the TBMD commander's staff (wardroom) create an initial plan to defend all assets under the TBMD commander's protection.

(A1.2.2) REVIEW PLAN FOR COMPLIANCE

The initial plan is reviewed for compliance with other requirements such as ROE, Higher Echelon Guidance, SOP etc. Once the initial plan is deemed compliant, it is released for coordination.

(A1.3) COORDINATE TBMD PLAN

The TBMD commander coordinates his plan with other non-organic TBMD units and higher echelon authority. When approved, he prepares it to be released as an OPTASK supplement.

(A1.3.1) COORDINATE TBMD DRAFT PLAN WITH ORGANIC UNITS

A draft TBMD plan is coordinated with organic units to resolve deconfliction.

(A1.3.2) COORDINATE TBMD DRAFT PLAN WITH NON-ORGANIC UNITS

The TBMD Commander coordinates the draft TBMD plan with non-organic units to resolve possible deconfliction.

(A1.3.3) FINALIZE TBMD PLAN

The coordinated (organic and non-organic) TBMD plan is verified to be compliant with Higher Echelon Guidance and ROE. The TBMD plan will then be released in the form of the TBMD OPTASK/Supplement

(A1.4) PROMULGATE OPTASK/ SUPPLEMENT

The coordinated TBMD plan is issued as the OPTASK TBMD supplement.

(A0.2) EXECUTE TBMD OPERATIONS

TBMD is composed of four operation elements: attack operations, active defense operations, passive defense operations, and BMC4I. The TBMD commander will not actively participate in the attack operations phase of the TBMD mission. These applicable elements have the following general characteristics:

Active Defense Operations apply to operations initiated to protect against a TBM attack by destroying the missiles in flight. Active defense includes multi-tiered defense in depth via multiple engagements, possibly using air, land and sea forces. It also may include electronic attack (EA) operations to disrupt guidance systems.

Passive Defense Operations are measures initiated to reduce vulnerability and to minimize the effects of damage caused by TBM attack. Passive defense includes TBM early warning, nuclear, biological and chemical (NBC) protection, counter-surveillance, deception, camouflage and concealment, hardening, electronic warfare, mobility, dispersal, redundancy, recovery and reconstitution.

Battle Management C4I (BMC4I) is an integrated system of doctrine, procedures, organizational structures, facilities, communications, computers and intelligence that support and enhance the other three operational elements. It includes missile warning and cueing of defense systems by missile warning sensors and ground stations. C4I provides command authorities at all levels with timely and accurate data and systems to plan, monitor, direct, control and report TBMD operations.

(A2.1) OBSERVE TBMD THREAT

This function establishes, maintains the battle space non-organic track data and coordinates non-organic TBM cueing and warning to non-organic units.

(A2.1.1) OBTAIN TBM INTELLIGENCE AND WARNING

The TBMD commander defines potential threats for his area of responsibility using intelligence information.

(A2.1.2) PREPOSITION ASSETS

The TBMD commander positions (AOR) sensors and firing units for the best possible coverage for TBM which threaten DAL.

(A2.1.3) OBTAIN TBM LAUNCH INDICATIONS

The TBMD commander correlates ballistic missile launches from all sources.

(A2.1.4) OBTAIN NON-ORGANIC TRACK DATA

Fusing the tactical picture is the process of combining indications, warning and launch detections/indications with incoming non-organic track data. The incoming data will also aid in the cueing of own ship sensors.

(A2.1.5) ID TRACK

Identifying the track is the process of taking non-organic track data and categorizing it as a possible BM threat. Organic sensors may or may not have acquired this track.

(A2.2)VALIDATE TBMD THREAT

Once threat track data has been detected and acquired by organic sensors, the track is coordinated with non-organic units and if the track is within the area of responsibility, a course of action using organic units is considered.

(A2.2.1) ACQUIRE WITH OWN SHIP SENSOR

This function is the process of acquiring a track with own ship organic sensors for the purpose of tracking the contact. The acquisition may have been cued by organic or non-organic sensors, or the organic sensor may have made the initial acquisition.

(A2.2.2) VALIDATE ORGANIC TRACK

This process takes the newly acquired track and validates it as a TBM.

(A2.2.3) CORRELATE ORGANIC TRACK WITH NON-ORGANIC TRACK DATA

This process compares the organic valid track with the track from a non-organic sensor to verify that they are the same track.

(A2.3) DECIDE COURSES OF ACTION

The TBMD Commander interacts with other warfare commanders, service, and allied units to develop the engagement plan. The recommended course of action will include the concept of operations and evaluation of sensors/weapons estimates. He also recommends non-organic support, directs control actions and sends force orders to organic assets for TBMD action.

(A2.3.1) EVALUATE IMPACT POINT VS DEFENDED ASSET LIST

This process predicts the enemy TBM impact points, and determines which assets are capable of engaging which contacts, from the individual unit (DAL) areas of responsibility.

(A2.3.2) ESTABLISH PRIORITY TARGETS

Target prioritization is obtained by performing assessment of the:

1. evaluated impact point data
2. TBMD target
3. ROE
4. Higher Echelon Guidance
5. TBMD OPTASK/Supplement.

(A2.3.3) COORDINATE ASSIGNMENT WITH NON-ORGANIC UNITS

The TBMD Commander coordinates the assigned target prioritization with non-organic units and establishes the coordinated Course of Action.

(A2.3.4) ASSIGN SHOOTER TO TARGET

The TBMD Commander assigns organic units' weapons to targets based on the coordinated Course of Action.

(A2.4) EXECUTE TBMD ACTION

The TBMD Commander provides assets to be defended, force orders, warnings and weapon status to organic assets Rules of engagement and guidance are provided to the TBMD Commander by higher authority.

(A0.3) MAINTAIN TBMD READINESS

The TBMD readiness function monitors TBMD force readiness and performs the support functions needed to ensure appropriate levels of force preparedness. Activities such as training, maintaining equipment readiness and logistic support are included in this function.

(A3.1) TRAIN FORCE IN TBMD OPERATIONS

The pre-deployment and enroute training is determined and scheduled by the Fleet CINC, Type Commander, Officer in Tactical Command (OTC)/Composite Warfare Commander (CWC), the Air Warfare Commander and the TBMD Commander. The training objective is to develop skills and teamwork among organic and non-organic TBMD assets. Enroute training should complement the pre-sail training. Readiness data is forwarded by organic platforms to the OTC/CWC and used to estimate capabilities/readiness and refine further training. Space, shore-based and other non-organic assets provide environmental data and simulations of surveillance products to support the exercise.

(A3.1.1) DETERMINE TRAINING REQUIREMENTS

The TBMD skills and capability to work as a team is evaluated as a result of required training and training feedback. The training requirements are then established and scheduled.

(A3.1.2) TRAIN IN SIMULATED TBMD ENVIRONMENT

The TBMD operator trains to specified training objectives. Performance data is provided as status of TBMD operators, and it is used to estimate personnel capabilities/readiness and refine further training. Feedback is also provided in support of training evaluations.

(A3.1.3) CONDUCT SINGLE UNIT TRAINING

TBMD unit trains to specified training objectives. Performance data is provided as status of TBMD unit readiness. It is used to estimate capabilities/readiness and refine further training. Feedback is also provided in support of evaluation of training requirements.

(A3.1.4) CONDUCT BATTLE GROUP TRAINING

Same as (A3.1.3) for Battle Groups

(A3.1.5) CONDUCT JOINT OPERATIONS TRAINING

Same as (A3.1.3) for Joint Operations

(A3.2) MAINTAIN TBMD SYSTEMS READINESS

To maintain TBMD systems readiness status, organic force assets report changes in status for the TBMD equipment/systems to the TBMD commander who reports to the Officer in Tactical Command, who reports to higher authority. Individual platforms repair battle damage and maintain their own systems as necessary. Individual platforms may modify assignments (when approved) to compensate for degradation among platforms. Also, the Fleet Commander/Fleet CINC may replace force assets when damage is sufficiently severe or if other assets can be made available.

(A3.3) MAINTAIN TBMD LOGISTICS READINESS

Planners must estimate the likely firing rate for TBM interceptors based on the planned engagement doctrine and the individual systems available in order to manage the weapons stocks.

This will govern the plans for resupplying the force, including individual unit firing doctrine, during engagements. Planners will determine whether to attempt to distribute firing assignments among engagement units to maintain a uniform rate of expenditure across the force or to concentrate firing assignments among a subset of firing units to empty their magazines first (freeing them for other missions and for rearming), while maintaining other units on-station as a TBMD force.

2. Navy TBMD Interoperability Architecture IDEF0 Diagrams

The following are the IDEF0 Diagrams used to describe the function "Perform TBMD Operations." The overall function of performing TBMD operations is broken down into three sub-functions: planning, execution and maintaining of TBMD operations. Those sub-functions are in turn broken down into more descriptive functions as described in Chapter III's sub-section C 1.

The IDEF0 diagrams were prepared during thesis research visits to NRaD with the support of their personnel on NRaD-owned software.

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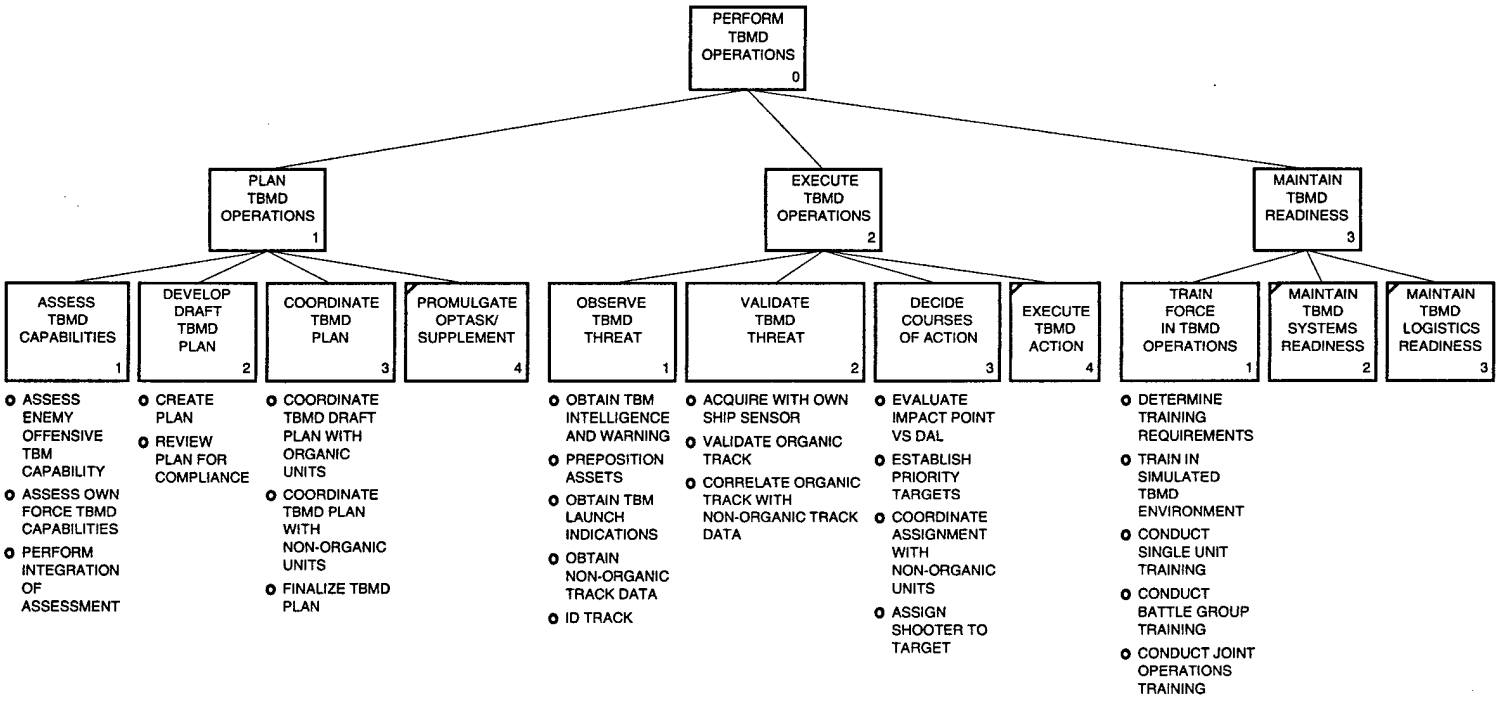

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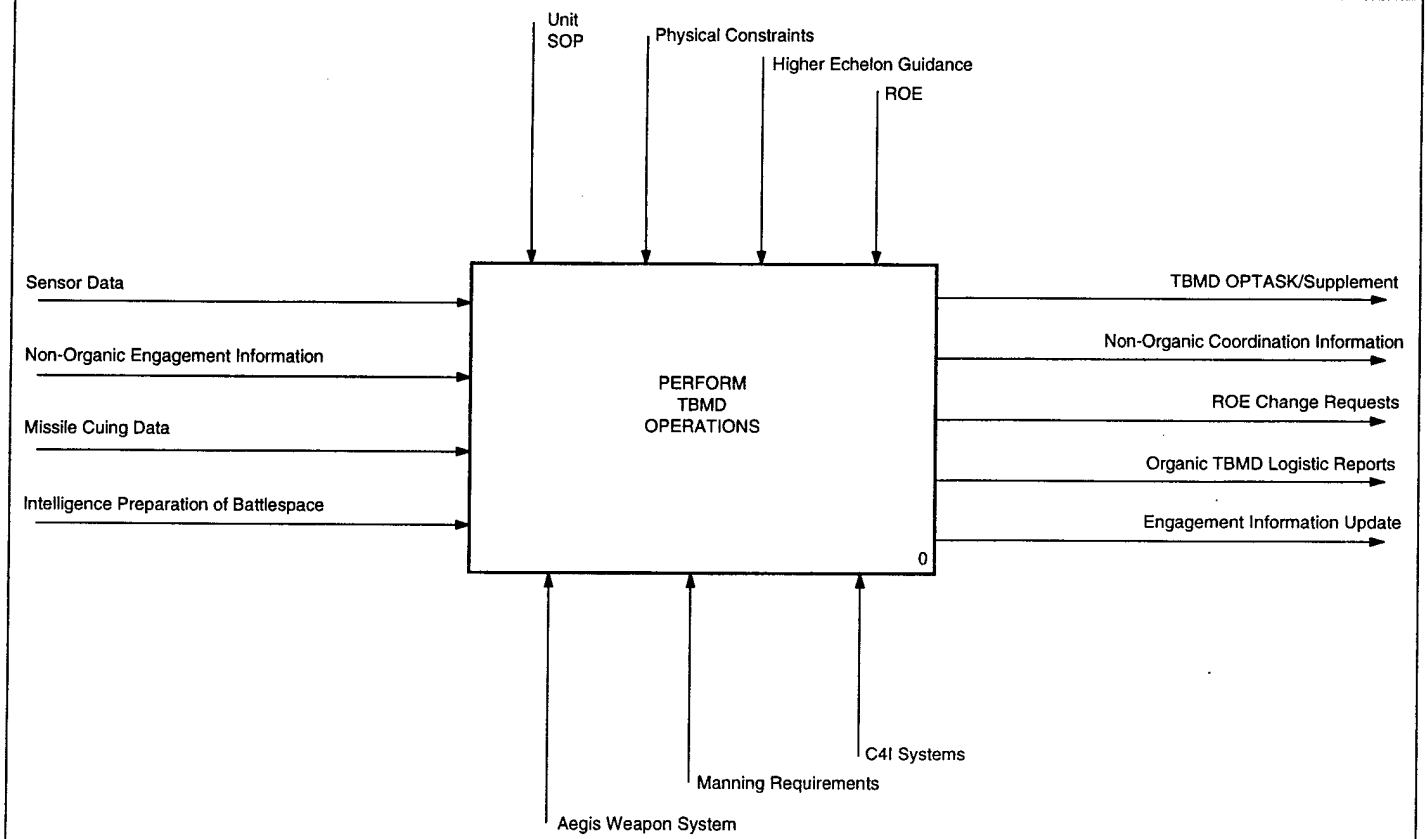

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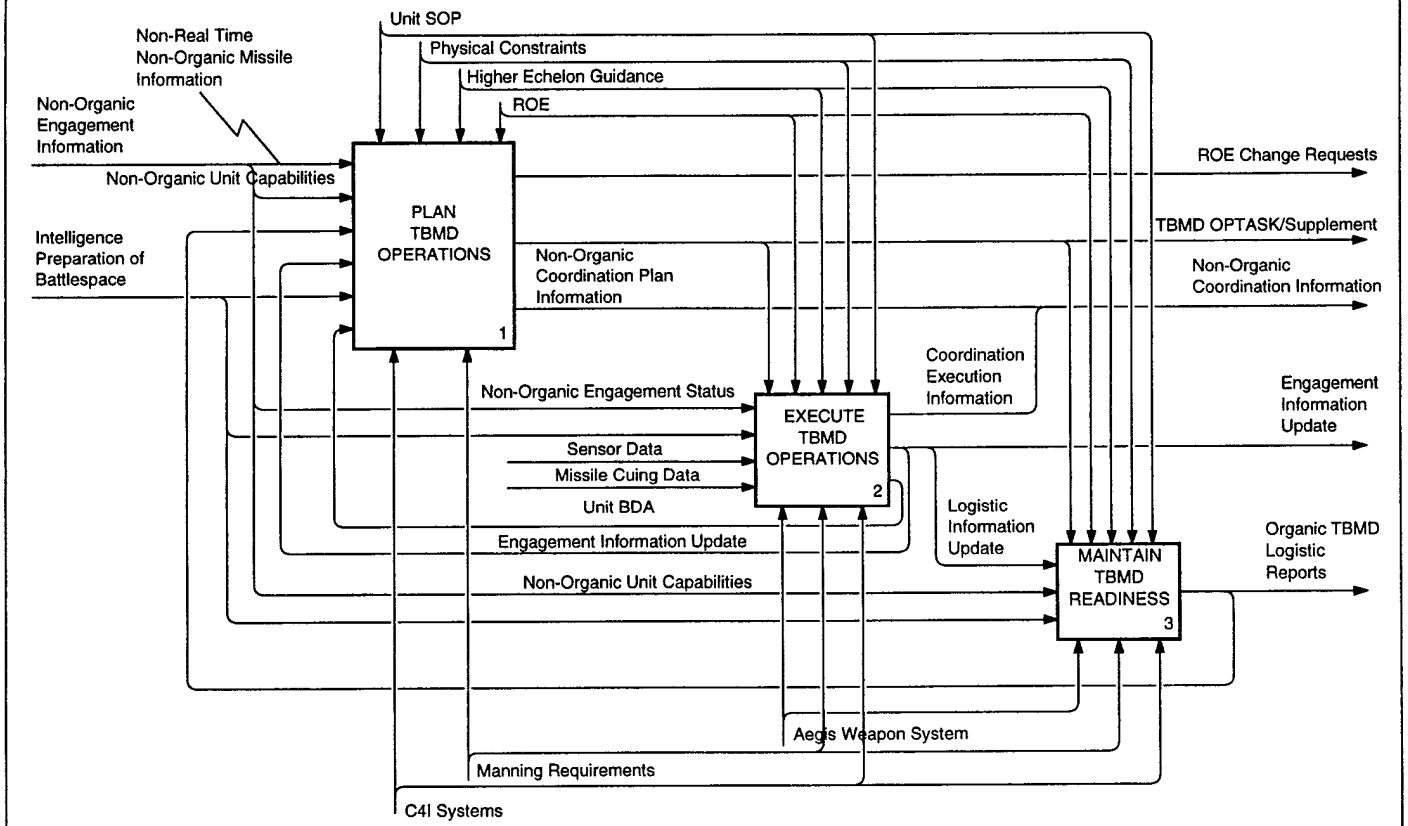

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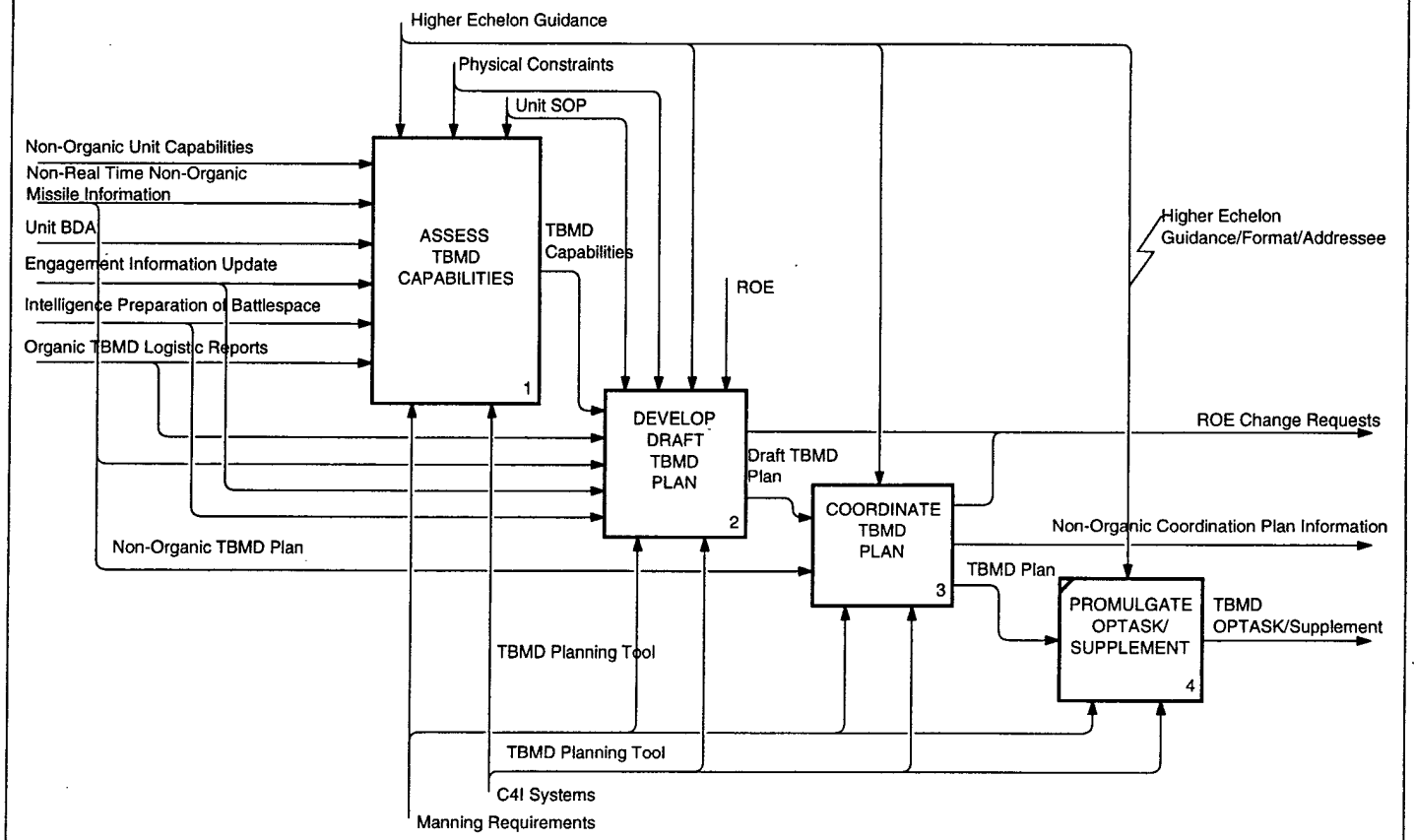

NODE: A1	TITLE: PLAN TBMD OPERATIONS	NUMBER:

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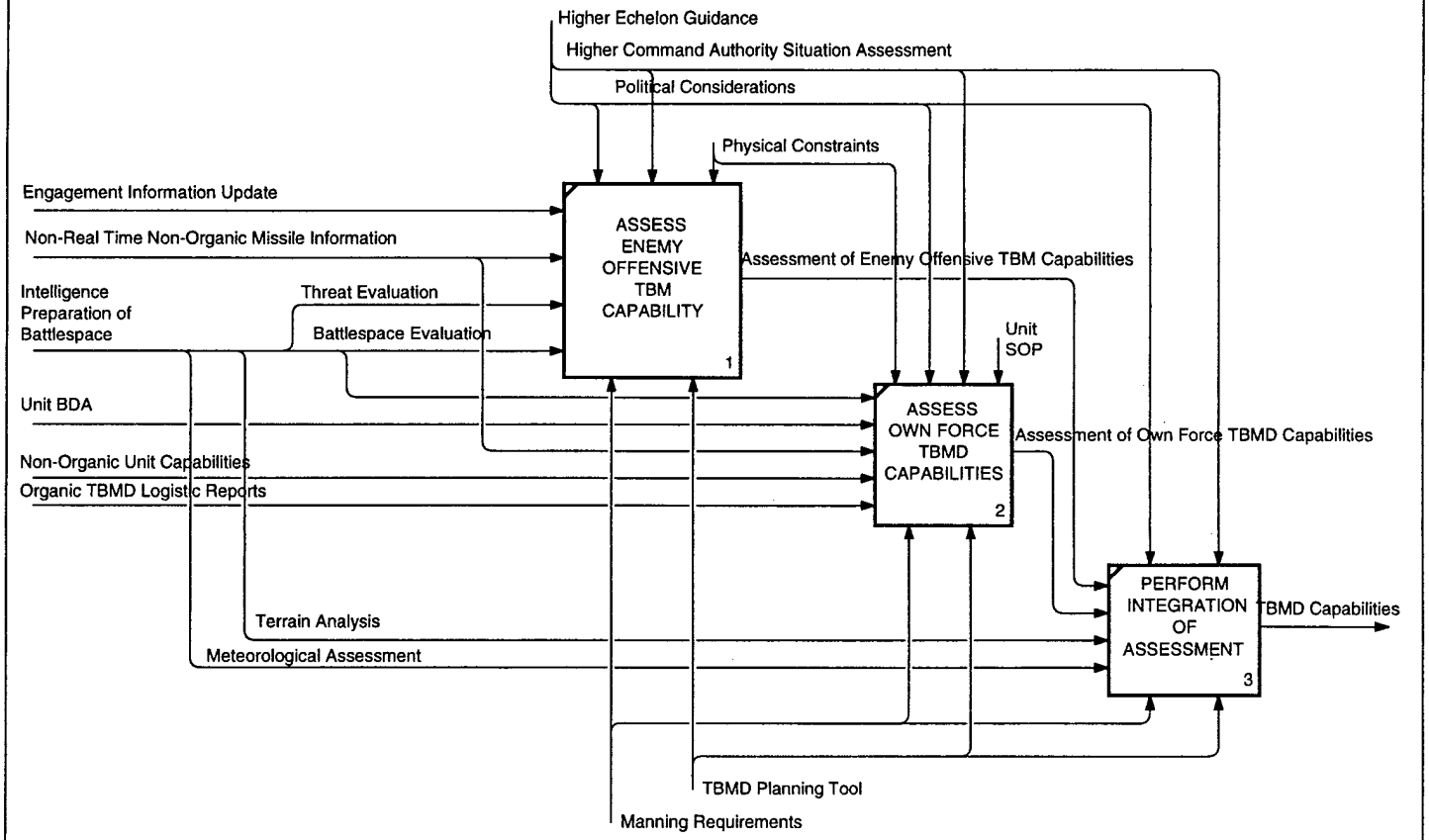

NODE: A11	TITLE: ASSESS TBMD CAPABILITIES	NUMBER:

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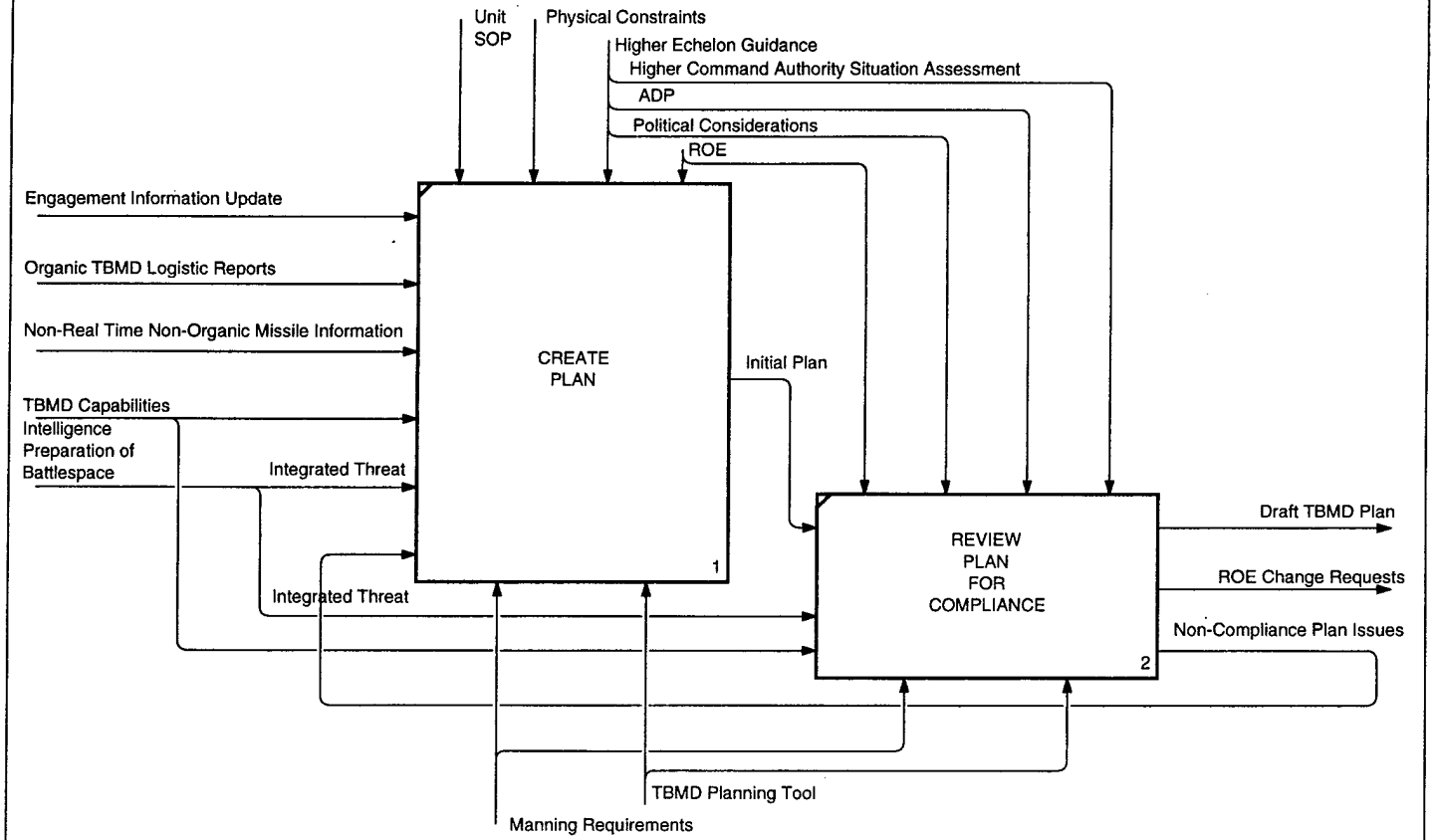

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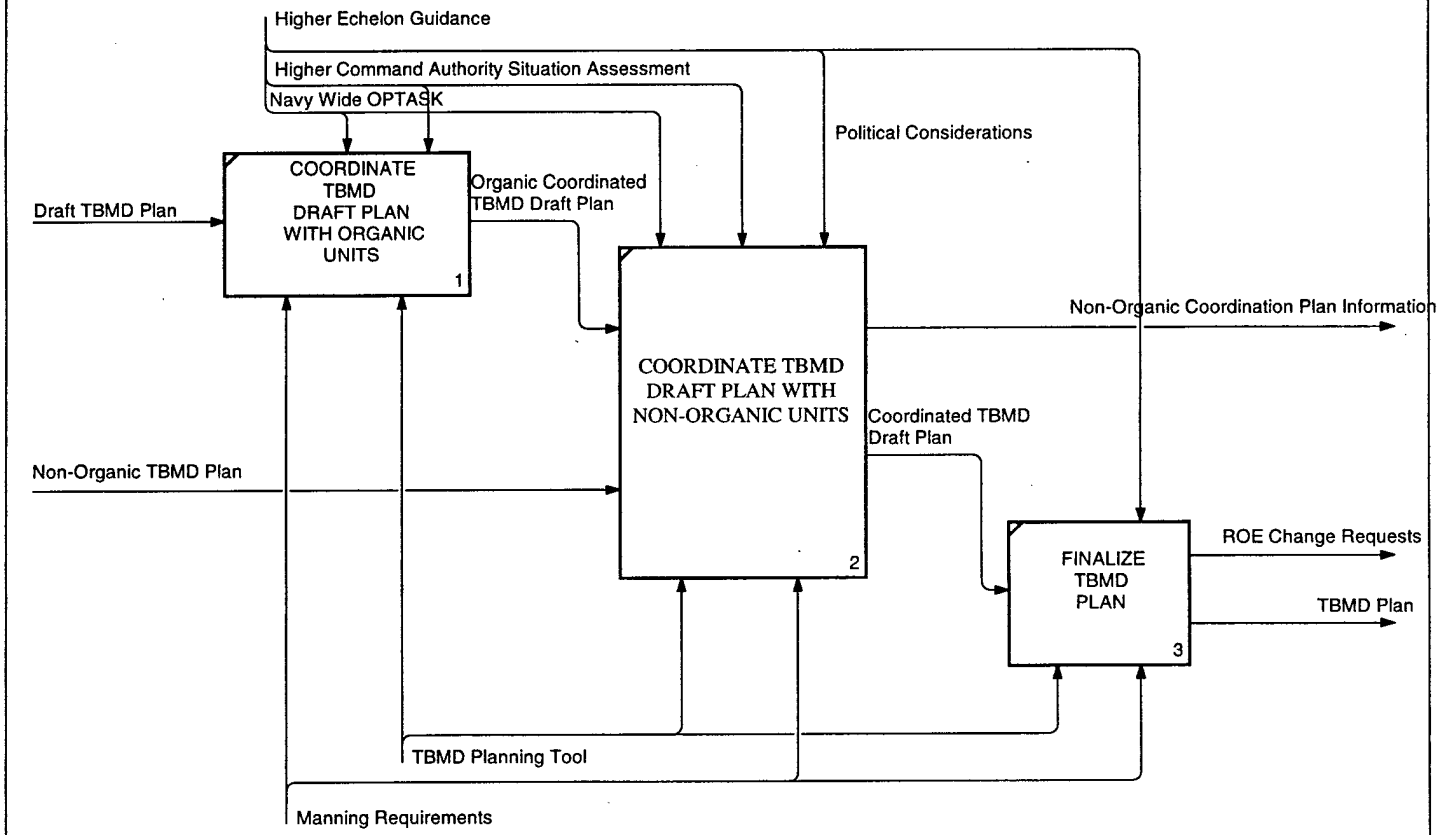

NODE: A13	TITLE: COORDINATE TBMD	NUMBER:

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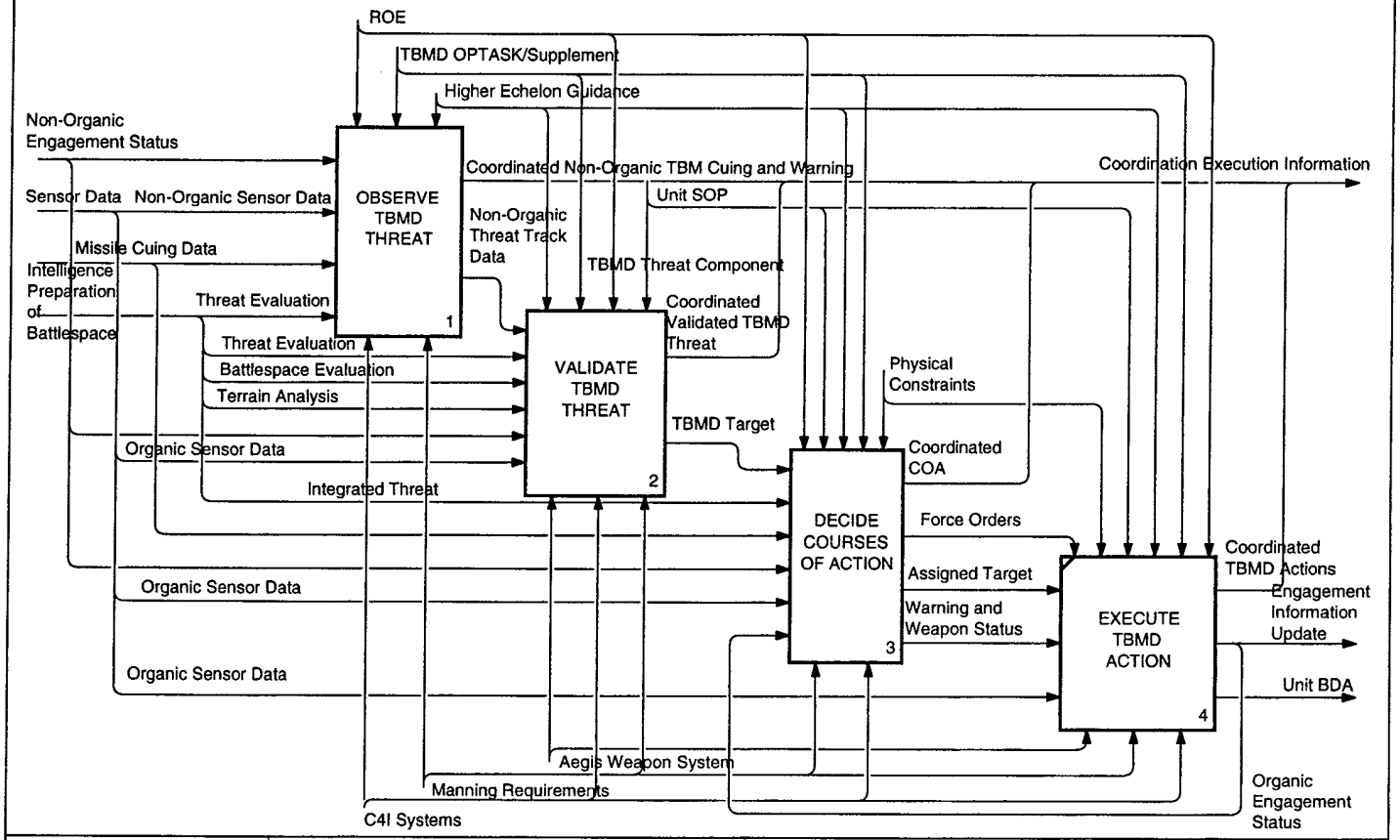

NODE: A2	TITLE: EXECUTE TBMD OPERATIONS	NUMBER:

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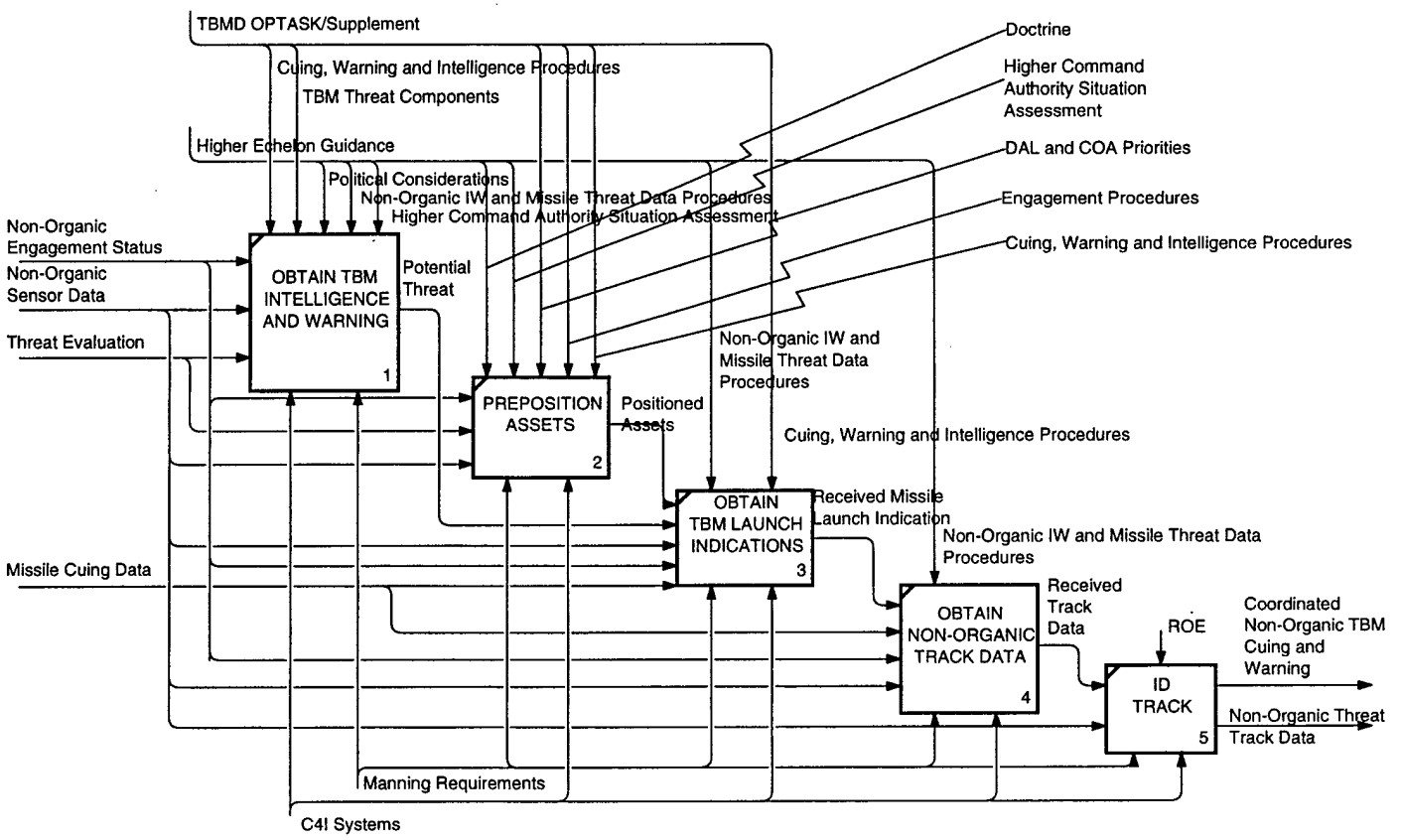

NODE: A21	TITLE: OBSERVE TBMD THREAT	NUMBER:

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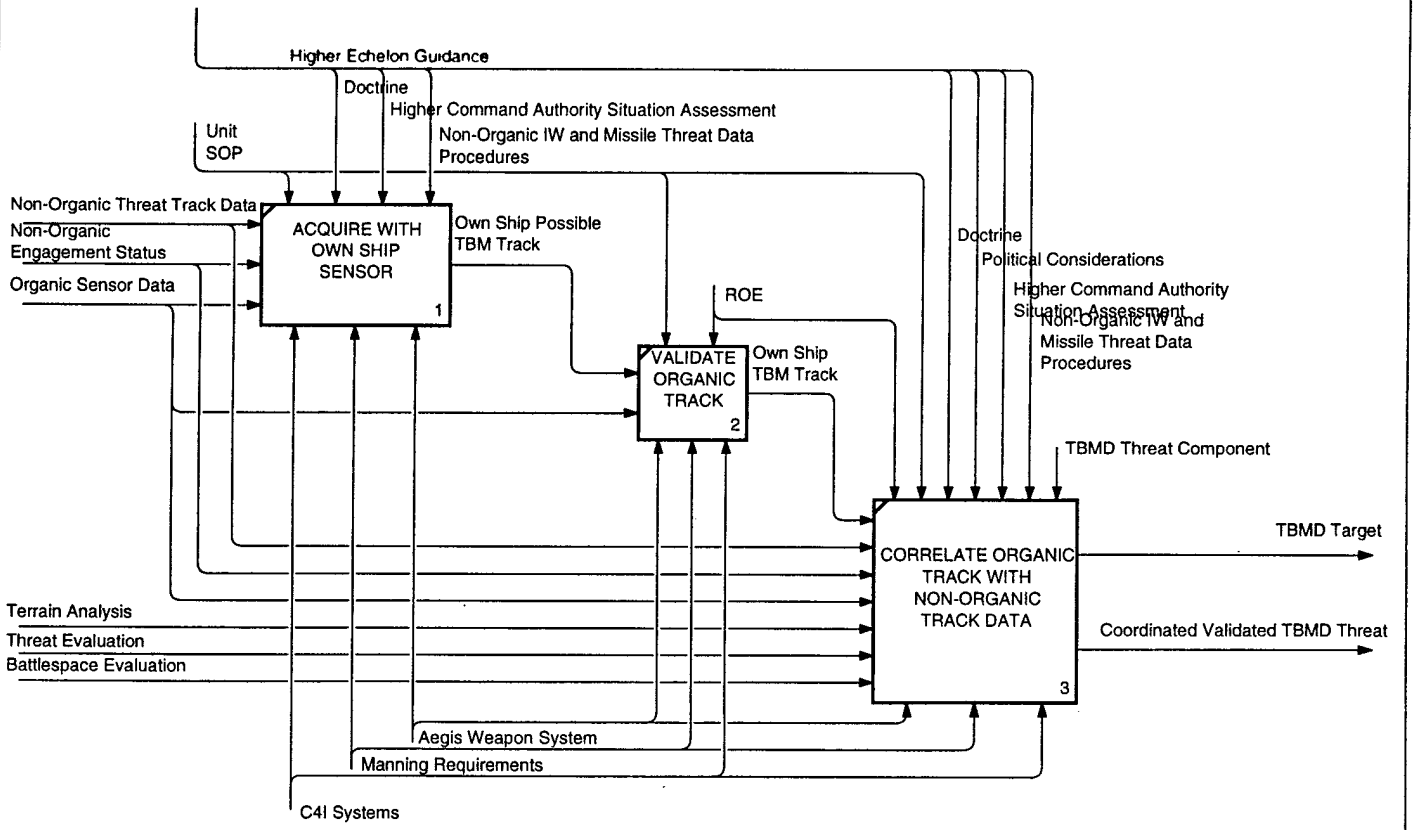

NODE: A22	TITLE: VALIDATE TBMD THREAT	NUMBER:

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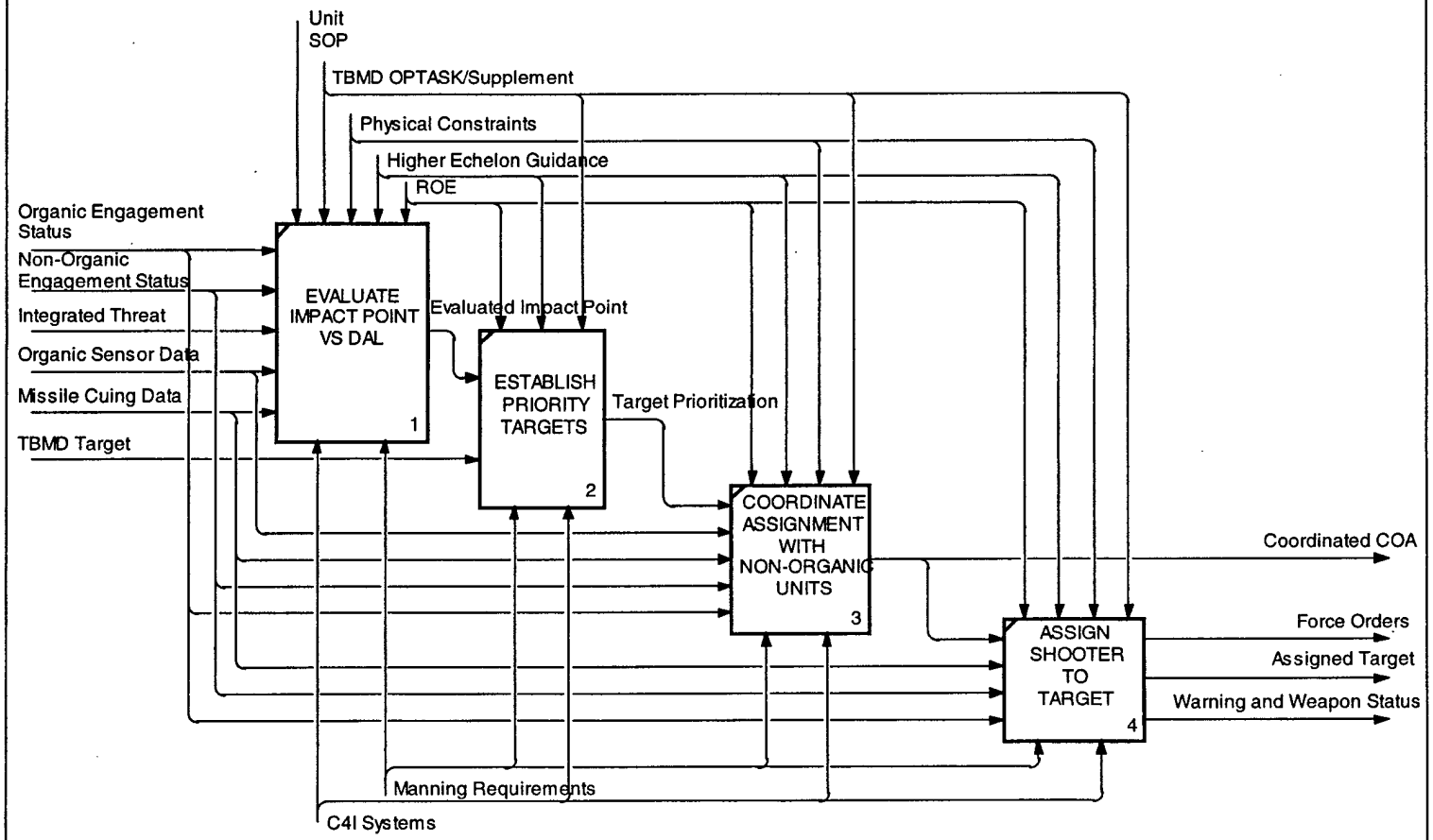

NODE: A23	TITLE: DECIDE COURSES OF ACTION	NUMBER:

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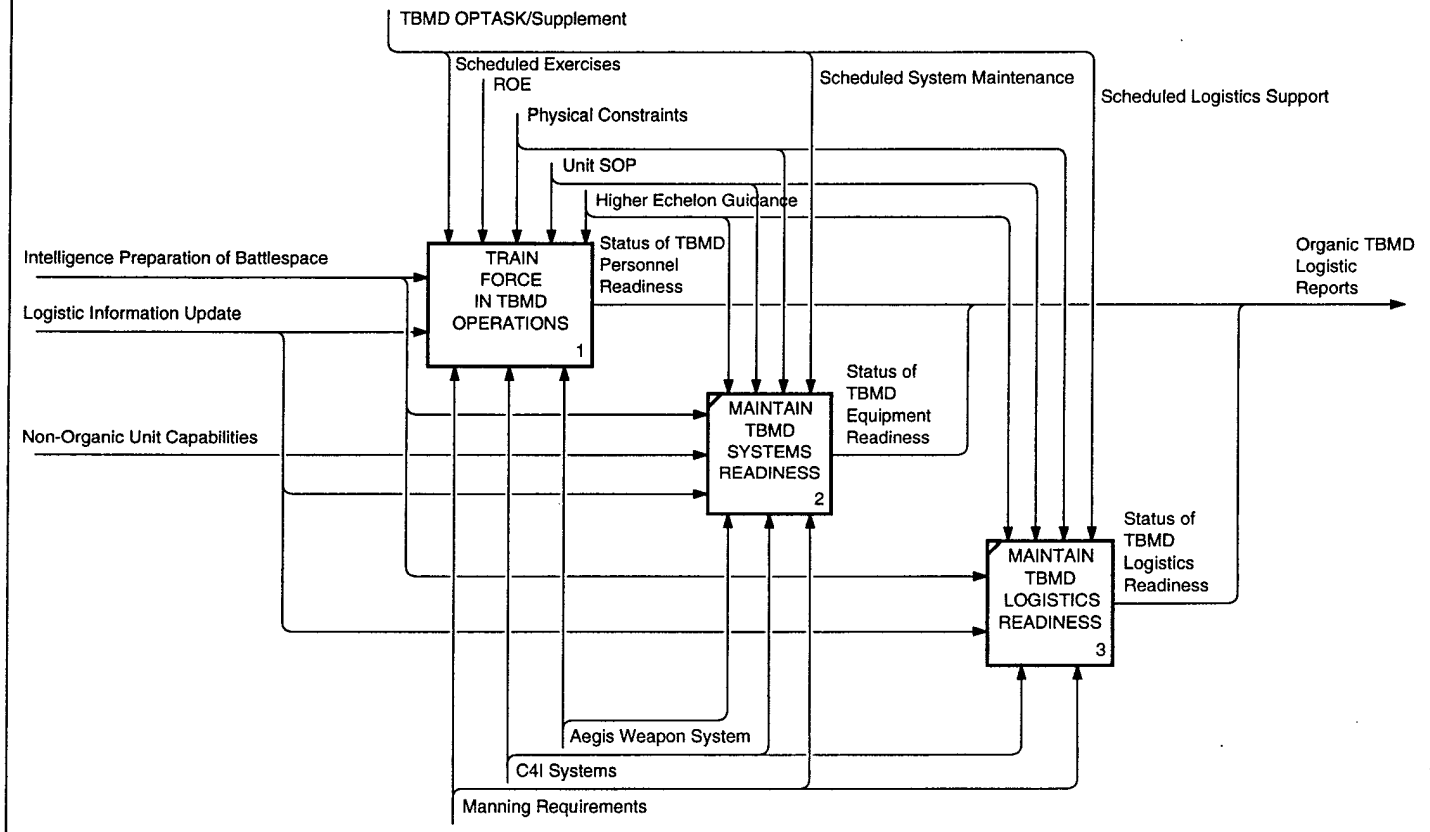

NODE: A3	TITLE: MAINTAIN TBMD READINESS	NUMBER:

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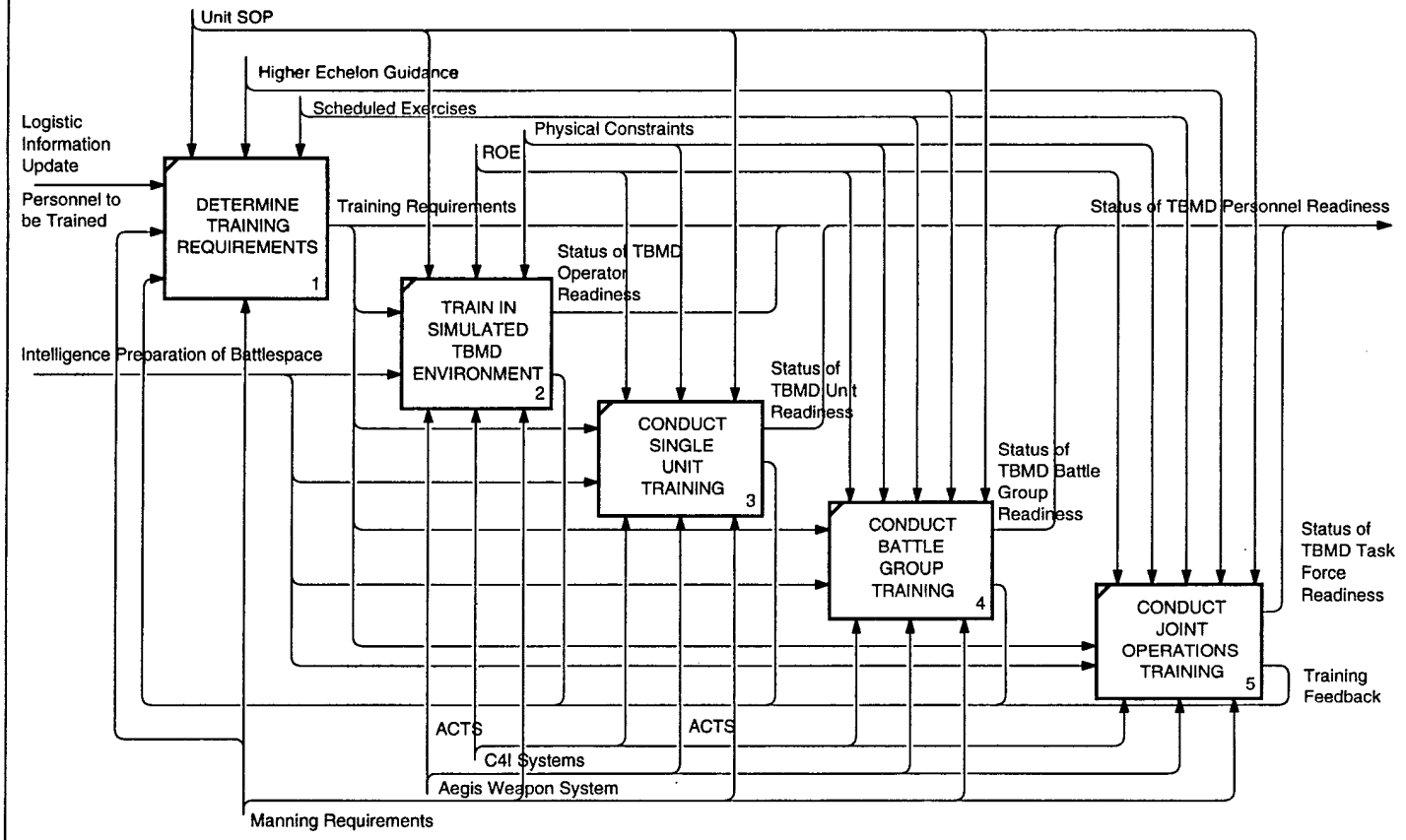

NODE: A31	TITLE: TRAIN FORCE IN TBMD OPERATIONS	NUMBER:

3. ICOM Definitions

a. AEGIS Combat Training System (ACTS)

The on-board trainer that is integrated into the AEGIS weapon system.

b. AIR DEFENSE PLAN (ADP)

The Air Defense Plan (ADP) is developed and modified by the Area Air Defense Commander (AADC). In a maritime environment these responsibilities will normally be assigned to the JFACC (Afloat) who may delegate responsibility to the AAWC and the CV Air Operations Officer. The ADP establishes area air defense responsibilities(AOR), airspace control procedures, provides as organization structure, sets alert requirements, and establishes Minimum Risk Routing (MRR).

c. AEGIS WEAPON SYSTEM

A totally integrated shipboard weapon system that combines computers, radars, and missiles to provide a defensive umbrella for surface shipping. The system is capable of automatically detecting, tracking, and destroying airborne, seaborne, and land-launched weapons [10].

d. ASSESSMENT OF ENEMY OFFENSIVE TBM CAPABILITIES

Assessment of enemy capability is an evaluation of the threat and the perceived threat's intentions for the day. The accuracy of the assessment is crucial to the overall performance of the mission and is based on the accuracy of intelligence information [11].

e. ASSESSMENT OF OWN FORCE TBMD CAPABILITIES

Assessment of friendly capability is an evaluation of own forces and how well they can perform against the threat's intentions. The accuracy of the assessment is crucial to the overall performance of the mission and is based on the accuracy of intelligence information [12].

f. ASSIGNED TARGET

An enemy theater ballistic missile (TBM) that has been assigned to an organic TBMD weapon system.

g. BATTLESPACE EVALUATION

Battlespace evaluation comes from Intelligence Preparation of the Battlespace (IPB), and defines the area of operations, and focuses intelligence assets on the battlespace [13].

h. C4I SYSTEMS

The facilities, equiptment, communications, procedures, and personnel essential to a commander for planning, directing, and controlling operations of assigned forces pursuant to the mission assigned.[14]

i. COORDINATED COA

The TBMD commander interacts with other warfare commanders, services, and allied units to coordinate all activities through the engagement phase. This information is the TBMD commander's planned course of actions. Coordinated COA is used to accomplish a mission. The coordinated COA is a product of the Joint Operation Planning and Execution System

development phase. The supported commander will recommend a course of action to the commander. The recommended course of action will include:

1. the concept of operations
2. evaluation of supportability estimates of supporting organizations
3. and an integrated time-phased data base of combat, combat support, and combat service support forces and sustainment.

When approved, the course of action becomes the basis for the development of an operation plan or operation order [15].

j. COORDINATED NON-ORGANIC TBM CUEING AND WARNING

This is TBM cueing and warning data detected by organic assets and relayed to non-organic assets.

k. COORDINATED TBMD ACTIONS

These are TBMD actions by organic assets during the execution of TMBD operations sent up and down the chain of command and to civilian authorities.

l. COORDINATED TBMD DRAFT PLAN

The coordinated TBMD Draft Plan is an initial plan of how the commander intends to carry out his mission that has been coordinated with the non-organic units.

m. COORDINATED VALIDATED TBMD THREAT

TBMD threats that have been validated by organic sensors.

n. COORDINATION EXECUTION INFORMATION

Execution information contains information concerning organic and non-organic assets and missile launches for the purpose of coordination. Short missile flight times require that available air-, land-, sea-, and space-based sensor/surveillance reports be integrated to provide a complete and current air and space picture. The coordination includes strike and attack operation assets.

o. CUEING, WARNING AND INTELLIGENCE PROCEDURES

Cues can come from space-based, airborne, or surface-based assets. When cues are to be provided from other than organic assets, special coordination may be required to ensure the cueing system and link provisions are in place. Generally (although scenario and TBM range dependent), the more rapid, accurate, and precise the cue, the shorter the time to acquire the target [16]. An enemy launch observed and identified through national, theater, or tactical surveillance systems triggers active defense and attack operations, along with initiating passive defense measures by military units and civilian authorities. TBM trajectory data are passed to surface- or air-based point (including self-protection) and area defensive systems. Depending on data quality, cueing of higher resolution sensor systems may be necessary to provide target engagement data immediately or to determine launcher locations. Enemy launch locations and other targeting information are passed simultaneously to appropriate units and commands with attack operations missions. Area systems, such as some surface-to-air missile systems or interceptors, provide defense in-depth by attacking TBMs at long ranges. Engaging missiles early in flight permits multiple engagements by the area and point defense systems and minimizes ground damage to friendly forces and infrastructure from missile and warhead debris. Active electronic countermeasures systems also can deceive TBM guidance systems late in flight [17].

p. DEFENDED ASSET LIST AND COURSE OF ACTION PRIORITIES

Defended Asset List (DAL) priorities and the Courses Of Action (COA) priorities are supplied by the Joint Staffs and require the defense of those DAL in the most efficient and effective manner. It is this phase of the Joint Operation Planning and Execution System within the crisis action planning process that provides for the development of military responses and includes (within the limits of the time allowed):

1. establishing force and sustainment requirements with actual units
2. evaluating force, logistic, and transportation feasibility
3. identifying and resolving resource shortfalls
4. recommending resource allocations
5. and producing a course of action via a commander's estimate that contains a concept of operations, employment concept, risk assessments, prioritized courses of action, and supporting data bases.

A course of action is developed on the best economic, diplomatic, political, and military judgment, designed to dissuade an adversary from a current course of action or operation.[18]

q. DOCTRINE

Fundamental principles by which the military forces or elements thereof guide their actions in support of national objectives. It is authoritative but requires judgment in application.[19]

r. DRAFT TBMD PLAN

The draft TBMD plan is an initial plan of how the TBMD Commander intends to carry out his mission.

s. ENGAGEMENT INFORMATION UPDATE

This engagement update is near real time information coming from the TBMD units. The update includes unit capabilities, weapon status, and engagement status, engagement assessments and BDA.

t. ENGAGEMENT PROCEDURES

Engagement procedures are descriptions of the employment of organic weapon systems in the most effective manner, for example, the employment of salvo fires (shoot-shoot-look-shoot).

u. EVALUATED IMPACT POINT

Determination from the impact point predictor of whether the impact point of a projectile, bomb, or re-entry vehicle falls into an organic asset's defended area.

v. FORCE ORDERS

The TBMDC and his force TAOs assess the tactical situation and execute command and control over TBMD forces to perform all aspects of the TBMD mission. This includes the required command, control, actions, and force orders for the force assets (F-14, F-18 and missile systems) to engage targets with hard kill weapons. Force orders are defined as one of the following [20]:

1. Weapons Free - Fire may be opened on any target(s) that has (have) not been identified as FRIEND.
2. Weapons Safe - Fire may be opened only in self defense or in response to a formal order.
3. Weapons Tight - Do not open fire unless target(s) has(have) been identified as HOSTILE.
4. Cease Fire -Discontinue firing; complete intercept if missile is in flight; continue to track.

5. Hold Fire - This order directs units to withhold or cease fire on the designated track.. Guidance for semiactive missiles which are already in flight should be discontinued. Hold Fire is an emergency order that temporarily terminates a particular engagement or restricts firing in a particular airspace. A Hold Fire order applies to a specific aircraft, missile unit, sector, altitude, or corridor.

Report of results of force orders execution is performed through secure radio reports between the AAWC and the BG Commander followed up with SITREP.

w. HIGHER COMMAND AUTHORITY SITUATION ASSESSMENT

This information transfer consists of the JFC's estimate of the situation, statement of objectives, and overall concept of operations. Based on the JFC's guidance and priorities, JTMD forces and resources are assigned [21].

x. HIGHER ECHELON GUIDANCE

This guidance is provided to the TBMD commander through the Integrated Battle Organization from the MAADC. The guidance provided by the Battle Group Commander (physically located on the carrier) is a result of an interactive coordinated efforts in the theater of operations. As the theater matures and becomes a sustained theater of operation less guidance is required. This guidance may be:

1. Warning Orders
2. Alert Orders
3. Operations Orders (OPORD).

This guidance follows a five section format that contains:

1. Situation
2. Mission Statement
3. Execution

4. Administrative
5. Command and Control information.

Also included are all applicable OPTASKS.

y. HIGHER ECHELON GUIDANCE/FORMAT/ADDRESSEE

Any information from higher authority promulgating the format and content of structured messages. (ATP-4, JP1, APP-4/ATP-1C/NWP 10-1012, NWP 10-1013(SUPPS 1-6, JOINT PUB 1-02)

z. INITIAL PLAN

This is the TBMD Commander's initial plan that is checked for compliance with outside directives/orders.

aa. INTEGRATED THREAT

Threat integration comes from Intelligence Preparation of the Battlespace(IPB) and ties battlespace evaluation, terrain analysis, meteorological assessment, and threat evaluation steps together to give the commander a multi-dimensional view of the battlespace [22].

bb. INTELLIGENCE PREPARATION OF BATTLESPACE (IPB)

This intellegence information is used to reduce uncertainties concerning the enemy, environment, and terrain for all types of operations. Intelligence preparation of the battlespace builds an extensive data base for each potential area in which a unit may be required to operate. The data base is then analyzed in detail to determine the impact of the enemy, environment, and terrain on

operations and presents it in graphic form. Intelligence preparation of the battlespace is a continuing process [23].

Analysis and target development of tactical missile (TM) threats should begin during peacetime. Intelligence Preparation of the Battlespace drives the development of a collection plan, which in turn identifies:

1. sensor types
2. collection windows
3. areas of coverage.

Development and refinement of a data base on threat TM capability(both indigenous and imported) must be a continuous process. IPB products are used to evaluate enemy capabilities, vulnerabilities, and probable courses of action. This process:

1. assists in situation/target development by showing commanders when/where they can most effectively engage the enemy
2. contributes significantly to the process of area limitation analysis
3. and ultimately to automated cueing of TMD sensors and weapon systems to threatening targets.

IPB includes updating TM data bases to maintain and provide near-real-time status of selected enemy TM-related capabilities (e.g., orders of battle, operating bases; type, range, and employment techniques of available missiles and/or warheads; missile launch, load, hide, and support sites; potential routes; intelligence and electronic warfare (IEW) systems; C2 nodes, and enemy defenses) [24].

The Joint Staff and CINC staffs should address the following objectives when preparing an IPB for a given region [25]:

1. Location of missile manufacturing and assembly plants
2. Locations of fixed missile launch facilities
3. Locations of missile storage facilities
4. Locations of missile fuel storage facilities

5. Identification and locations of missile firing units
6. Number of mobile launch systems
7. Numbers and types of ballistic missiles
8. Numbers and types of missile warheads (e.g., WMDs)
9. Numbers and types of cruise missiles
10. Capabilities of missile/warhead combinations
11. Delivery systems available for cruise missiles
12. Ballistic and cruise missile doctrine
13. Detailed analysis of enemy TM doctrine and terrain
14. Anticipated enemy courses of actions (COA)
15. Approaches that can be used to develop appropriate responses to enemy COA

cc. LOGISTIC INFORMATION UPDATE

This is any information that is applicable to logistics such as casualty reports and number of weapons fired.

dd. MANNING REQUIREMENTS

The level to which a given unit is manned as defined by the Bureau of Naval Personnel.

ee. METEOROLOGICAL ASSESSMENT

This information includes meteorological facts pertaining to the atmosphere, such as wind, temperature, air density, and other phenomena which affect military operations [26].

ff. MISSILE CUING DATA

Information provided to the TBMD Commander concerning launch warnings, launch point and time determination, kinematics, threat type determination, impact point and time prediction, weapons cuing, and communications, etc. [27] Comes from multiple sources including space based components, special operation forces, USSPACECOM and airborne assets.

gg. NAVY WIDE OPTASK

This information transfer contains: tactical situation, schedule of events, threat information, ROE, friendly/neutral/hostile air characteristics, minimum risk route information, TBMD capabilities, connectivity, surveillance loading, own force capabilities, performance assessment, joining/departing units, unit readiness, and impact of other warfare operations [28].

hh. NON-COMPLIANCE PLAN ISSUES

Issues that arise by assessing the initial plan for compliance with ROE, political considerations, ADP and higher command authority situation assessment.

ii. NON-ORGANIC COORDINATION INFORMATION

Close coordination among component commanders, the JFC, and the AADC (if designated) is necessary to employ the most appropriate resources and measures to execute JTMD operations and to ensure a synergistic effort. Component-to-component coordination may also be required in some situations as a result of the compressed timelines and short reaction times inherent in JTMD operations. Coordination among component commanders for JTMD operations usually includes:

1. Components' concepts of operations and assigned missions for JTMD operations.
2. Requests for employment of JFC and supporting CINC sensors.
3. Targeting and target deconfliction for both attack and active defense operations.
4. Intelligence, surveillance, and reconnaissance operations and capabilities.
5. Employment and placement of air and airspace control measures and procedures, naval and amphibious control measures, and fire support coordinating measures.
6. Joint suppression of enemy air defenses (J-SEAD).
7. Area air defense operations.
8. Special operations.
9. C4I.
10. Command and control warfare (C2W).

11. EW operations and capabilities.
12. Passive defense measures, including deception operations.
13. C4I protection operations. [29]

jj. NON-ORGANIC COORDINATION PLAN INFORMATION

This information transfer contains preplanned non-real time information that deals with responses, stationing, engagement, and reporting for the purpose of coordination with non-organic assets.

kk. NON-ORGANIC ENGAGEMENT INFORMATION

Non-organic near real time missile information comes from non-organic units relative to TBMD assets such as location, material status, manning, and logistics.

ll. NON-ORGANIC ENGAGEMENT STATUS

This is near real time data that provides tactical data such as weapon status, engagement states, engagement assessment, etc. from the non-organic units.

mm. NON-ORGANIC I&W AND MISSILE THREAT DATA PROCEDURES

From higher echelon authority we receive additional intelligence, warning and missile threat data.

nn. NON-ORGANIC SENSOR DATA

Non-organic sensor data is a representation of facts, concepts, or instructions about sensors in a formalized manner suitable for communication, interpretation, or processing by humans or by automatic means [30].

oo. NON-ORGANIC TBMD PLAN

This communication contains the non-organic Commanders TBMD plan for the purpose of coordination.

pp. NON-ORGANIC THREAT TRACK DATA

Confirmed or possible ballistic missile track data comes from non-organic assets. Once track data has been detected and acquired, it is evaluated and identified as a friend, foe or unknown. For the "unknown contacts, i.e., non-cooperative target recognition compliant" information such as altitude, speed, flight pattern are correlated with friendly flight plans, friendly flight corridors, commercial air routes, MRR procedures, and any other information available for positive identification. Should all of these methods fail to produce positive identification, the track is designated as unknown. Effective measures designed to provide timely identification include positive radar control, visual control, flight plans, IFF, and air corridors. A detailed discussion of these measures is found in NWP 32.

qq. NON-ORGANIC UNIT CAPABILITIES

Non-organic engagement status, weapon system, sensor parameters, and capability information comes from non-organic assets to the TBMD Commander. This consists of near real time data

from a non-organic asset that provides tactical data such as the weapon status, engagement status, engagement assessment, etc.

rr. NON-REAL TIME NON-ORGANIC MISSILE INFORMATION

This information is relative to TBMD non-organic assets such as:

1. location
2. type of platform
3. material status
4. manning status
5. logistic status.

ss. ORGANIC COORDINATED TBMD DRAFT PLAN

This communication contains the TBMD Draft Plan that has been coordinated with other TBMD organic assets.

tt. ORGANIC ENGAGEMENT STATUS

This communication contains information concerning the status of organic assets' engagements with TBMD targets.

uu. ORGANIC SENSOR DATA

Sensor data provided by organic assets is a representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by humans or by automatic means [31].

vv. ORGANIC TBMD LOGISTIC REPORTS

The report is directed to the BGC, CJTF and CINC. The report includes weapons inventory, fuel status, equipment causality reports, personnel status, etc.

ww. OWN SHIP POSSIBLE TBM TRACK

This information will normally be transfered within a piece of equipment. It is the initial detection of a track by the organic system's radars, before it becomes a confirmed track.

xx. OWN SHIP TBM TRACK

Data received from organic assets about a TBM track, such as type, kinematics, position, velocity, and acceleration, disseminated to organic assets and non-organic units.

yy. PERSONNEL TO BE TRAINED

Those individuals required in either a military or civilian capacity to accomplish the assigned mission. This consists of requirements for personnel to enhance their capacity to perform TBMD functions and tasks.

zz. PHYSICAL CONSTRAINTS

All known physical factors affecting military operations, including time, space, weather and terrain.

ab. POLITICAL CONSIDERATIONS

The information from higher authority on:

1. whether the contemplated course of action is worth the cost in manpower, material, and time involved
2. is consistent with the law of war
3. and militarily and politically supportable [32].

ac. POSITIONED ASSETS

From the TBMD Commander, to organic assets directing those assets' positions to provide the most effective response to the TBMD threat.

ad. POTENTIAL THREAT

From multiple sources to the TBMD Commander, defining the existing TBMD threats.

ae. RECEIVED MISSILE LAUNCH INDICATION

From multiple organic or non-organic sources to the TBM Commander giving the early notification of a hostile ballistic missile launch.

af. RECEIVED TRACK DATA

Data received from non-organic sources about a TBM track such as type, and kinematics, in position, velocity, and acceleration.

ag. RULES OF ENGAGEMENT

Rules of Engagement (ROE) are directives issued by competent military authorities which delineate the circumstances and limitations under which United States forces will initiate and/or

continue combat engagement with other forces. ROE should be delineated, published, and disseminated to and exercised by alliance members for compliance and as a planning consideration for future operations. Any national ROE that differs from the multinational ROE should be identified, published, and understood by all national commands.[33]

ah. ROE CHANGE REQUESTS

Request changes to the ROE from the TBMD Commander to the BGC, DJTF and CINC.

ai. SCHEDULED EXERCISES

A military maneuver or simulated wartime operation involving planning, preparation, and execution. It is carried out for the purpose of training and evaluation. It may be a combined, joint, or single-service exercise, depending on participating organizations [34].

aj. SCHEDULED LOGISTICS SUPPORT

A scheduled composite of all the support considerations necessary to assure the effective and economical support of all TBMD assets. It is an integral part of all other aspects of system acquisition and operation such as refueling, rearming, spare parts and food replenishment [35].

ak. SCHEDULED SYSTEM MAINTENANCE

Periodic prescribed inspection and/or servicing of TBMD related equipment accomplished on a calendar, mileage, or hours of operation basis. Also included is scheduled system down time to perform this maintenance. The maintenance schedule must be coordinated with operations staff to insure TBMD coverage.

al. SENSOR DATA

Any sensor data from organic or non-organic units used by the TBMD Commander to accomplish his mission.

am. STATUS OF TBMD BATTLE GROUP READINESS

The capability of a battle group to perform the missions or functions for which it is organized or designed.

an. STATUS OF TBMD EQUIPMENT READINESS

The status about which equipment and systems are capable of performing the missions or functions for which they were organized or designed.

ao. STATUS OF TBMD LOGISTICS READINESS

The status of TBMD logistic readiness from assets. This includes the ability to deliver the outputs for which they were designed which includes the ability to deploy and employ without unacceptable delays. Key among the many factors that should be considered when developing sustainment plans for JTMD operations are:

1. deployment of the weapons to their area of employment
2. resupply of ammunition
3. repair parts
4. supporting equipment
5. fuel
6. supporting personnel.

US doctrine requires services to provide their own logistic support; however, the CINCs are authorized to exercise directive authority over logistic and transportation priorities based on

transportation capacity, transportation requirements, and urgency of need. Transportation assets can be more efficiently used and transportation requirements more readily met through early assessment of the theater's logistic requirements. Early planning will permit the CINCs to fully exploit more efficient, but slower, sealift assets. Ground-based TMD systems can also be transported by air into a theater, but this places an additional burden on the US airlift capacity. CINCs must balance the increased risk of imminent TM attack with the cost associated with diverting airlift assets for the deployment of JTMD forces. If CINCs alter the TPFDL to meet TMD requirements, they must assess the cost of doing so in terms of the effects this will have on overall theater logistic operations.

ap. STATUS OF TBMD OPERATOR READINESS

The capability of operators to perform the missions or functions for which they are trained.

aq. STATUS OF TBMD PERSONNEL READINESS

The communication defines the status of the qualified personnel required to accomplish assigned missions.

ar. STATUS OF TBMD TASK FORCE READINESS

The capability of a task force to perform the missions or functions for which it is trained.

as. STATUS OF TBMD UNIT READINESS

The capability of an unit to perform the missions or functions for which it is trained.

at. TARGET PRIORITIZATION

A prioritized list of targets relative to organic assets. The list may have high priority for more than one shooter if the impact point is within their AOR. The list may have very low priority for all organic assets if the impact point is outside organic assets' area of responsibility (AOR).

au. TBM THREAT COMPONENTS

The TBMD Commander defines the parameters to be evaluated to determine which contact is a TBMD threat.

av. TBMD CAPABILITIES

This signal contains an assessment of the capabilities of all assets organic and non-organic to perform the TBMD mission.

aw. TBMD OPTASK/SUPPLEMENT

This report generated by the TBMD Commander relates to the force required to accomplish the overall TBMD plan. The OPTASK TBMD Supplement specifies:

1. the procedures
2. the predetermined responses
3. the assets management for the AAW mission, to the AADC for inclusion as an annex to the Air Warfare Plan.

COMSECONDFLT, COMTHIRDFLT, COMSIXTHFLT, and COMSEVENTHFLT promulgate the Navy-wide OPTASK TBMD that is the standing OPTASK message. Prior to deployment the AAWC/CVBG releases a supplement to the OPTASK specific for the Battle Group tailored to the available assets and mission. As the physical location of the Battle Group changes,

supplements are revised as necessary. The OPTASK TBMD Supplement may be further modified by the Daily Intentions Message [36].

ax. TBMD PLAN

This plan is the unformatted TBMD OPTASK/Supplement.

ay. TBMD PLANNING TOOL

This is a software tool that enables the TBMD Commander to pool information from various sources that provides any applicable TBMD data such as tactical data bases, enemy orders of battle, etc. This software will support the development of the draft TBMD plan and any necessary supporting briefings.

az. TBMD TARGET

TBMD target is a target that has been validated by organic sensors and ID.

ba. TBMD THREAT COMPONENT

The distinguishing characteristics of a ballistic missile that make it an identifiable target (i.e., velocity and altitude).

bc. TERRAIN ANALYSIS

The collection, analysis, evaluation, and interpretation of geographic information on the natural and manmade features of the terrain to predict the effect of the terrain on military operations [1]. Terrain analysis evaluates the effects of geography, terrain, and bathymetry on friendly/adversary capabilities to maneuver, attack, employ sensors, and communicate [37].

bd. THREAT EVALUATION

Threat evaluation data encompasses a detailed study of the threat and a predictive analysis of probable adversary courses of action and friendly force survivability for each case [38].

be. TRAINING FEEDBACK

The feedback to training provides the lessons learned from training with possible recommendations.

bf. TRAINING REQUIREMENTS

Training requirements are obtained from personnel aptitudes, needs, readiness criteria and plans. Shore-based training activities support at-sea training in engagement of threats. The training objective is to develop skills and teamwork among organic and non-organic assets. Enroute to the objective area, training exercises complement pre-sail training of organic assets.

bg. UNIT BDA

Battle damage assessment is the timely and accurate estimate of damage resulting from the application of military force, either lethal or non-lethal, against a predetermined objective. Battle damage assessment can be applied to the employment of all types of weapon systems (air, ground, naval, and special forces weapon systems) throughout the range of military operations. Battle damage assessment is composed of physical damage assessment, functional damage assessment, and target system assessment [39].

bh. UNIT SOP

The Standing Operating Procedure (SOP) is a set of instructions established by a tactical unit covering those operations which lend themselves to a standardized process without loss of effectiveness. This SOP is applicable unless otherwise ordered.

bi. WARNING AND WEAPON STATUS

The warning (white, yellow, red) and weapon status (tight, free, safe) establishes the readiness level of the battle group [4]. The OTC/CWC and the AAWC selects the appropriate defensive posture based on the warning and weapons status. The defensive posture requires positioning of force and the desired warning and weapons status.

IV. SUMMARY AND CONCLUSIONS

A. SUMMARY

"Today, the nation's existing TBM defense capability rests with the PATRIOT system and its evolving improvements."[40] In the numerous exciting reports of ongoing TBMD development, it is easy for the seagoing operator to become deceived by the whirl of programs and budgets, COEA studies, R&D pilot ventures, operational test and evaluation, battlegroup workups, "future studies," and wargaming simulation. Thick briefing books and lengthy slide presentations show a plethora of systems in advanced stages of development, either being tested or awaiting further funding. There is, however, only one Active Defense weapon ready to go to war now, and that is PATRIOT (MIM-104).

If funding levels remain constant over the next several years the Navy Area Defense (NAD) will put to sea at the turn of the century. NAD is one of the Ballistic Missile Defense Organization's core systems, and thus (along with PATRIOT PAC-3 and THAAD) has a great deal of developmental and bureaucratic momentum. The SM2 Block IVA is the latest version in a series of surface-to-air missiles that will give the AEGIS system the capability to engage conventional AAW targets as well as TBMs. The increased capability of the SM2 Block IVA, combined with the software changes enhancing the SPY-1 radar, give NAD a much larger defended area than PATRIOT PAC-3, thus developing an intermediate step in the DOD's multi-tiered approach to TBMD. The development of the NAD architecture will further assist in the development of the next tier of naval ballistic missile defense for Navy Theater Wide (NTW) Defense.

B. CONCLUSIONS

If a regional contingency involving a TBM-armed , Weapon of Mass Destruction (WMD) capable adversary were to erupt tomorrow there is currently one active defense system that could be employed to defend against potential attack, the PATRIOT MIM-104. However, potential enemies have the ability to create a weapon that can outperform the PATRIOT, thus prompting the creation of advanced systems such as:

1. Navy Area Defense (NAD)
2. Navy Theater Wide Defense (NTW)
3. Theater High Altitude Air Defense (THAAD)
4. PAC-3 Extended Range Interceptor (ERINT).

The Navy's new systems are being developed from existing technologies and platforms, and the funding has already been allocated for those follow-on systems. In order for the Navy to achieve its goal of fielding the Navy Area Defense (NAD) system, changes have to be made to current equipment, operational tactics, and planning. Steps must be taken to ensure an effective migration of the "as is" systems and tactics to the "to be" versions. After comparing the physical architectures and the information architectures, in addition to interviews with current AAW subject matter experts, it became evident that there are areas of potential problems with the transition. Many solutions to these problems are included in a current system upgrade/improvements and in the development of a new system. Some of these solutions may be wishful thinking due to budget contrainsts. This thesis has explored all of the potential problems and solutions. They are broken down into three main categories: equipment, operations, and planning/training.

1. Equipment

a. In accordance with the Navy Wide OPTASK TBMD the Aegis ships need the ability to shift from TBMD search mode to area air defense mode, and vice versa, in a timely manner. When stationing Aegis platforms employing NTDCP in a TBMD role, a second air defense capable ship should be placed in a shotgun position to provide for area air defense.

b. Scheduled maintenance must be accomplished on the Aegis Weapon System. Much of this scheduled maintenance requires system shutdown, therefore a schedule must be developed that allows for system maintenance while maintaining coverage of the defended area. System developers must be sensitive to the constraints that maintenance imposes on mission performance.

c. The ability to re-arm Vertical Launch Systems at-sea in severe environmental conditions is a desirable feature to provide operational flexibility and sustainability. Also, rapid adjustment to a dynamic threat environment is a valuable operational attribute. An example is a surface ship outloaded for patrol with the most likely needed missile and payload mix for its mission. However, a changing threat or new mission requirements could require a change of missile and payload mix, and a capability for at-sea reconfiguration or changeout is needed.

The essentials of the problem are that no shipboard mechanisms exist today capable of replenishing either Tomahawk missiles or the SM-2 Block IV and Block IVA missiles (under development) aboard AEGIS ships (CGs and DDGs) under at-sea forward-deployed conditions. Any current shipboard mechanisms which do perform a missile replenishment function can do so only in gentle sea conditions (< sea state 3) and in temperate climates. Further, any future Tomahawk or SM-2 Block IV missile replenishment operation can receive no assistance from the

existing crane system on board AEGIS ships because the weight of either missile in its canister exceeds the crane's loading capacity.

Unless a new underway replenishment system is provided, such replenishments will require that the ship go to a friendly port which has the appropriate crane systems to handle such weapons safely. The retirement of all AD36 and AD41 class destroyer tenders by the end of 1996 removes the only other existing option for such replenishment.[41]

2. Operations

a. When is a track considered "Hostile" for the purposes of identification and weapons release?

b. How will the TBMD commander decide which TBMD asset will fire at the incoming threat?

c. What is the most efficient way to assign assets to targets?

d. Does the individual asset commander decide whether to shoot or not?

e. What role does the Defended Asset List play in the assignment of priorities to an inbound threat?

f. Because of the probable firing doctrine (i.e., shoot-shoot-look-shoot) many engagement assets could potentially be wasted due to redundant assignments.

g. There is a need for development of new data link symbology for TBMD. There is currently a symbol for a TBM, but is there going to be a symbol for an unknown assumed hostile ballistic missile? Will the symbology change between the different states?

h. An accurate display of the predicted impact point and the surrounding area of uncertainty will be vital in the weapons release decision. As demonstrated in the Roving Sands

95 exercise, if all available TBMD assets engage an incoming target there is a high probability of kill. However, the amount of TBMD weapons expended would not allow for a sustained presence without immediate rearming. Assigning a single TBMD asset a geographical area to defend conserved the number of weapons used in the engagements, but allowed many of the incoming weapons to reach their targets. A combination of the two must be used to defend the friendly assets effectively as well as conserve TBMD weapons for sustained operations.

One method of accomplishing this goal is to prioritize the items on the defended assets list and assign more than one TBMD asset to each item. The prioritization will determine if more than one TBMD asset will engage a single incoming threat. For example, if the defended asset was a nuclear power plant all of the TBMD assets would engage the incoming missile if possible. If the item on the DAL is not a high priority then fewer numbers of TBMD assets would engage the TBMs. This prioritization would allow for the most efficient and effective protection possible.

3. Planning/Training

a. What are the criteria for kill assessment and the requirement for launch of backup engagement assets?

b. We need the ability to link with civilian air control agencies, starting with our own FAA.

c. We need additional training in joint capabilities and limitations.

d. New Aegis Combat Training System(ACTS) scenarios must be developed to train watch sections for this new mission. The scenarios should also be used to test newly developed

tactics for enhanced protection of assets assigned to the TBMD commander in addition to those placed under his protection on the Defended Asset List (DAL).

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APPENDIX

The following definitions describe the IDEF Model for "perform AAW." This model was completed by NRaD, Code 4121 for the Ballistic Missile Defense Organization. The functions described in the following definitions and IDEF0 diagrams were used as the "as is" or baseline model for the creation of the "perform TBMD operations" model. The concepts described in Chapter IV were derived by examining both models simultaneously and analyzing the differences.

Definitions

Activity Name: Assess Battle Damage & Kill

Activity Definition: The AAWC and the force TAO assess the battle damage to own forces and kill results of engagements of enemy air platforms and missiles. The battle damage and kill assessment report is relayed to the Battle Group Commander through secure radio via the Situational Report. This information is also used to maintain the tactical situational awareness, to assess friendly/enemy expectation of capability and to develop the AAW Plan.

Activity Number: 214

Activity Name: Assess Friendly/Enemy Expectation of Capability

Activity Definition: Assessment of enemy expectation of capability is an evaluation of the threat and the perceived threat's intentions of the day. Assessment of friendly capability is an evaluation of own forces and how well they can perform against the threat's intentions. The accuracy of the assessment is crucial to the overall performance of the AAW mission and is based on the accuracy of intelligence and other information. Assessment includes friendly and

enemy order of battle, demonstrated proficiency, training level, pattern of operation, and indicators and warnings.

Activity Number: 11

Activity Name: Coordinate/ Control Assets & Report Results

Activity Definition: The AAWC and the force TAO assess the tactical situational and executes command and control over AAW forces to perform all aspects of the AAW mission. This includes the required command and control actions and force orders for the force assets (F-14, F-18 and AAW missile systems) to engage targets with hard kill weapons. Force orders are defined as one of the following: Weapons Free - Fire may be opened on any target(s) that has (have) not been identified as FRIEND. Weapons Safe - Do not open fire/cease firing. Fire may be opened only in self defense or in response to a formal order. Weapons Tight - Do not open fire unless target(s) has (have) been identified as HOSTILE. Cease Fire - Do not open fire or discontinue firing; complete intercept if missile is in flight; continue to track. Hold Fire - This order directs units to withhold or cease fire on the designated track. Guidance for semiactive missiles which are already in flight should be discontinued. Hold Fire is an emergency order that temporarily terminates a particular engagement or restricts firing in a particular airspace. A Hold Fire order applies to a specific aircraft, missile unit, sector, altitude, or corridor, and should not be given for an entire AAW system. Report of results of force orders execution is performed through secure radio reports between the AAWC and the BG Commander followed up with SITREP. (Reference f: NWP 32, ANTIAIR WARFARE (U))

Activity Number: 223

Activity Name: Detect Radar Track

Activity Definition: Radar operators on board naval combatant ships and aircraft utilize sensor data and the battle damage kill assessment reports to detect, establish, display, and maintain radar tracks. The output of this function is radar data .

Activity Number: 2111

Activity Name: Develop AAW Plan

Activity Definition: The AAW Plan is promulgated as the OPTASK AAW Supplements and the Daily Intentions Message and are the results of a coordinated effort between the AAW Staff, the Battle Group Staff and the Air Wing Staff. The Navy Wide Standing OPTASK AAW is used as a guide for development of the OPTASK AAW Supplements. OPTASK AAW Supplements are issued periodically based on any major changes to the tactical situational. The Operations Orders (OPORD) and, if the Battle Group (BG) is part of a Joint Task Force (JTF), the Joint Air Defense Plan (JADP) provide guidance that are reflected in the supplement. Information is also obtained from component coordination for assets availability and INTEL. The Daily Intentions Message contain the details of the day-to-day AAW asset apportionment to include numbers, types, positioning, time on station, and assignments of aircraft and AAW missile ships. The Daily Intentions Message also addresses changes to elements such as task organization, AAW procedures, joining procedures, EMCON, surveillance requirements, tanking procedures, communication suite, ID procedures, data links procedures, constraints to the operating environment, commercial air routes, VFR flight activities, geographical and meteorological information, assessment of the friendly and enemy expectation of capability, threat anticipated actions, intercept and escort policies, engagement tactics, target weaponeering, air-to-air

refueling, minimum risk routing (MRR) procedures, codes of authentication procedures, and divert landing locations. There may be occasions when the AAWC is assigned the responsibility for development of the LINK Plan which then becomes incorporated as part of the AAW Plan and promulgated as the OPTASK LINK Supplements. The OPTASK LINK Supplements contains the details of the day-to-day LINK assets apportionment such as track number assignment, link numbers assigned to participating units, assignment of track number blocks used for reporting, as well as instructions for changing frequencies and link reporting requirements. The AAWC may provide inputs to guidance and the ATO as far as Rules Of Engagements (ROE) are concerned. The execution of the ROE may reveal more effective approach to the ROE which could be either relaxation or increase of the rules. The request for changes of the ROE is in a message form called "Request for ROE Changes". When the changes to the ROE has been approved they becomes incorporated in the AAW Plan and reflected in the OPTASK AAW Supplement and the Daily Intentions Message.

Activity Number: 13

Activity Name: Engage w/ Hard Kill Weapons

Activity Definition: The AAWC and the force TAO provide force orders to F-14 (Phoenix, Sidewinder, Sparrow, and guns), F-18 (Sparrow, Sidewinder, AMRAAM, and guns) and SAM-capable ships (SM-1 and SM-2) against air targets. Results of engagement are provided to the AAWC and the force TAO.

Activity Number: 224

Activity Name: Establish AAW Situation Awareness

Activity Definition: The overall purpose of this function is to establish and maintain the real time AAW tactical situational awareness. This includes the functions to establish the battle space track data, identify (ID) the tracks, establish threat priority and assess battle damage and kill. The tactical situational awareness provides the AAWC and the force Tactical Action Officer (TAO) the required real time information for execution of the overall command and control of the AAW defensive force.

Activity Number: 21

Activity Name: Establish Battle Space Track Data

Activity Definition: This function establishes and maintains the battle space track data. Radar operators on board naval combatant ships and aircraft detect, establish, and maintain track data. Component track supervisors support the force track supervisor to manage and maintain the overall battle space track data. Sensor data and battle damage kill assessment reports are correlated to maintain the real time battle space track data.

Activity Number: 211

Activity Name: Establish Link Data

Activity Definition: Component track supervisors, component track coordinators, force track supervisor and force track coordinator utilizes the tactical data links to share radar data in accordance to link procedures established in the OPTASK AAW Supplements and the OPTASK LINK Supplements. Radar data are shared via Link-11 and Link-16 among combatant ships, E-2

aircraft, AOC, AWCAS, Tactical Air Operations Center (TAOC), etc. Link-4A target data is used for combat air patrol (CAP) aircraft.

Activity Number: 2112

Activity Name: Establish Threat Priorities

Activity Definition: The AAWC and the force TAO establish threat priorities based on the threat potential and prioritize them for engagement. The AAW target prioritization is an assessment of evaluated track data, INTEL, battle damage/kill assessment report, sensor data, environmental data, own asset status, operations feedback, OPTASK AAW, Daily Intentions Message, and guidance, especially the rules of engagement (ROE). Threat assessment includes the following considerations: 1. The most immediate, time critical threat. 2. Nature of the threat: anti ship missile (ASM) platforms, strike support aircraft (EC). targeting, strike coordination, tactical strike aircraft, or ASMs in flight. 3. Range of threat: within or beyond maximum ASM launch range. 4. Threat composition: single or multiple targets, stepped or broad front formations. 5. Own-force engagement capability. Although threat detection, identification, and assessment normally occur after the battle is joined, the AAWC establishes threat prioritization criteria well in advance of the battle. He ensures that the guidance provided can be executed by the unit commanders in engaged ships and aircraft during the heat of battle and during periods of degraded communications. His guidance therefore is simple, clear, and flexible. (Reference a: NWP 10-1-21 (Rev. A) ANTIAIR WARFARE COMMANDER'S MANUAL)

Activity Number: 213

Activity Name: Establish Threat Sector/ Intercept & Escort Policies

Activity Definition: Based on the assessment performed on the AAW friendly and enemy expectation of capability, and INTEL (to include political considerations) and with the CWC guidance, AAWC determines the probable threat sectors, and defines the extent of the AAW battle space. Threat sectors are defined as the most probable areas that an attack may come from. Intercept and escort policies define the range for intercept to occur and the escort policies to be followed after intercept.

Activity Number: 12

Activity Name: Execute AAW Actions

Activity Definition: The AAWC and the force TAO execute command and control with force orders to engage with hard kill weapons. The AAW operations are against enemy air (Blue Air versus Red Air) based on OPTASK AAW Supplement, Daily Intentions Message, Guidance, ATO, position of assets, targeting data, sensor data and results of engagement. Prior to execution of force orders, the engagement posture is selected and assets are positioned for engagement.

Activity Number: 22

Activity Name: Execute AAW Operations

Activity Definition: Execute AAW Mission establishes the AAW environment and executes AAW actions. The AAW operations are against enemy air units, i.e., Blue Air versus Red Air. The function to establish the AAW environment supports the execution of AAW actions by providing real time tactical situational awareness. Execute AAW actions performs the necessary force activities required to counter any AAW threat. This includes the required command and

control actions and force orders for execution of force assets (F-14, F-18 and missile systems) to engage target with hard kill weapons. The main output of this function are the results of engagement such as negated missiles and defended sectors.

Activity Number: 2

Activity Name: I.D. Track Data

Activity Definition: Once track data has been detected and acquired, it is evaluated and identified as a friend, foe or unknown and what type of weapons platform it is. For the "unknown contacts, i.e., non cooperative target recognition compliant" information such as altitude, speed, and flight pattern are correlated with friendly flight plans, friendly flight corridors, commercial air routes, MRR procedures, and any other information available for positive identification. Should all of these methods fail to produce positive identification, the track is designated as unknown. Within the process of air defense the most critical process is the detection and identification of contact track data and must be rapidly accomplished at a reasonable range to allow some flexibility in the engagement process. Effective measures designed to provide timely identification include positive radar control, visual control, flight plans, IFF, and air corridors. A detailed discussion of these measures is found in NWP 32. (Reference f: NWP 32, ANTIAIR WARFARE (U))

Activity Number: 212

Activity Name: Integrate AAW Plan w/ C2W Plan

Activity Definition: The integration of the AAW Plan with the C2W Plan is a coordination process of specific issues which may affect the AAW or the C2W mission. Those issues are resolved prior to promulgation of either the AAW Plan or the C2W Plan. Coordination is

performed between the AAWC at the cruiser and the Battle Group Staff and the C2 Warfare Team on the carrier. An example of a C2W and AAW coordination issue is to minimize the potential for EW interference with own force AAM/SAM targeting.

Activity Number: 14

Activity Name: Manage Track Data

Activity Definition: The force track coordinator manages, maintains, and coordinates the up-to-date battle space track data with the use of the tactical data links. This assures that the battle space track data has no dual, gridlock, correct participating assignments, correct track block, correct frequency, and that the data is coherent.

Activity Number: 2113

Activity Name: Perform AAW Operations

Activity Definition: Perform Anti-Air Warfare (AAW) Operations is a model that presents AAW operations from the perspective (or "viewpoint") of the AAW Commander (AAWC/AW) and the organic (Carrier Battle Group) and non-organic (Joint Force not assigned to the Carrier Battle Group) assets that contribute to the AAW defensive mission. The mission of the AAWC is to defend the force against air attacks such as Theater Missile Defense (TMD), cruise missiles (sea and land based), manned aircraft, and air to surface missiles (ASM). To exercise this mission, the AAWC plans the antiair warfare (AAW) battle, gives the warfighters simple directions that can be executed during all phases of the battle, and provides assistance to them in the performance of their missions. In any major conflict, U.S. naval forces will probably be employed at a battle force or battle fleet level. In this situation, the force/fleet commander's staff

conducts the required planning, effects the necessary liaison, allocates assets, and establishes the AAW mission, doctrine, policies, and plans to be executed by the individual battle groups. Battle Group (BG) Commanders repromulgate as necessary, and carry out assigned tasks in accordance with preplanned procedures that have been tailored to the particular situations. For small scale, low-intensity, or Third World tactical situations, planing and coordination may be relegated to the BG level, thus requiring the BG Commander/AAWC to create the BG AAW plan for the specific situation. AAWC Command Relationship: The Composite Warfare Commander (CWC) is responsible for defense of the battle group, but may delegate functions pertaining to antiair warfare (AAW) to the AAWC. The AAWC is subordinate to the CWC and is responsible to him for protecting the force against hostile air platforms and airborne weapons. The CWC retains ultimate control with command override, sometimes referred to as "command by negation". In some situations, the AAWC may delegate authority to sector antiair warfare commanders (SAAWCs) or local antiair warfare coordinators (LAAWCs). The AAWC retains control over his subordinates by monitoring their actions and exercising command override. The SAAWCs report to the AAWC. LAAWCs report to their respective SAAWCs, if established, and otherwise, to the AAWC. (Reference a: NWP 10-1-21 (Rev. A) ANTIAIR WARFARE COMMANDER'S MANUAL.)

Activity Number: 0

Activity Name: Plan AAW Operations

Activity Definition: The products of Plan AAW Operations are the OPTASK AAW Supplement and its modifier the Daily Intentions Message. Those messages are generated by the AAWC with inputs from the senior officers onboard the cruiser which may include the Commanding Officer

(CO), Executive Officer (XO), Operations Officer (OPS), Combat Information Center Officer (CICO), Signal Security Officer (SSO), as well as the Battle Group Staff and approved by the CWC. The AAWC uses the Navy Wide Standing OPTASK AAW as a guide for generating the OPTASK AAW Supplements. The OPTASK AAW Supplements are complemented and modified by the Daily Intentions Message that contain the details of day-to-day operations. Those messages addresses critical elements applicable to the specific mission such as the constraints of the operating environment to include commercial air routes, VFR flight activities, geographical and meteorological information, assessment of the friendly and enemy expectation of capability, friendly intelligence capability, the Chain-of-Command, engagement tactics, AAW disposition planning, surveillance requirements, coordination with the EW Plan, and communications. The Composite Warfare Commander (CWC) may assign the function to promulgate the OPTASK LINK Supplements from the Command and Control Warfare (C2W) Commander to the AAWC. In this circumstance the AAW Plan includes the LINK Plan. The OPTASK LINK Supplement contains the details of the day-to-day LINK assets apportionment such as track number assignment, link numbers assigned to participating units, assignment of track number blocks used for reporting, as well as instructions for changing frequencies and link reporting requirements. Those messages are promulgated in accordance with APP 4, Volume I, Allied Maritime Structured Message (U) and APP 4, Volume II, Allied Maritime Formatted Messages (U) (Reference b and c). The AAWC may provide inputs to guidance and the ATO as far as Rules Of Engagements (ROE) are concerned. The execution of the ROE may reveal more effective approaches to the ROE which could be either relaxing or tightening of the rules. The request for changes of the ROE is in a message form called "Request for ROE Changes". When

the changes to the ROE has been approved they becomes incorporated in the AAW Plan and reflected in the OPTASK AAW Supplement and the Daily Intentions Message.

Activity Number: 1

Activity Name: Position/ Reposition Engagement Assets

Activity Definition: Position / Reposition Initial Engagement Assets are the execution of the force initial positioning orders and the repositioning orders.

Activity Number: 222

Activity Name: Promulgate AAW Plan

Activity Definition: The AAW Plan is promulgated as the OPTASK AAW Supplements, the OPTASK LINK Supplements, and the Daily Intentions Messages. Those messages are promulgated by the AAWC with inputs from the senior officers onboard the cruiser which may include the Commanding Officer (CO), Executive Officer (XO), Operations Officer (OPS), Combat Information Center Officer (CICO), Signal Security Officer (SSO), approved by the CWC.

Activity Number: 15

Activity Name: Select Engagement Posture

Activity Definition: Select Engagement Posture is a selection of the appropriate defensive posture performed by the OTC/CWC and the AAWC based on an ongoing assessment of the tactical AAW picture. The outcomes of this function are the Force Position Orders and the Warnings and Weapons Status. Attendant to the determination of AAW areas and zones is the

selection of a suitable force disposition for AAW. Judicious disposition planning for AAW allows sufficient flexibility to enable the forces to counter other potential threats. The AAW formation, disposition, and stationing factors are discussed in NWP 32, Antiair Warfare (U), ATP 31, NATO Above Water Warfare Manual (U), and ATP 1, Volume I, Allied Maritime Tactical Instructions and Procedures (U). Figure 5-3 (U) Naval Surface-to Air Missile Systems is confidential and has the list of missiles/capabilities/platforms. (Reference a: NWP 10-1-21 (Rev. A) ANTIAIR WARFARE COMMANDER'S MANUAL)

Activity Number: 221

Arrow Name: *OPTASK LINK Supplements

Arrow Definition: The OPTASK LINK Supplements message may be promulgated by the Command and Control Warfare Commander (C2WC). Information contained in the OPTASK LINK Supplements include link reporting requirements, track number assignment, link numbers assigned to participating units, assignment of track number blocks used for reporting, instructions for changing frequencies, etc.

Arrow Name: AAW Plan

Arrow Definition: The AAW Plan is the AAWC plans and directions for the execution of the AAW missions. The AAW Plan is promulgated as the OPTASK AAW Supplements Message and the Daily Intentions Message and may also include the OPTASK LINK Supplements.

Arrow Name: AAW Staff

Arrow Definition: The following are the billets to perform AAW operations and they may be referred to as the AAW Staff: Commanding Officer (CO), Executive Officer (XO), Anti-Air Warfare Commander (AAWC), Operations Officer (OPS), Combat Information Center Officer (CICO) and Signal Security Officer (SSO).

Arrow Name: AAW Staff, Battle Group Staff & Air Wing Staff

Arrow Definition: The following are the billets to perform AAW operations, and they may be referred to as the AAW Staff: Commanding Officer (CO), Executive Officer (XO), Anti-Air Warfare Commander (AAWC), Operations Officer (OPS), Combat Information Center Officer (CICO) and Signal Security Officer (SSO). Other billets used to perform AAW operations are the Battle Group Staff and the Air Wing Staff. The Battle Group Staff is comprised of the Battle Group Commander, Chief of Staff, Operations Officer, INTEL Officer, and C2W Officer. The Air Wing Staff is comprised of the Commander of the Air Group (CAG), Deputy CAG, CAG Operations , E-2 representative, and the Fighter representative.

Arrow Name: AAWC + Battle Group Staff

Arrow Definition: Anti-Air Warfare Commander (AAWC) and the Battle Group Staff.

Arrow Name: ACO

Arrow Definition: The Airspace Control Order (ACO) is developed and modified by the Airspace Control Authority (ACA). The responsibilities of the ACA and the AADC are interrelated. In a maritime environment these responsibilities will normally be assigned to the

JFACC (Afloat) who may delegate responsibility to the AAWC and the CV Air Operations Officer. The ACOs are published daily in the ATO/SPINS message and provide a means for higher commands to provide specific, detailed orders to subordinate units to effect airspace management. The ACO also notifies all pertinent agencies of the effective time of activation and the composite structure of the airspace to be used. The ACO can define and establish special purpose airspace for military operations, including air routes, base defense zones, coordinating measures/lines, drop zones, pickup points, restricted areas, etc. The ACO provides for a coordinated, deconflicted, integrated, and flexible use of airspace, with the airspace control system of host nations. If the Battle Group is not part of a Joint Task Force and consequently there is no ATO, the information provided for in the ACO will be found in the OPTASK AAW Supplement and/or the Daily Intentions Message.

Arrow Name: ADP

Arrow Definition: The Air Defense Plan (ADP) is developed and modified by the Area Air Defense Commander. The responsibilities of the Airspace Control Authority (ACA) and the AADC are interrelated. In a maritime environment these responsibilities will normally be assigned to the JFACC (Afloat) who may delegate responsibility to the AAWC and the CV Air Operations Officer. The ADP establishes area air defense responsibilities, provides as organization structure, sets alert requirements, and establishes Minimum Risk Routing (MRR).

Arrow Name: ADS and Sensors

Arrow Definition: Air Display System (ADS) and Sensors.

Arrow Name: ADS, Link 11, 16, 4A, LMS 11, voice

Arrow Definition: Air Display System (ADS), Link 11, 16, 4A, LMS 11 and voice.

Arrow Name: Assessment

Arrow Definition: Assessment is an assessment of the friendly and enemy expectation of capability. Assessment of enemy capability is an evaluation of the threat and the perceived threat's intentions for the day. Assessment of friendly capability is an evaluation of own forces and how well they can perform against the threat's intentions. The accuracy of the assessment is crucial to the overall performance of the AAW mission and is based on the accuracy of intelligence and other information.

Arrow Name: ATO

Arrow Definition: The Joint Force Air Component Commander (JFACC) directs the employment of air forces and interdiction capable missiles assigned to the Joint Force Commander (JFC). The Air Tasking Order (ATO) message is issued daily by the JFACC to direct the actions of the different wings in the theater of operations. The ATO directs all planned air activities of the day. Missions are identified by wing and include mission number, name, and number/type of aircraft, time on target (TOT), and altitude. The ATO also contains the Direct Support Sortie that specifies tanking, EW and INTEL (photo/reconnaissance) flights to be performed. The ATO is written in an abbreviated format to condense the size of the printed document for faster photocopying and electronic transmission. (Everything that flies will be in the ATO.) Information that does not easily fit into the formatted portion of the ATO, yet necessary for the

complete understanding of the missions to be flown, is included in a free text portion of the ATO called the Special Instructions (SPINS). This method is used to provide units with a wide range of information from communications to tanker missions. The AAWC provides inputs to the ATO via the OPTASK AAW Supplements, Daily Intentions Message and SITREP.

Arrow Name: AW & Force TAO

Arrow Definition: The Anti-Air Warfare Commander (AAWC or AW) and the Force Tactical Air Operation Officer.

Arrow Name: AW, Pilots, INTEL, Force & Component: TAO, Track Coord, I.D. & ESM Operators

Arrow Definition: The Anti-Air Warfare Commander (AAWC or AW), Pilots, INTEL personnel, Force and Component personnel such as: Tactical Air Operation Officer, Track Coordinator, I.D. & ESM Operators.

Arrow Name: Battle Damage KA Reports

Arrow Definition: The AAWC and the force TAO assess the battle damage to own forces and kill results of engagements of enemy air platforms and missiles. The battle damage and kill assessment report is relayed to the Battle Group Commander through secure radio as part of the Situation Report (SITREP). This information is also used to maintain the tactical situation awareness, assess friendly/enemy expectation of capability and develop the AAW Plan.

Arrow Name: Battle Space Track Data

Arrow Definition: Radar operators on board naval combatant ships and aircraft detect, establish, and maintain track data. Component track supervisors support the force track supervisor to manage and maintain the overall battle space track data. Sensor data and battle damage kill assessment report are correlated to maintain the real time battle space track data. Battle Space Track Data has the following components: time, x, y, z, heading and speed.

Arrow Name: Billets

Arrow Definition: Billets are the required personnel to perform the function. The following are the billets to perform AAW operations and they may be referred to as the AAW Staff: Commanding Officer (CO), Executive Officer (XO), Anti-Air Warfare Commander (AAWC), Operations Officer (OPS), Combat Information Center Officer (CICO) and Signal Security Officer (SSO). Other billets used to perform AAW operations are the Battle Group Staff and the Air Wing Staff. The Battle Group Staff is comprised of the Battle Group Commander, Chief of Staff, Operations Officer, INTEL Officer, and C2W Officer. The Air Wing Staff is comprised of the Commander of the Air Group (CAG), Deputy CAG, CAG Operations , E-2 representative, and the Fighter representative.

Arrow Name: C2 Architecture

Arrow Definition: C2 architectures are defined as the established command and control structure. Updates to the C2 architectures are performed by the OPTASK AAW Supplements and the Daily Intentions Messages. If the theater of operation has the JFACC function, the ATO will provide

updates to the C2 architecture, and the AAWC incorporates those updates in the OPTASK AAW Supplements and the Daily Intentions Messages.

Arrow Name: Component Coordination AAW/C2W

Arrow Definition: Component Coordination AAW/C2W is the Anti-Air Warfare Commander coordination with the Command and Control Warfare Command (C2WC), who coordinates electronic warfare in the force, and the command, control, and communications countermeasures.

Arrow Name: Component Request

Arrow Definition: The AAWC receives requests from various components for support of air operations. An example of component request would be from a FFG who may request control of a F-14 for two hours in order to maintain the qualifications of an air intercept controller. This does not occur often. However if the AAWC also is assigned as the AADC a request may come from a HAWK battery who is experiencing casualties and requests a 12 hour cover while performing repairs. Coordinated Issues: After the AAW and the EW plan have been integrated the issues that required coordination have been settled and integrated in the AAW Plan. The Daily Intentions Message is now ready for promulgation.

Arrow Name: Coordinated Issues

Arrow Definition: After the AAW and the EW plan have been integrated, the issues that required coordination have been settled and integrated in the AAW Plan. The Daily Intentions Message is now ready for promulgation.

Arrow Name: Coordination

Arrow Definition: The AAWC interacts with other warfare commanders, services, and allied units and coordinators from planning through the engagement phase. The AAWC coordinates force AAW defense and works closely with the air element coordinator (AREC), who provides supporting aircraft; the Command and Control Warfare Command (C2WC), who coordinates electronic warfare in the force; and the command, control, and communications countermeasures. The AAWC coordinates in order to optimize the use of multimission-capable assets; avoid conflicting requirements for aircraft, deck space, and services in various situations; exchange information about the tactical situations; and guard against mutual interference between friendly units and inadvertent engagement of friendly units. Should unresolved conflicting requirements remain, the CWC is the final authority. (Reference a: NWP 10-1-21 (Rev. A) ANTIAIR WARFARE COMMANDER'S MANUAL. and modified at the 19 July 94 - Naval Doctrine Command - meeting.)

Arrow Name: Coordination Issues

Arrow Definition: In the effort to integrate the AAW Plan with the EW Plan, specific issues which may affect the AAW or the EW mission require coordination. Coordination is performed between the AAWC on the cruiser and the Battle Group Staff and C2 Warfare Team on the carrier. Those issues are resolved prior to promulgation of either the AAW Plan or the EW Plan. The Battle Group Commander has the final decision on unresolved issues. An example of EW and AAW coordination issue is to identify the required coordination to minimize the potential for EW interference with own force AAM/SAM targeting.

Arrow Name: Daily Intentions Message

Arrow Definition: This report is generated by the AAWC/CVBG and relates to the AAW Intentions for the next day. The Daily Intentions Message is a modifier to the OPTASK AAW Supplement. The OPTASK AAW Supplement and Daily Intentions Message are the major interconnection between the functions "Plan AAW Operation" and "Execute AAW Operations". The Daily Intentions Message contain the details of the day-to-day AAW asset apportionment to include numbers, types, positioning, time on station and assignments of aircraft and missile ships. The Daily Intentions Message also addresses changes to elements such as task organization, AAW procedures, joining procedures, EMCON, tanking procedures, communication suite, ID procedures, data links procedures, constraints to the operating environment, commercial air routes, VFR flight activities, geographical and meteorological information, assessment of the friendly and enemy expectation of capability, threat anticipated actions, intercept and escort policies, engagement tactics, target weaponeering, air-to-air refueling, minimum risk routing (MRR) procedures, codes of authentication procedures, and divert landing locations.

Arrow Name: Environmental Data

Arrow Definition: Environmental Data are received from shore and space activities and provides raw and processed environmental data. Environmental data is also available on board ship such as charts as well as reports from other force units, pilot reports and IREPS messages. The environmental considerations follows: Meteorological such as cloud cover, precipitation, visibility, daylight and darkness, inversion layers, ducting, refraction, severe weather, extreme temperatures, and wind/jet stream. Oceanographic such as water depth, physical ocean obstacles,

land mass chock points, and proximity to land mass. Geographic/Topographic such as physical obstacles, limiting avenues of approach, potential cover for hostile forces, and potential cover for own forces. (Reference a: NWP 10-1-21 (Rev. A) ANTIAIR WARFARE COMMANDER'S MANUAL)

Arrow Name: Evaluated Track Data

Arrow Definition: Once track data has been detected and acquired, it is evaluated and identified as a friend or foe and what type of weapons platform it is. For the "unknown contacts, i.e., non cooperative target recognition compliant" information such as altitude, speed, flight pattern are correlated with friendly flight plans, friendly flight corridors, commercial air routes, RTF and MRR procedures, and any other information available for positive identification. Should all of these methods fail to produce positive identification, the track is designated as unknown. Within the process of air defense the most critical process is the detection and identification of contact track data and must be rapidly accomplished at a reasonable range to allow some flexibility in the engagement process. Effective measures designed to provide timely identification include positive radar control, visual control, flight plans, IFF, and air corridors. A detailed discussion of these measures is found in NWP 32, ANTIAIR WARFARE (U)

Arrow Name: F-14 (Phoenix, Sidewinder, Sparrow, guns); F-18 (Sparrow, Sidewinder, AMRAAM, guns), missile systems (SM-1&2); voice, Tactical Data Link

Arrow Definition: The weapons used by the F-14: Phoenix, Sidewinder, Sparrow, guns; the weapons used by the F-18 aircraft: Sparrow, Sidewinder, AMRAAM, guns and the shipboard Missile Systems: SM-1&2. Voice, and the Tactical Data Link.

Arrow Name: F-14, F-18, Missile System Operator

Arrow Definition: The manning required to operate the F-14 and F-18 aircraft and the Missile System Operator.

Arrow Name: Force & Component Track Coordinator and Track Sup

Arrow Definition: Force Track Coordinator coordinates the tracks in the Force level. Component Track Coordinator coordinates the tracks in the component level. Track supervisor is called the Track Sup.

Arrow Name: Force & Component Track Coordinator and Track Sup, Radar Operator

Arrow Definition: Force Track Coordinator coordinates the tracks in the Force level. Component Track Coordinator coordinates the tracks in the component level. Track supervisor is called the Track Sup. Radar Operator operates the radars.

Arrow Name: Force Orders

Arrow Definition: The AAWC and the force TAO assess the tactical situation and execute command and control over AAW forces to perform all aspects of the AAW mission. This includes the required command and control actions and force orders for the force assets (F-14, F-18 and missile systems) to engage targets with hard kill weapons. Force orders are defined as one of the following: Weapons Free - Fire may be opened on any target(s) that has (HAVE) not been identified as FRIEND. Weapons Safe - Do not open fire/cease firing. Fire may be opened only in self defense or in response to a formal order. Weapons Tight - Do not open fire unless

target(s) has (have) been identified as HOSTILE. Cease Fire - Do not open fire or discontinue firing; complete intercept if missile is in flight; continue to track. Hold Fire - This order directs units to withhold or cease fire on the designated track. Guidance for semiactive missiles which are already in flight should be discontinued. Hold Fire is an emergency order that temporarily terminates a particular engagement or restricts firing in a particular airspace. A Hold Fire order applies to a specific aircraft, missile unit, sector, altitude, or corridor, and should not be given for an entire AAW system. Report of results of force orders execution is performed through secure radio reports between the AAWC and the BG Commander followed up with SITREP. (Reference f: NWP 32, ANTIAIR WARFARE (U))

Arrow Name: Force TAO

Arrow Definition: The Force level Tactical Air Operation (TAO) Officer.

Arrow Name: Force Track Coordinator

Arrow Definition: The Force level Track Coordinator.

Arrow Name: Genser & SI Traffic, Voice

Arrow Definition: Genser Traffic is the hard copy message traffic received at the radio room. Special Intelligence (SI) traffic is also hard copy messages from the radio room. Voice is voice communication.

Arrow Name: Genser & SI Traffic, Voice, Charts

Arrow Definition: Genser Traffic is the hard copy message traffic received at the radio room. Special Intelligence (SI) traffic is also hard copy messages from the radio room. Voice is voice communication. Charts are the geographical charts used.

Arrow Name: Genser & SI Traffic, Voice, Tactical Data Link, ADS

Arrow Definition: Genser Traffic is hard copy radio message Special Intelligence (SI) Traffic is hard copy secure radio messages. Voice assets are the radios. Tactical Data Links are the NTCS-A, Link-11 and Link-16. ADS is the AEGIS Display System.

Arrow Name: Genser & SI Traffic, Word Processor

Arrow Definition: Genser Traffic is the hard copy message traffic received at the radio room. Special Intelligence (SI) traffic is also hard copy messages from the radio room. Word Processor is any available software that is used to generate a text document.

Arrow Name: Guidance

Arrow Definition: Guidance is provided to the Anti-Air Warfare Mission Area Commander by the Battle Group Commander, who in turn receives guidance from the Joint Force Commander (JFC). The guidance provided by the Battle Group Commander (physically located on the carrier) is a result of an interactive coordinated effort as the theater of operations matures. As the theater matures and becomes a sustained theater of operation, less guidance is required. This guidance may be called Warning Orders, Alert Orders, or Operations Orders (OPORD). This guidance follows a five-section format that contains Situation, Mission Statement, Execution, Administrative, and Command and Control information. The Situation describes the enemy and

the friendly situation of the theater. The Mission Statement defines what is the mission of the Anti-Air Warfare Mission Area Commander. Execution is the JFC-expected executions of the AAW orders performed by the Anti-Air Warfare Mission Area Commander. Administrative orders are the logistic orders to maintain the mission. Command and Control information includes an identification of the chain of command in the theater and the Rules of Engagement (ROE). The Anti-Air Warfare Commander (AAWC) and the Battle Group Commander (CVBG) provides to the JFC a Situation Report that relays the events of the operations (SITREP) at the end of each event and/or every 24 hours, a Daily Intentions Message, and the OPTASK AAW Supplements. The JFC sends out the formal guidance as described above based on those inputs and coordinates between the components and warfare commanders such as the Anti-Submarine Warfare Commander (ASWC), the Anti-Surface Warfare Commander (ASUWC), and the Command Control Warfare Commander (CCWC). The AAWC (AW) reports via secured radio to the CVBG (AB) as required such as new contacts, changes to the tactical picture, changes to the CAP station, new targets, etc. The CVBG in turn reports the information as needed up the chain of command such as to Third Fleet or NAVFOR. Guidance is then provided via secure radio down the chain of command. In real time operations one must realize that the chain of command and control functions may vary and that the AAW is executing the AAW mission as needed unless negated.

Arrow Name: In Position Assets

Arrow Definition: In Position Assets are the result of AAW assets following the initial positioning orders or the repositioning orders.

Arrow Name: Initial Positioning Orders

Arrow Definition: Engagement AAW assets initially position themselves as directed in the Daily Intentions Message following the AAW plan.

Arrow Name: INTEL

Arrow Definition: Onboard naval command ships there are Intelligence (INTEL) Centers that are responsible for receiving, processing, fusing, and distributing INTEL to appropriate warfare commanders. INTEL provides an estimate of the threat's capabilities and intentions. INTEL can be disseminated either by voice, data links, or hard copy messages.

Arrow Name: INTEL to include Political Considerations

Arrow Definition: Onboard naval command ships there are Intelligence (INTEL) Centers that are responsible for receiving, processing, fusing, and distributing INTEL to appropriate warfare commanders. INTEL provides an estimate of the threat's capabilities and intentions. INTEL can be disseminated either by voice, data links, or hard copy messages. This includes political considerations.

Arrow Name: JAOP

Arrow Definition: In conjunction with components, the JFACC is responsible for developing the Joint Air Operation Plan (JAOP) which may include strategic air warfare, theater-wide AAW/air interdiction, maritime support, area air defense, airspace control, airborne reconnaissance and surveillance, and Combat Air Patrol (CAP). The JAOP will account for all tasked joint air

sorties to accomplish or support the JFC's objectives. The JAOP should be submitted early and remain dynamic for subordinate planning. The JAOP provides operational direction and tasks to subordinate forces for the execution of joint air tasking. The JAOP must address logistical constraints. The feasibility of joint air operations depends on a viable, sustainable concept of operations. The JAOP must also include provisions for the transition of the JFACC between platforms or components afloat or ashore. The JAOP encompasses all facets of air and space operations to include strike, EW, and ECM.

Arrow Name: Linked Data

Arrow Definition: Force track supervisor, force track coordinator, component track supervisors and component track coordinators utilize the tactical data links to share radar data in accordance with link procedures established in the OPTASK LINK Supplements. Radar data are shared via Link-11 and Link-16 among combatant ships, E-2 aircraft, AOC, AWCAS, Tactical Air Operations Center (TAOC), etc. Link-4A target data is used for combat air patrol (CAP) aircraft.

Arrow Name: Operations Feedback

Arrow Definition: The AAWC and the force TAO receive results of engagement, assess the AAW situation and report results to the CVBG by voice as operations feedback which is also incorporated in the SITREP. This information is also used to maintain the tactical situation awareness, establish threat priorities, assess friendly and enemy expectations of capability, and develop the AAW Plan.

Arrow Name: OPTASK AAW Supplements

Arrow Definition: This report is generated by the AAWC/CVBG and relates to the force the overall AAW plan. The OPTASK AAW Supplement specifies the procedures, the predetermined responses, and the assets management for the AAW mission. COMSECONDFLT, COMTHIRDFLT, COMSIXTHFLT, and COMSEVENTHFLT promulgate the Navy-wide OPTASK AAW that is the standing OPTASK message. Prior to deployment the AAWC/CVBG releases a supplement to the OPTASK specific for the Battle Group tailored to the available assets and missions. As the physical location of the Battle Group changes, supplements are revised as necessary. The OPTASK AAW Supplement may be further modified by the Daily Intentions Message.

Arrow Name: OPTASK LINK Supplements

Arrow Definition: The Composite Warfare Commander (CWC) may assign the function to promulgate the OPTASK LINK Supplements from the Command and Control Warfare (C2W) Commander to the AAWC. In this circumstance the AAW Plan includes the LINK Plan. The OPTASK LINK Supplement contains the details of the day-to-day LINK assets apportionment such as track number assignment, link numbers assigned to participating units, assignment of track number blocks used for reporting, as well as instructions for changing frequencies and link reporting requirements.

Arrow Name: Organic & Non-Organic Assets

Arrow Definition: Organic and non-organic assets are the required assets to perform the function. The following are the assets required to perform AAW operations: Radio, Genser traffic (hard

copy message from radio), Special Intelligence (SI) traffic (hard copy secure message from radio), Tactical Data Link (NTCS-A, Link-4A, Link-11, Link-16), AEGIS Display System (ADS), Link Management System (LMS), voice, charts, word processor, missiles (Phoenix, Sidewinder, Sparrow, Advance Medium Range Anti Air Missile (AMRAAM), SM-1 and SM-2), guns, and air search radars (SPY-1, SPS-49, SPS-48E, APS-138, APS-139, APS-145, APG-71, APG-65, AAS-38, AWG-9, APG-71, APY-2)

Arrow Name: Own Assets Status (Real Time)

Arrow Definition: Part of Tactical Situation Awareness is information concerning the real time status of own assets which may vary pending the unfolding of events. This information is used real time by the AAWC and the Force TAO in the execution of AAW actions.

Arrow Name: Own Asset Status

Arrow Definition: The OPSUM, CASREP and AMRR are reviewed and a summary is provided to the AAWC on the status of the assets allocated to him. The Operation Summary (OPSUM) is generated daily by each ship and relates to the CVBG the logistics and administrative situation. The Casualty Report (CASREP) message is transmitted by each unit when an equipment experiences a casualty. The CASREP indicates how long the equipment is expected to be out, the nature of the equipment failure, and if parts or technical support is required to bring the system back on line. The Aircraft Material Readiness Report (AMRR) message is transmitted by the Air Wing Commander and contains information related to the material readiness of aircraft and any outstanding discrepancy.

Arrow Name: Radar Data

Arrow Definition: Radar operators on board naval combatant ships and aircraft utilize sensor data and the battle damage kill assessment reports to detect, establish, display, and maintain radar tracks. The output of this function is radar data.

Arrow Name: Radar Operators

Arrow Definition: Radar operators are the personnel required to operate the radars.

Arrow Name: Repositioning Orders

Arrow Definition: The AAWC and the force TAO coordinate and control in real time AAW assets. As the tactical situation changes the AAWC and/or the force TAO will issue repositioning orders to component units.

Arrow Name: Request for ROE Changes

Arrow Definition: The AAWC may provide inputs to guidance and the ATO as far as Rules Of Engagements (ROE) are concerned. The execution of the ROE may reveal more effective approaches to the ROE which could be either relaxing or tightening of the rules. The request for changes of the ROE is in a message form called "Request for ROE Changes". When the changes to the ROE has been approved, they becomes incorporated in the AAW Plan and reflected in the OPTASK AAW Supplement and the Daily Intentions Message.

Arrow Name: Results of Engagement w/ Hard Kill Weapons

Arrow Definition: Engagement assets such as F-14s, F-18s, and SAM-capable ships report to the AAWC by voice the results of engagement with hard kill weapons.

Arrow Name: ROE

Arrow Definition: Roles of Engagement (ROE) are the rules to be followed when engagement is executed. The Commander in Chief (CINC) issues ROE messages that specify what, where and when for engagement to occur. Because of the political significance of ROE decisions, ROE may come from the national level. The ROE contain the criteria to decide what is a hostile Intentions and what is not a hostile Intentions, target identification, weapon control status, and the right to self defense. ROE are tailored to the physical location and as the Battle Group moves the specific CINC issues ROE messages for the region. There may be circumstances that the AAWC may request via message changes to the ROE. When the changes have been provided to the AAWC he promulgates then in the OPTASK AAW Supplement and/or the Daily Intentions Message.

Arrow Name: Sensor Data

Arrow Definition: Sensor Data is data obtained by organic and non-organic assets. Sensor data follows: ESM data, visual, processed radar data (different radars on different platforms), NCTR, SARTIS, etc.

Arrow Name: SITREP

Arrow Definition: The AAWC (AW) reports via secure radio to the CVBG (AB) as required such as when there are changes to the tactical picture, changes to the CAP station, a new target, etc. SITREP includes information on threat, target identification data, battle damage kill assessment report, status of data link, weapon status and warning status. The format for the SITREP is contained in the OPTASK AAW Supplements. The CVBG in turn reports the information as needed up the chain of command such as to Third Fleet or NAVFOR.

Arrow Name: Tactical Data Links & Voice

Arrow Definition: Tactical Data Link are the NTCS-A, Link-11, and Link-16. The voice data is the data obtained by voice.

Arrow Name: Tactical Data Links, Air Search Radars, and Voice

Arrow Definition: Tactical Data Links are the NTCS-A, Link-11, and Link-16. The airborne radars are APS 125/138/139/145, and APG 71. The voice data is the data obtained by voice.

Arrow Name: Tactical Data Links, LMS-11 & Voice

Arrow Definition: Tactical Data Link are the NTCS-A, Link-11, and Link-16. LMS-11 and the voice data is the data obtained by voice.

Arrow Name: Tactical Situation Awareness

Arrow Definition: The tactical situation awareness provides the AAWC and the force Tactical Action Officer (TAO) the required real time information for execution of the overall command and control of AAW defensive force. This includes identified track information, threat priority,

and assessment of battle damage and kill. Tactical situation awareness is the "who, what, where" real time tactical picture of friendly and enemy forces.

Arrow Name: Targeting Data

Arrow Definition: Targeting data includes target identification information, target description and criticality, target vulnerability, aim point, munitions effectiveness against target, and restrike recommendations. INTEL is a major source of targeting data.

Arrow Name: Threat Sector/Intercept & Escort Policies

Arrow Definition: Based on the assessment performed on the AAW friendly and enemy expectation of capability, and INTEL (to include political considerations), and with the CWC guidance, AAWC determines the probable threat sectors and defines the extent of the AAW battle space. Threat sectors are defined as the most probable areas that an attack may come from. Intercept and escort policies define the range for intercept to occur and the escort policies to be followed after intercept.

Arrow Name: Voice, Tactical Data Link, ADS

Arrow Definition: Voice assets are the radios. Tactical Data Link are the NTCS-A, Link-11, and Link-16. ADS is the AEGIS Display System.

Arrow Name: Warnings & Weapons Status

Arrow Definition: The OTC/CWC and the AAWC selects the appropriate defensive posture based on an ongoing assessment of the tactical AAW picture. The defensive posture requires

positioning of forces and the desired warning and weapons status. The warning (white, yellow, and red) and weapon status (tight, free, safe) establish the readiness level of the battle group.

Arrow Name: Watch Station

Arrow Definition: The Watch Stations are assigned watch station duties to be staffed during real time operations.

USED AT:	AUTHOR: Marlen Z. Conklin	DATE: 16 June 1994		WORKING	READER DATE	CONTEXT:
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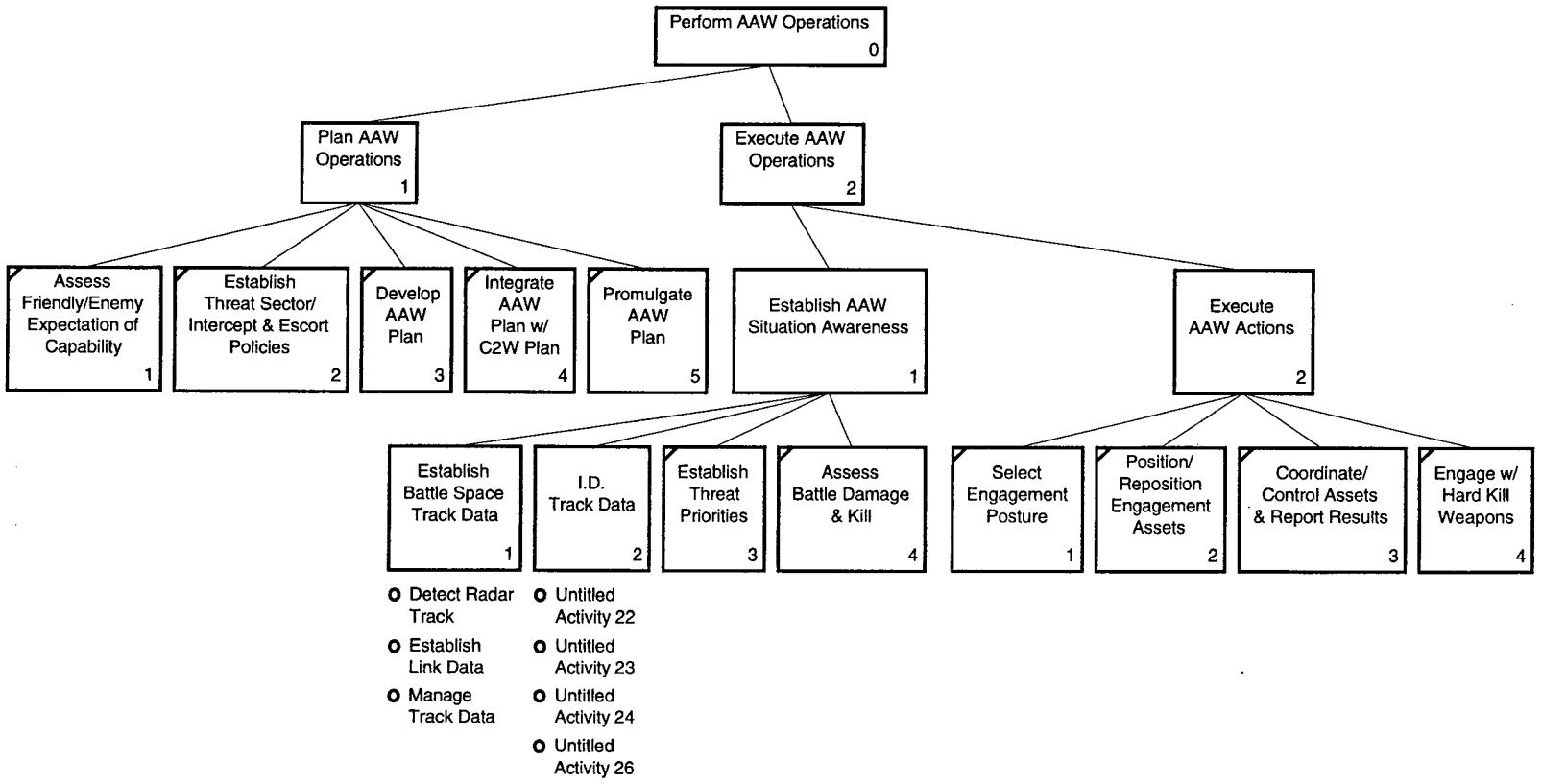

NODE: A0	TITLE: Perform AAW Operations	NUMBER:

USED AT:	AUTHOR: Marlen Z. Conklin	DATE: 17 June 1994		WORKING	READER DATE	CONTEXT:
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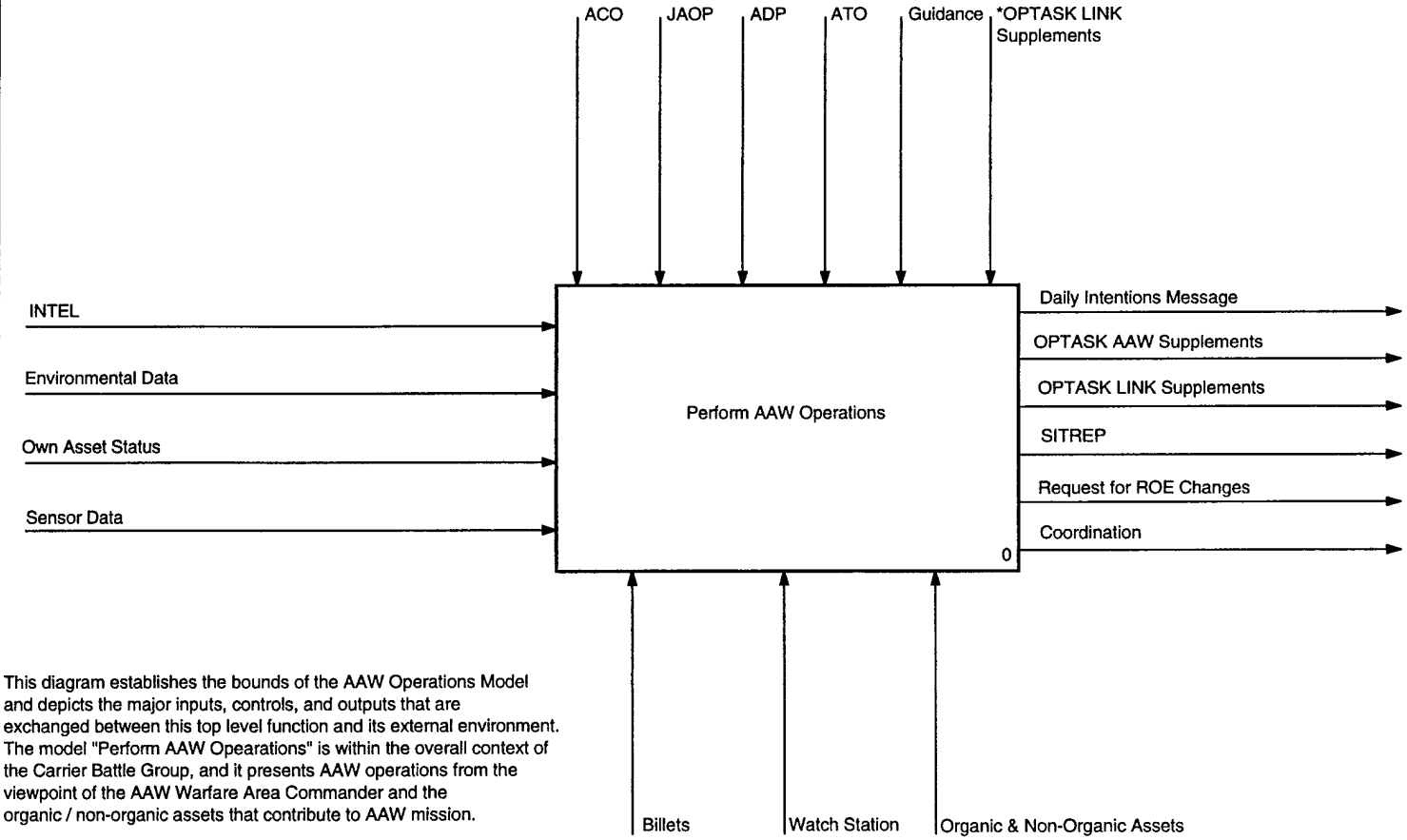

This diagram establishes the bounds of the AAW Operations Model and depicts the major inputs, controls, and outputs that are exchanged between this top level function and its external environment. The model "Perform AAW Opearations" is within the overall context of the Carrier Battle Group, and it presents AAW operations from the viewpoint of the AAW Warfare Area Commander and the organic / non-organic assets that contribute to AAW mission.

NODE: A-0	TITLE: Perform AAW Operations	NUMBER:

USED AT:	AUTHOR: Marlen Z. Conklin	DATE: 20 June 1994		WORKING	READER DATE	CONTEXT:
	PROJECT: BMDO - NAVY AAWC MODEL	REV: 19 July 1994		DRAFT		TOP
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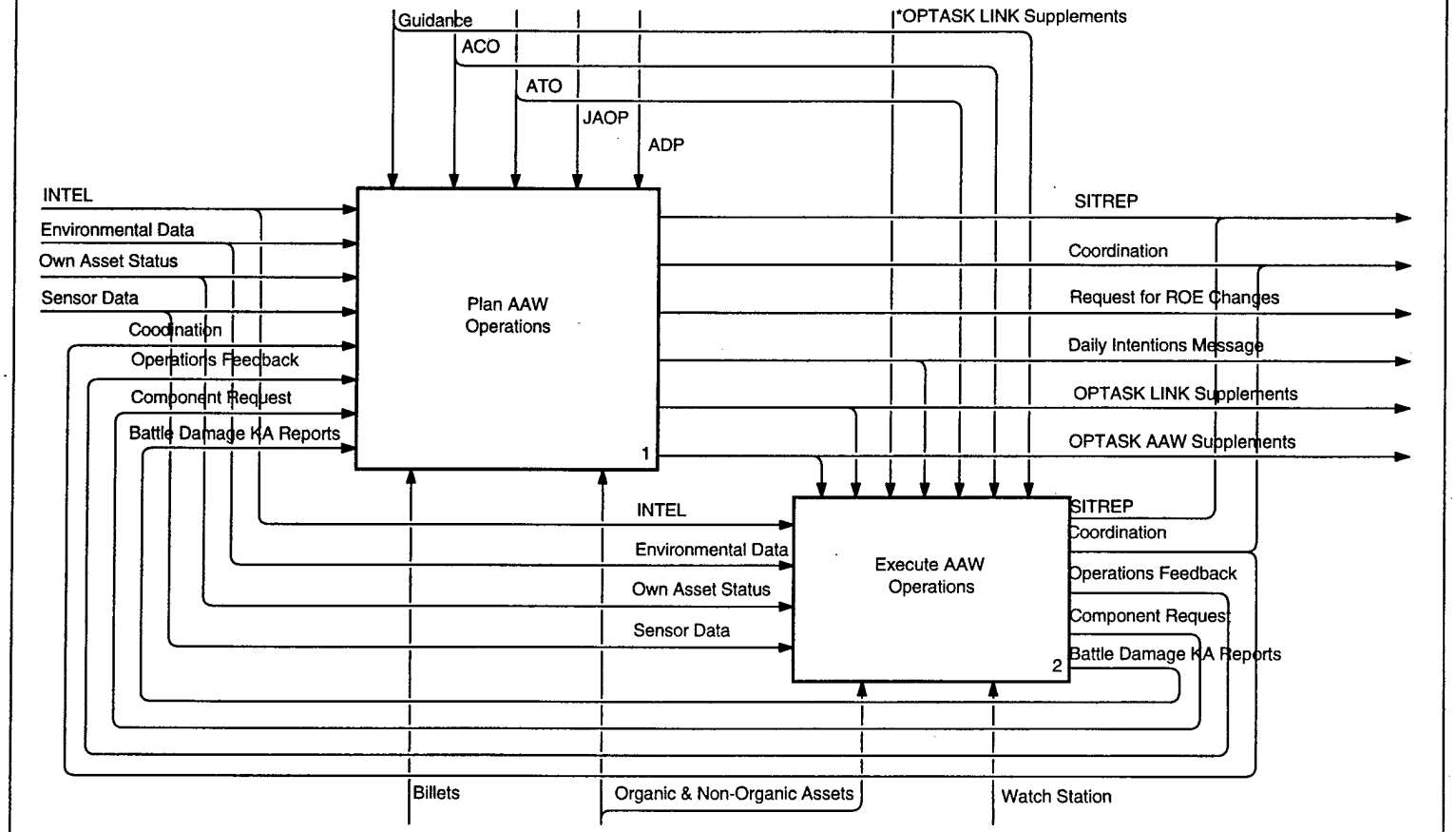

NODE: A0	TITLE: Perform AAW Operations	NUMBER:

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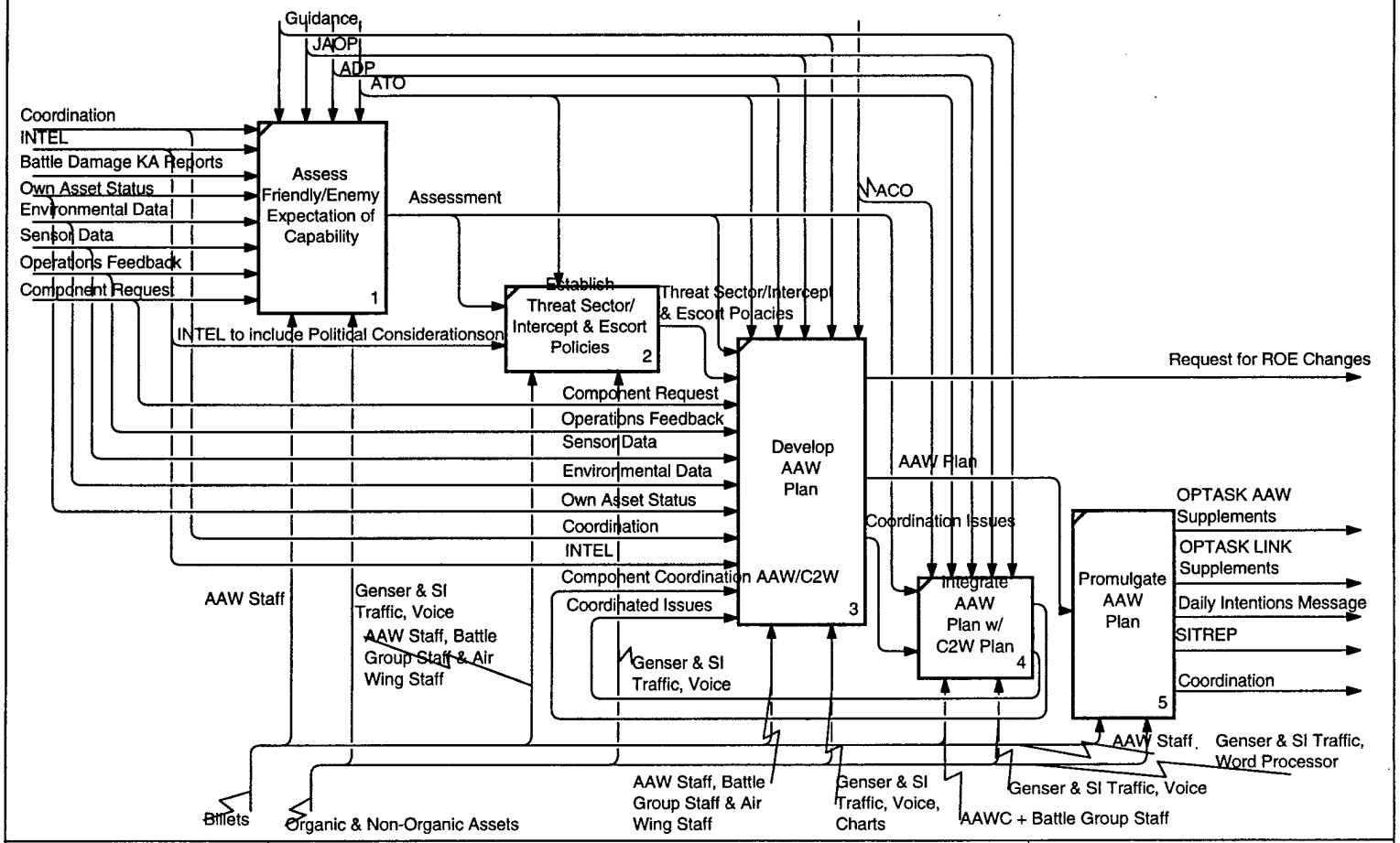

NODE: A1	TITLE: Plan AAW Operations	NUMBER:

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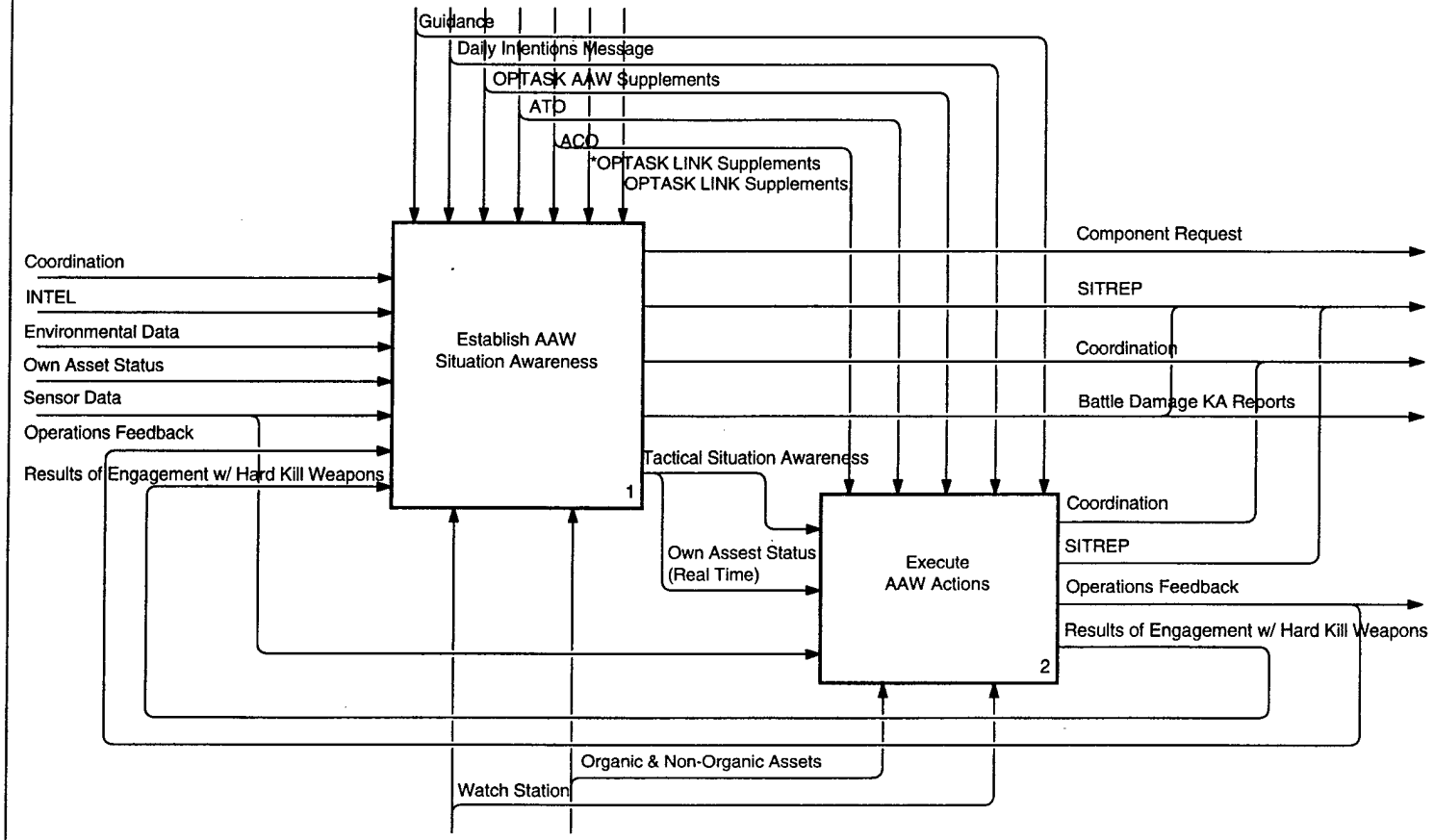

NODE: A2	TITLE: Execute AAW Operations	NUMBER:

USED AT:	AUTHOR: Marlen Z. Conklin	DATE: 20 June 1994		WORKING	READER DATE	CONTEXT:
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			■	RECOMMENDED		■ ▭
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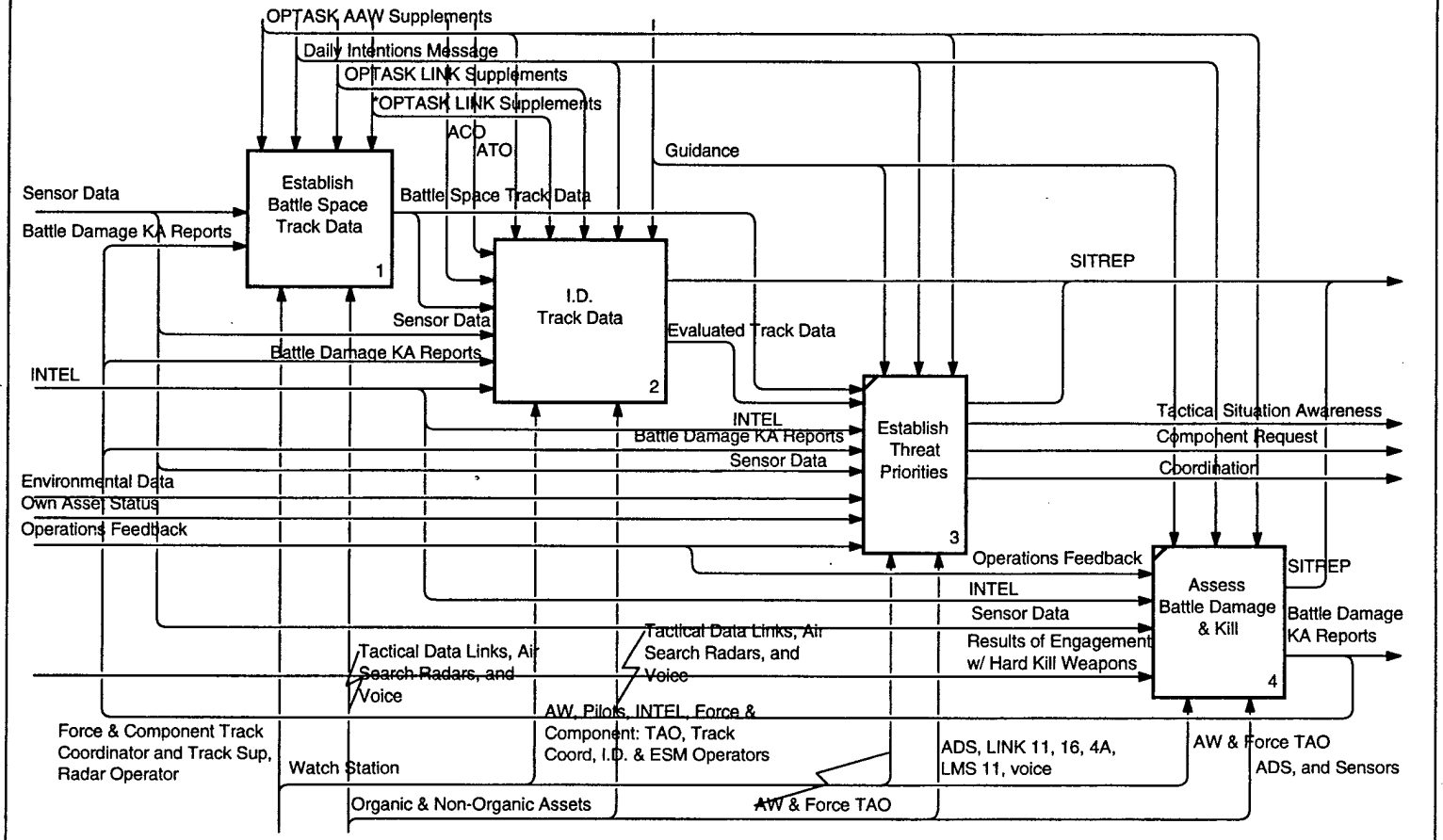

NODE: A21	TITLE: Establish AAW Situation Awareness	NUMBER:

USED AT:	AUTHOR: Marlen Z. Conklin	DATE: 20 June 1994		WORKING	READER DATE	CONTEXT:
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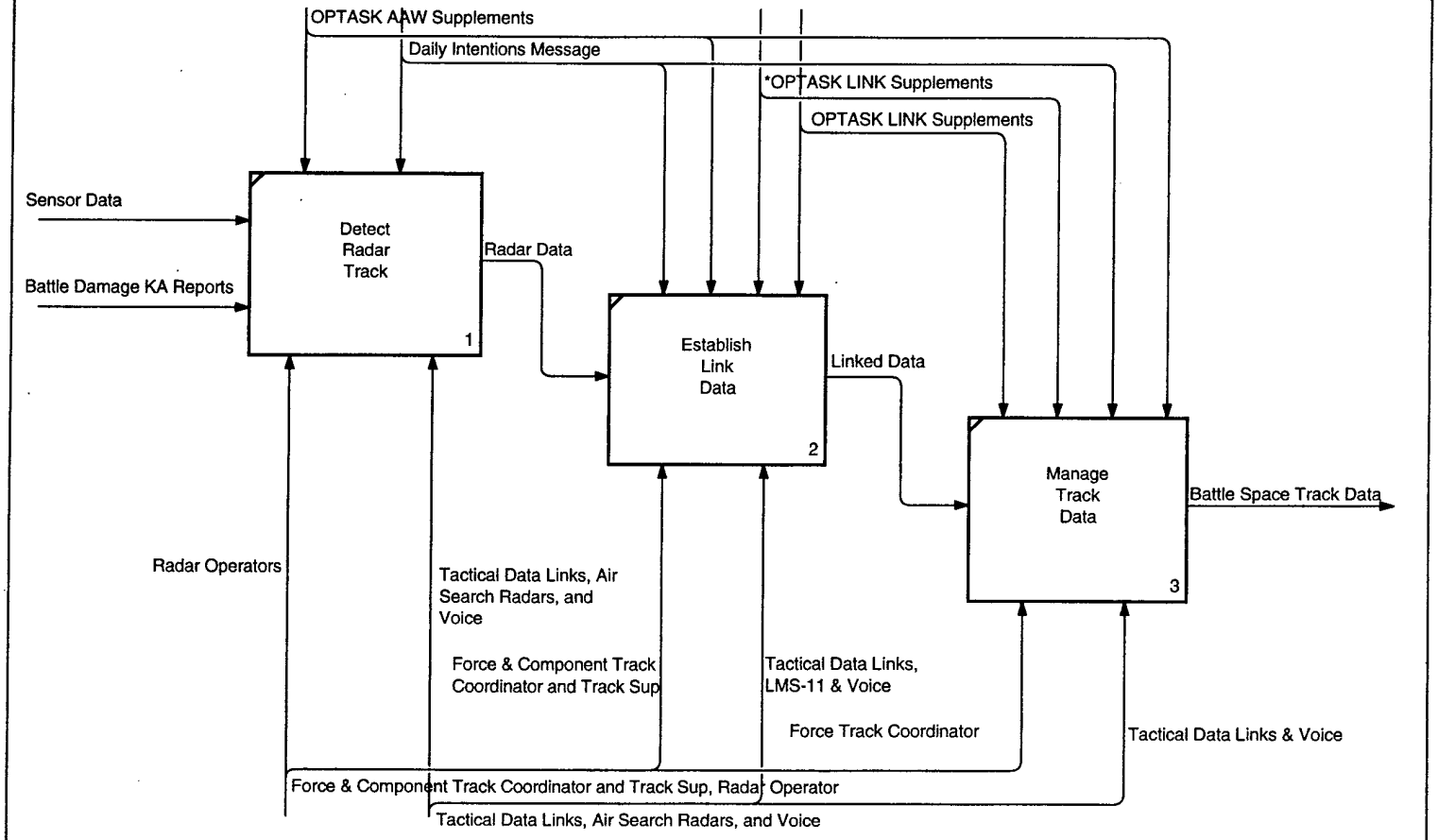
			■	RECOMMENDED		
	NOTES: 1 2 3 4 5 6 7 8 9 10			PUBLICATION		A21



NODE: A211	TITLE: Establish Battle Space Track Data	NUMBER:

USED AT:	AUTHOR: Marlen Z. Conklin	DATE: 20 June 1994		WORKING	READER DATE	CONTEXT:
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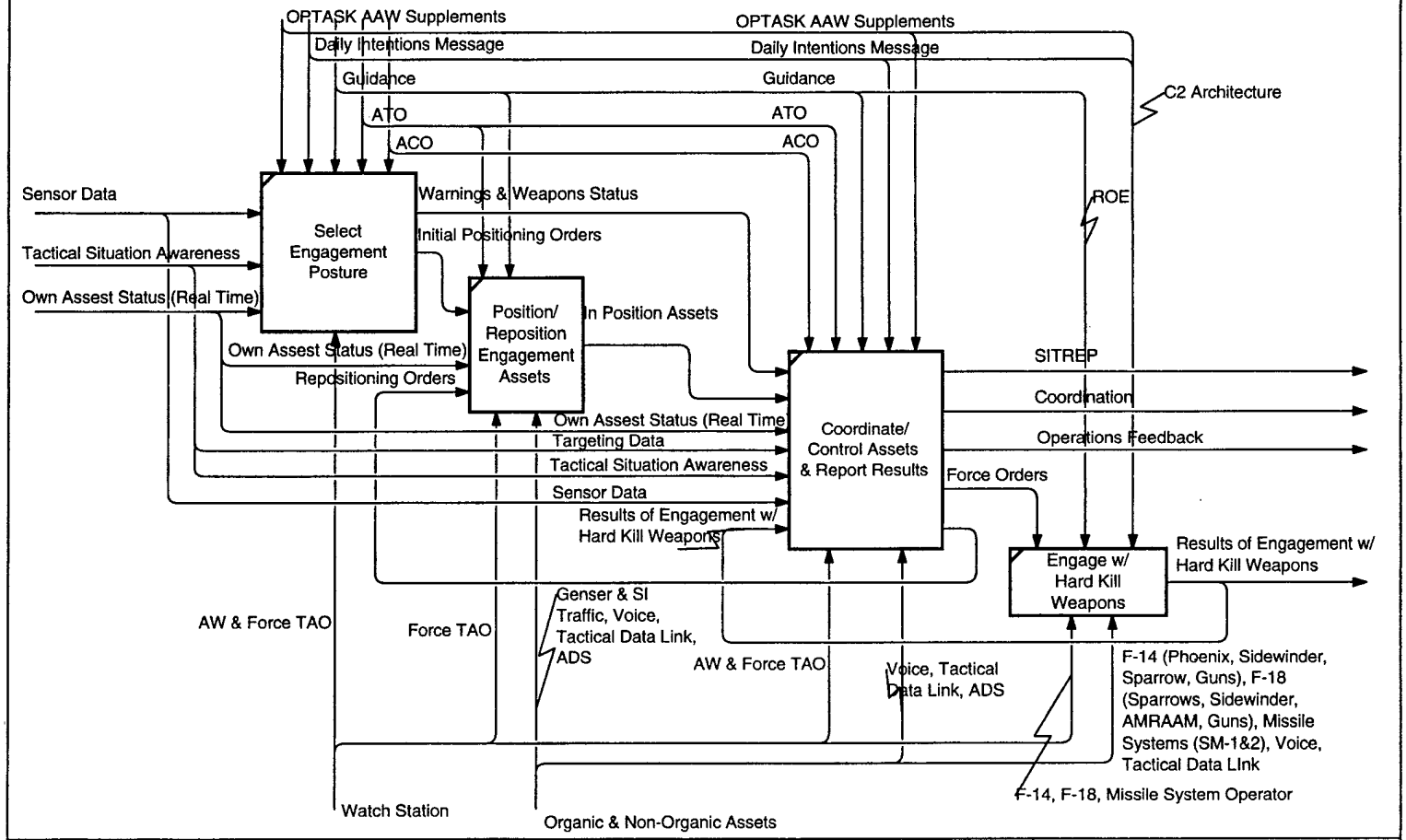

NODE: A22	TITLE: Execute AAW Actions	NUMBER:

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